International Agency for Research on Cancer

World Health Organization

IARC HANDBOOKS OF CANCER PREVENTION

Tobacco Control

Volume 14

Effectiveness of Tax and Price Policies for Tobacco Control

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SEVENTH FRAMEWORK PROGRAMME

PPACTE
PRICING POLICIES AND CONTROL OF TOBACCO IN EUROPE

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International Agency for Research on Cancer

The International Agency for Research on Cancer (IARC) was established in 1965 by the World Health Assembly, as an independently funded organization within the framework of the World Health Organization. The headquarters of the Agency are in Lyon, France.

The Agency conducts a programme of research concentrating particularly on the epidemiology of cancer and the study of potential carcinogens in the human environment. Its field studies are supplemented by biological and chemical research carried out in the Agency's laboratories in Lyon and, through collaborative research agreements, in national research institutions in many countries. The Agency also conducts a programme for the education and training of personnel for cancer research.

The publications of the Agency contribute to the dissemination of authoritative information on different aspects of cancer research. Information about IARC publications, and how to order them, is available via the Internet at: http://www.iarc.fr/en/publications/index.php.

This publication represents the views and opinions of an IARC Working Group on the Effectiveness of Tax and Price Policies for Tobacco Control which met in Lyon, France, 17 May–22 May 2010.

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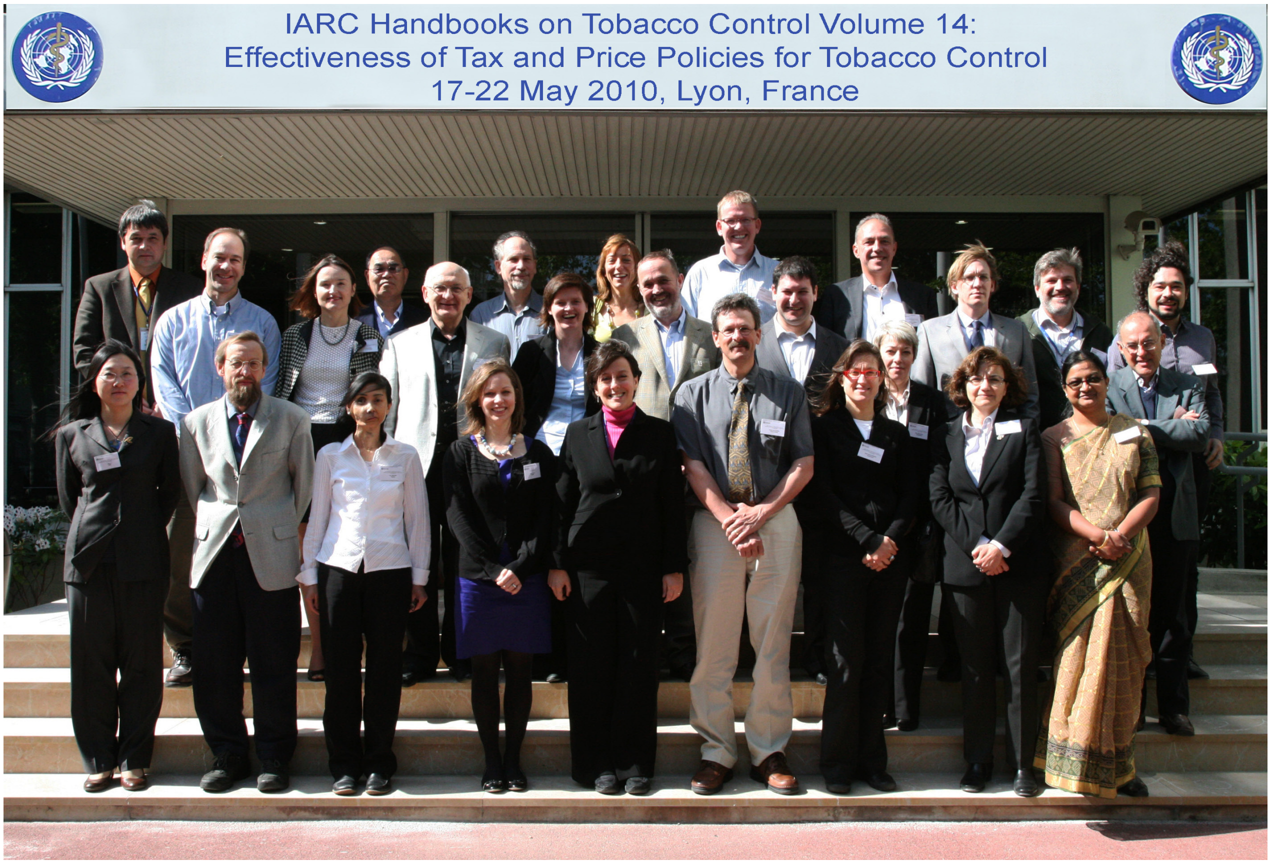

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Table of contents

List of participants

Frank Chaloupka *(Chair)*
Economics, College of Business Administration
Health Policy and Administration
University of Illinois at Chicago
601 S. Morgan St, Room 2103
Chicago, Il 60607–7121
United States of America

Evan Blecher
American Cancer Society
250 Williams Street, NW
Atlanta, Georgia 30303–1002
United States of America

Luke Clancy
Tobacco Free Research Institute
Digital Depot
Thomas Street
Dublin 8
Ireland

Laura Currie
Tobacco Free Research Institute
Digital Depot
Thomas Street
Dublin 8
Ireland

Sofia Delipalla
Tobacco Free Initiative
World Health Organization
20, avenue Appia
CH-1211 Geneva 27
Switzerland

Esteve Fernandez
Tobacco Research Unit
Cancer Prevention and Control Department
Catalan Institute of Oncology
Av. Gran Via s/n Km. 2.7
08907 L'Hospitalet (Barcelona)
Spain

Silvano Gallus
Department of Epidemiology
Istituto di Ricerche Farmacologiche Mario Negri
Via La Masa, 19
20156 Milano
Italy

Anna Gilmore
School for Health
University of Bath
Claverton Down
Bath BA2 7AY
United Kingdom

Fiona Godfrey
The Union (IUATLD)
88 rue des Sources
Weimerskirch
L2542 Luxembourg
Luxembourg

Teh-Wei Hu
214 University Hall
School of Public Health
University of California
Berkeley, CA
United States of America

Roberto Iglesias *(Unable to attend)*
Aliança do Controle do Tabagismo/
Alliance for Tobacco Control
Avenida Nossa Senhora de Copacabana 330/404
22020–001 Rio de Janeiro – RJ
Brazil

Luk Joossens
Framework Convention Alliance
Belgian Foundation against Cancer
479 Chaussée de Louvain
B-1030 Brussels
Belgium

Carlo La Vecchia
Department of Epidemiology
Istituto di Ricerche Farmacologiche Mario Negri
Via La Masa, 19
20156 Milan
Italy

David Levy
HBSA of Pacific Institute for Research and Evaluation
11720 Beltsville Dr, Suite 900
Calverton 20705–3102
United States of America

Nigar Nargis
Department of Economics
University of Dhaka
Dhaka-1000,
Bangladesh

Lien Nguyen
Centre for Health and Social Economics – CHESS
National Institute for Health and Welfare
PO Box 30, FI-00271 Helsinki,
Finland

Zeynep Onder
Bilkent University
Faculty of Business Administration
Bilkent, Ankara 06800
Turkey

Markku Pekurinen
(Unable to attend)
Centre for Health and Social Economics – CHESS
National Institute for Health and Welfare
PO Box 30, FI-00271 Helsinki,
Finland

Anne-Marie Perucic
Tobacco Free Initiative
World Health Organization
20, avenue Appia
CH-1211 Geneva 27
Switzerland

Hana Ross
International Tobacco Control Research
American Cancer Society
250 Williams Street, NW
Atlanta, GA 30303–1002
United States of America

Katherine Smith *(Unable to attend)*
School for Health
University of Bath
Bath BA2 7AY
United Kingdom

John A. Tauras
Department of Economics
University of Illinois at Chicago
601 S. Morgan
Chicago, IL 60607–7121
United States of America

Frank van Driessche[1]
European Commission
Directorate general for Taxation and the Customs Union
Excise duties and transport, environment and energy taxes
Rue de la loi 200
B 1049 Brussels
Belgium

Corné van Walbeek
School of Economics
Room 4.75 Leslie Social Science Building
University of Cape Town
Cape Town,
South Africa

Ayda Yurekli *(Unable to attend)*
Tobacco Free Initiative
World Health Organization
20, avenue Appia
CH-1211 Geneva 27
Switzerland

IARC Secretariat

John Daniel, Editor
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François Deloche (Bibliography)
Roland Dray (Photography)
Sylvia Moutinho (Bibliography)
Stéphanie Royannais (Layout)

[1] Invited specialist (an invited specialist is an expert in the subject under assessment, but also has declared a conflicting interest. Under such circumstances, the expert does not participate in the evaluation process while his expertise guides the description of general remarks on the intervention under assessment).

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Preface

Tobacco smoking causes cancer to over 15 organ sites, and exposure to secondhand smoke and parental smoking cause cancer in non-smokers and in the offspring (Secretan *et al.*, 2009). Tobacco use represents the largest preventable cause of cancer worldwide. In particular, tobacco smoking is pandemic and covers all ages, affecting over a billion people. The eradication of tobacco use can only be achieved by preventing children and adolescents from starting use today. Quitting smoking will reduce disease and mortality in a shorter time span, as the risk of several cancers decreases with increasing time since cessation even after several decades of smoking (IARC, 2007).

Article 6 of the World Health Organization Framework Convention on Tobacco Control (WHO FCTC) is one of the instruments in the treaty aimed at reducing the demand of tobacco use in the population (WHO, 2005). It directs ratifying nations to adopt three measures:

- To implement tax policies, and if appropriate, price policies on tobacco products to achieve a reduction in the consumption of tobacco in the population;
- To prohibit or limit the sale and importation of tax-free and duty-free tobacco products; and lastly,
- To report periodically to the Conference of the Parties the country-specific rates of tobacco taxes and the trends in tobacco use.

Adherence to the treaty will induce countries to revise existent tobacco control policies and set priorities, including the use of taxes. Handbook Volume 14 can inform policy-makers in those countries to fulfil the demands of WHO FCTC Article 6.

The use of taxes to increase the retail price of tobacco products can affect both initiation and cessation. The examination of the effectiveness of this intervention for tobacco control is the central theme of Volume 14 in the IARC Handbooks of Cancer Prevention series.

IARC Handbook Volume 14 presents an evidence-based evaluation of the literature published up to May 2010 on the effectiveness of tax and price policies in reducing the prevalence and consumption of tobacco use (Chaloupka *et al.*, 2011). The volume also covers the impact of cross-border shopping, smuggling, and the tobacco industry's use of discount prices and other strategies on reducing the effectiveness of taxes. The volume was authored by a Working Group of experts from 12 countries who gathered, critically analysed, synthesized and peer-reviewed the evidence in an interval of approximately 8 months and later finalized the draft chapters in a six-day meeting of experts in Lyon, France in May 2010. The main chapters present the evidence, and include tables presenting key descriptors of the studies reviewed on the effect of taxes on aggregated demand for tobacco, adult tobacco use, use among young people and use among the poor. Volume 14 includes a summary chapter describing the key findings and conclusions from each chapter. The evaluation and recommendations for research and public health are presented in additional, succinct chapters.

Two WHO publications provide complementary data regarding the use of taxes on tobacco products as a tobacco control intervention. The WHO Report on the Global Tobacco Epidemic (2008) presents the MPOWER package, a set of six policy interventions, including increases in taxes, promoted to reduce tobacco use and associated mortality. This report includes the level of implementation of tax policies across the world, including the price of the most popular brand of cigarettes, the amount of taxes as a percent of the retail price, the type of tax applied and the affordability of the most popular brand. A second publication, *WHO Technical Manual on Tobacco Tax Administration*, focuses on tax administration and offers the best practices to countries around the world that have signed the WHO-FCTC and are required to implement effective tax and price policies (WHO, 2010).

This IARC Handbook provides an in-depth and up-to-date critical review on the effectiveness of various tax-related interventions to curb the global tobacco epidemic. Together with the two WHO publications this will allow policy makers to base their decisions on the latest scientific evidence and choose the most effective interventions.

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Chapter 1
Overview of Handbook Volume 14

The scientific evaluation of the effectiveness of cancer prevention interventions is part of the mission of the International Agency for Research on Cancer (IARC). This commitment is reflected in the IARC Handbooks of Cancer Prevention that focus on the evaluation of tobacco control policies. Handbook Volume 12 was the first in the Tobacco Control series providing a framework for evaluating tobacco control policies (IARC, 2008). Handbook Volume 13 was the first of the series to focus on a specific policy, with a comprehensive evaluation of the effectiveness of smoke-free legislations in reducing exposure to secondhand tobacco smoke (SHS), tobacco use among youth and adults, and other outcomes (IARC, 2009).

This Handbook, Volume 14, extends the discussion on the impact of public policies on a major cause of cancer—tobacco use—by presenting, summarizing and evaluating the research evidence on the effectiveness of tax and price policies for tobacco control. Tax and price policies are central to the World Health Organization's Framework Convention on Tobacco Control (WHO FCTC). Article 6 of the treaty, the first to address a specific tobacco control policy, states (WHO, 2005):

> 1. The Parties recognize that price and tax measures are an effective and important means of reducing tobacco consumption by various segments of the population, in particular young persons.
> 2. Without prejudice to the sovereign right of the Parties to determine and establish their taxation policies, each Party should take account of its national health objectives concerning tobacco control and adopt or maintain, as appropriate, measures which may include:
>   a. Implementing tax policies and, where appropriate, price policies, on tobacco products so as to contribute to the health objectives aimed at reducing tobacco consumption; and
>   b. Prohibiting or restricting, as appropriate, sales to and/or importations by international travellers of tax- and duty-free tobacco products.
> 3. The Parties shall provide rates of taxation for tobacco products and trends in tobacco consumption in their periodic reports to the Conference of the Parties in accordance with Article 21.

Given the potential role of tax and price differentials in contributing to tax avoidance and evasion, tax and price policies are further addressed in Article 15 of the WHO FCTC, which calls on countries to eliminate "all forms of illicit trade in tobacco products, including smuggling, illicit manufacturing and counterfeiting" (WHO, 2005).

Maximizing the effectiveness of tax and price policies in achieving reductions in tobacco use and its health consequences requires a clear understanding of the impact of these policies on initiation and escalation of tobacco use, cessation and relapse, tobacco product consumption, substitutability of tobacco products, tax avoidance and evasion, and related outcomes. At the same time, those making or advocating tobacco tax and price policies must understand the impact of these policies on other outcomes, including their impact on government revenues, employment and inflation. This Handbook provides a thorough review of this evidence.

Price of tobacco and tobacco use

One of the most fundamental laws of economics is that of the downward-sloping demand curve, which states that increases in the price of a given product will lead to reductions in the quantity demanded of that product, while reductions in price will lead to increases in quantity demanded. The extensive empirical research on the demand for tobacco products confirms that the law of the downward-sloping demand curve applies to tobacco products. Much of this research comes from the United States and other high-income countries, but over the past decade, numerous studies of the demand for tobacco products have been done in low- and middle-income countries.

Higher prices influence the demand for tobacco products in two ways. First, they reduce the prevalence of tobacco use by discouraging non-users from taking up tobacco use, by encouraging existing users to quit, and by helping former users stay quit. Second, higher tobacco prices reduce the consumption of tobacco products among those who continue to use tobacco after a price increase. The strength of these responses is measured by the price elasticity of the demand for tobacco products, which is defined as the percentage change in consumption that results from a 1% price increase. The seminal World Bank publication *Curbing the Epidemic* concluded that the price elasticity of cigarette demand is around −0.4 for developed countries and between −0.4 and −0.8 for developing countries (Jha and Chaloupka, 1999).

There are numerous methodological challenges in estimating the impact of tobacco prices on tobacco use. Given the wide range of tobacco products, selecting and/or developing an appropriate price measure can be difficult. Some studies have used tobacco product excise tax rates as proxies for tobacco product prices, because tax in most countries represents a larger share of retail price and is also the primary policy tool for manipulating tobacco product prices. However, a tax increase may not always result in a corresponding change in tobacco retail prices. The degree of pass-through depends on the structure of the market (monopolistic, oligopolistic or competitive) as well as the business and political agenda of tobacco companies.

The availability and quality of data present another challenge, particularly for low- and middle-income countries. Aggregate time-series data on cigarette sales are most readily available, even in low-resource countries. However, since they represent tax-paid cigarette sales rather than actual consumption, the presence of cross-border shopping, cigarette smuggling, illicit production and other forms of tax avoidance and evasion can bias upward the estimates of the effects of taxes and prices on cigarette demand.

Another complication when analysing aggregate data results from the fact that tobacco product prices are determined by the interaction of supply and demand. If this is not accounted for, the resulting estimates of the price elasticity of demand can be biased. In addition, macro-level studies cannot distinguish between several behavioural changes that lead to change in tobacco demand, such as initiation, cessation or change in quantity of tobacco product consumed. Neither can these studies examine differences in responsiveness to changes in price among different population subgroups defined by age, gender, race/ethnicity, socioeconomic status and other characteristics of the population.

Individual-level data collected in surveys overcome some of the challenges associated with the use of aggregate data, but they are more expensive to gather, so their availability (and, if available, their quality) can be limited in lower-resource countries. The most common problem with using individual-level data from a single cross-sectional collection is the lack of price variation within most countries, resulting in an inability to estimate the price elasticity of demand. Employing self-reported cigarette prices collected as part of the survey and which usually exhibit some degree of variation is not an ideal option, as the price an individual pays is likely to be related to their smoking behaviour, potentially biasing the resulting estimate of price elasticity. Individual-level data thus should be augmented with externally collected data on price, tobacco control public policies and other important determinants of demand. In addition, individual-level data can also suffer from reporting biases such as underreporting of tobacco consumption.

These and other challenges in estimating the impact of taxes and prices on tobacco use are described in more detail in the following chapters. Many of the methodological challenges in estimating the impact of tobacco prices on tobacco use have been overcome by employing diverse and sophisticated econometric and other statistical methods. In addition, some recent data (such as the CDC/WHO Global Adult Tobacco Surveys and the International Tobacco Control Policy Evaluation Project surveys) have been collected specifically for studying tobacco use and the impact of tobacco control policies, which helps to overcome the typical challenges of modeling the demand for tobacco products.

Tobacco tax as a public policy

Nearly every country in the world taxes tobacco products. Almost all countries levy excise or other taxes that are specific to tobacco products, many apply duties on imported tobacco products, and many apply value-added or sales taxes on these products. In 1776, Adam Smith, the father of modern economics, discussed the appropriateness of taxing tobacco products in his classic volume *An Inquiry into the Nature and Causes of the Wealth of Nations:*

> "Sugar, rum and tobacco are commodities which are no where necessaries of life, which are become objects of almost universal consumption, and which are therefore extremely proper subjects of taxation. [...] In the mean time the people might be relieved from some of the most burdensome taxes; from those which are imposed either upon the necessaries of life, or upon the materials of manufacture. The labouring poor would thus be enabled to live better, to work cheaper, and to send their goods cheaper to market. The cheapness of their goods would increase the demand for them, and consequently for the labour of those who produced them. This increase in the demand for labour, would both increase the numbers and improve the circumstances of the labouring poor. Their consumption would increase, and together with it the revenue arising from all those articles of their consumption upon which the taxes might be allowed to remain."

Historically, and still the case in many countries, the primary aim of tobacco taxation was to generate government revenue. Tobacco products are generally good candidates for taxation, given that they are typically produced by a small number of manufacturers, have relatively few substitutes, and exhibit relatively inelastic demand.

Over time, as the research evidence demonstrating that higher tobacco product taxes and prices reduce tobacco use has accumulated, the role of tobacco taxes has changed and increasingly these taxes are used as a policy tool to improve public health by reducing tobacco consumption and accounting for the external cost of smoking. A significant increase in tobacco product taxes and prices has been demonstrated to be the single most effective and cost-effective intervention for reducing tobacco use, particularly among the young and the poor; thus the central role of tobacco tax and price policies in the WHO FCTC.

Challenges of using tax and price to control tobacco use

Despite the public health rationale for increasing tobacco taxes to reduce tobacco use and its health and economic consequences, some dispute the social benefits of this intervention. Opponents of higher tobacco taxes question their revenue-generating potential and the sustainability of these revenues. They point out to the possible negative economic impact of higher tobacco taxes, particularly when it comes to tobacco-related employment, the prosperity of sectors indirectly associated with tobacco business, upward pressure on inflation, the negative distributional impact of higher tobacco taxes on the poor, and the danger of tax avoidance and tax evasion in response to higher taxes. Government interference in the decision whether or not to consume tobacco is portrayed as an infringement on individuals' freedom to choose.

However, many obstacles cited as barriers to implementation of higher tobacco-product taxes are misleading. For example, the inelasticity of demand for tobacco products and the relatively low share of tax in price in most countries mean that significant increases in tobacco taxes will generate significant increases in government revenues. Advances in tobacco farming and tobacco product manufacturing lead to job losses in the tobacco sector during periods of stable tobacco taxes, while tobacco-dependent jobs lost as a result of higher taxes are replaced by jobs in other sectors as those deterred from using tobacco products spend the money that they once spent on tobacco on other goods and services and the government spends new tax revenues, creating jobs in other sectors.

Nevertheless, it is critical to gain the necessary political support to increase tobacco taxes, because the industry opposes higher taxes most severely, as is evident for example from examining documents found in legal discovery during lawsuits against the industry and made publicly available. The strategy for securing that support will vary from country to country. One strategy used successfully in a growing number of countries has been the dedication of revenues from tobacco taxes to other tobacco control or health promotion activities, including some specifically targeting the poor. This Handbook reviews the evidence on the revenue and economic impact of tobacco taxes, their effects on the poor, public support for these taxes, and the effects of taxes dedicated for tobacco control on tobacco use and its consequences.

Outline of the Handbook

The production of this Handbook involved several steps, beginning with the selection of the topic. Given the centrality of tax and price policies to the WHO FCTC, the large and growing research evidence on the impact of taxes and prices on tobacco use and related outcomes, and IARC's participation in the research project entitled Pricing Policies and the Control of Tobacco in Europe (PPACTE), a grant proposal funded by the European Commission, the topic of tax and price policies was selected. Specifically, the goal of Handbook Volume 14 is to present and assess the scientific evidence on the effectiveness of tax and price policies in tobacco control.

In collaboration with WHO and IARC, a preliminary outline for the Handbook was developed by the Chair of the Working Group (WG) of Volume 14. Twenty-one scientists and policy experts from 12 countries, including high-, middle- and low-income countries from multiple regions, and including several researchers from the PPACTE project, agreed to participate as members of the WG. In the fall of 2009, experts revised and expanded the preliminary outline for the volume and identified relevant literature; in the spring of 2010 draft chapters presenting and critically reviewing this literature were prepared.

From 17 to 22 May 2010, IARC gathered 18 members of the WG in Lyon, France to finalize this Handbook on the evidence for the effectiveness of tax and price policies in tobacco control. Pertinent work published up to the week of the Handbook Meeting was established as eligible for inclusion *a priori*. At the meeting, the WG revised the chapters which are organized into the following domains: overview of tobacco taxation (Chapter 2); tobacco industry pricing strategies and tax-related lobbying (Chapter 3); tax, price and aggregate demand for tobacco (Chapter 4); tax, price and adult tobacco use (Chapter 5); tax, price and tobacco use among young people (Chapter 6); tax, price and tobacco use among the poor (Chapter 7); tax avoidance and tax evasion (Chapter 8); and the economic and health impact of tobacco taxation (Chapter 9). Each chapter assessed the quality and limitations of the data when conducting its critical review.

A strength of this volume is the involvement of researchers from a large number of countries representing a variety of scientific disciplines, including economists, epidemiologists, public health and public policy experts. This collaborative effort provided an opportunity to bridge the gap in terminology employed by various disciplines and to find a common vocabulary to interpret and discuss the findings in the published scientific literature. Econometric terms can be novel for an epidemiologist. The term "endogeneity," a situation when an explanatory variable is correlated with the error term, for example, is less familiar to an epidemiologist who may describe the same condition as "reversed causality" or as a situation where the exposure will "cause" the intermediate variable. For example, if income is the exposure/or independent variable and health is the outcome/the dependent variable, smoking would be an intermediate variable between income and health, because people with higher income are less likely to smoke. An economist may express the same concept by saying that smoking is endogenous to income. A "confounder," a term commonly used in epidemiology referring to a factor associated with an exposure and the outcome, but not on the causal pathway between the exposure and the outcome, is not used in econometrics. Economists sometime use the term "confounders" to refer to problematic unmeasured "omitted variables" that are not included in the analysis. They also may use the term "confounder" to signify a generic control variable in the model. An "ecological study," the term used by epidemiologists, can be translated as "macro-level study" for an economist, while the term "ceteris paribus" (other things being equal) would need to be explained to an epidemiologist that is not familiar with this expression. This Handbook clarifies terms used when describing the evidence, and where possible, uses terminology that is common across disciplines. Therefore, it contributes to diminishing communication barriers among the research community.

It is hoped that the research evidence presented in this Handbook will support policymakers, public health professionals, and tobacco control advocates in their effort to champion the use of tobacco taxes as a means to control tobacco use as well as to generate resources for tobacco control programs. The WHO FCTC is entering into force in a progressively increasing number of countries (173 Parties as of June 2011). The conclusions presented in this volume will provide research background for discussions at the Conference of Parties to the WHO-FCTC when it considers the development of guidelines for taxing tobacco products. This Handbook will offer an evidence-based context for the research findings generated by the European Commission-funded project PPACTE. PPACTE addresses European Union policy needs related to the WHO FCTC process and has potential to contribute to tobacco control not only in Europe but also abroad. By embracing a global view, this Handbook builds a bridge between tobacco control policies in Europe and in the rest of the world.

Chapter 2. Overview of tobacco taxation

Tobacco products are subject to different types of taxes and to different tax levels. The types of taxes, the tax structure in place, and the enforcement of tobacco tax policy reflect political, social and economic considerations and can cause significant retail price differentials.

In many cases, tax level is related to income, with low-income countries having low taxes and vice versa. High-income countries tend to favour specific (per-unit) excise tax regimes, while low- and middle-income countries rely more on *ad valorem* (value-based) excise taxes. Specific excise taxes generally result in higher tobacco product prices. Some countries have implemented more complex taxation regimes in an attempt to find a balance between budgetary, health, and free market competition objectives. For example, several countries are using a part or all of tobacco tax revenues for funding health or tobacco control activities.

The tax level and the tax regime have implications for consumer behaviour, the behaviour of the tobacco industry, and the effectiveness of tobacco tax as a public policy measure. Specific excise taxes can increase tobacco companies' pricing power, raise their profits and increase market concentration. Differential rates on different types of tobacco products or even on items within the same product category result in price gaps and opportunities for product substitution to lower-taxed products and brands.

Chapter 2 describes the mechanisms of using tobacco taxes to influence retail prices of tobacco products. It discusses the effectiveness of tax policy in reducing tobacco use under different tax regimes and stresses the importance of applying similar tax levels for reducing the incentive for product substitution. It demonstrates that sizeable increases in taxes on tobacco products under a properly designed tax system will result in concomitant increases in retail prices. In view of the important revenue-generating potential of tobacco taxes, particularly for low-resource countries, Chapter 2 discusses the strategy of using a share of tobacco tax revenue to strengthen weak health systems in these countries.

Chapter 3. Industry pricing strategies and other pricing policies

Recognizing the powerful impact of taxes and prices on the demand for tobacco products, tobacco companies have demonstrated zeal in influencing tax policies to minimize their impact on tobacco use and on their profits.

Tobacco companies have engaged in aggressive and well-funded lobbying activities all over the world. Their lobbying practices and strategies may vary with the level of government they want to influence.

The impact of tobacco taxes on prices can be modified by the industry's response to the tax increase. Since most tobacco product markets are highly concentrated, recent significant tax increases have led to price increases larger than justified by the tax increase alone, generating higher profit margins for the tobacco industry.

Tobacco companies also use a variety of marketing techniques that reduce prices on selected tobacco products. These tactics can soften the impact of tobacco tax increases specifically targeting youth and the poor. Price-related marketing efforts are also designed to acquire market share from the competition.

Public policies can influence tobacco retail prices by multiple means, such as setting tobacco taxes, regulating prices and limiting price-related marketing. These include, for example, the implementation of minimum pricing policies, the use of specific as opposed to *ad valorem* tax structure, and bans on price-reducing marketing techniques.

Chapter 3 examines industry pricing strategies, price-related marketing efforts, price manipulations and market segmentation. It describes industry efforts to reduce the impact of taxation on tobacco use by trying to change tobacco tax policy, including tax structure and tax levels, by opposing tobacco tax earmarking, and by engaging in anti-tax lobbying activities. These activities have some similar characteristics across countries and the targeted level of government, even though most evidence comes from North America.

The tobacco industry's tax lobbying efforts could be curtailed by using the provisions of Article 5.3 of the WHO FCTC, which aims to limit tobacco industry influence on tobacco control policy-making. However, very little is known about the effectiveness of policies that ban industry price-related marketing or introduce minimum pricing.

Chapter 4. Tax, price and aggregated demand for tobacco

A large body of the empirical research employs macro- level data to study the impact of tax and price on demand for tobacco products. There is significant variation in the theoretical models as well as the econometric methods applied to these data. Initial evidence based on data from the USA and the United Kingdom that has demonstrated a negative relationship between the price and the demand for tobacco products has been augmented by a growing number of studies from low- and middle- income countries.

Chapter 4 summarizes the evidence and contrasts the results based on the older and more recent studies using aggregate-level data. The focus is on the comparison of price and income elasticities of tobacco demand, both over time and across country income groups. Chapter 4 also points to the strengths and limitations of using aggregated and individual-level data to assess the demand for tobacco products, and the impact of price and tax policies on this demand.

The price elasticity of demand measures the response rate (in percentage terms) of an aggregate measure of consumption (e.g. cigarette sales) to a one-percent increase in the price of tobacco. The important issue is whether the demand for tobacco can be classified as price-elastic (the price elasticity is greater than one in absolute value) or as price-inelastic (the price elasticity is less than one in absolute value). The magnitude of the price elasticity has implications for the impact of prices/taxes increases on public health and tax revenue.

Income is another important determinant of the demand for tobacco products. Since tobacco is considered a normal good, economic theory predicts that as aggregate income increases, aggregate demand for tobacco increases as well. Therefore, income elasticity (the percentage change in consumption of a product that results from a one-percent increase in income) is expected to be positive. It is less clear whether there is a difference in the income elasticity observed in countries with different levels of income or whether income elasticity changes over time.

Since the demand for tobacco products responds inversely to tobacco price and positively to disposable income, Chapter 4 introduces the concept of affordability, which captures the effect of price and income on tobacco demand simultaneously. It points out that in a growing economy, the price of tobacco would have to increase at the same rate as income to maintain a given affordability level and to prevent consumption from rising.

Chapter 4 also briefly discusses studies on substitution between tobacco and other harmful substances (e.g. alcohol) and between different types of tobacco products in response to changes in relative tax and price levels.

Chapter 5. Tax, price and adult tobacco use

Household and individual-level data have also been used to study the impact of tobacco taxes and prices on the demand for tobacco products. These data, collected by various survey methods, allow us to examine the differential impact of tobacco control measures, including tobacco taxes/prices, on tobacco use among population subgroups with similar characteristics based on age, gender, socioeconomic status, etc. In addition, these micro-level data can distinguish between the impact of price/tax on prevalence and intensity of use, and allow researchers to study behavioural changes such as tobacco use initiation, uptake, cessation, and switching from everyday to some-day tobacco use.

Chapter 5 focuses on studies that examine the effect of price and tax on adult tobacco use. It describes empirical methods employed to assess the impact of price/tax on individual level demand for tobacco and how these methods have evolved and improved over time. Of particular interest are the magnitude of impact measured by the price elasticity of demand and the relative impact of price/tax on prevalence versus intensity of cigarette use. Gender differences in price responsiveness to demand for tobacco have also been of interest to researchers using the micro-level data on tobacco use. The chapter summarizes the studies focusing on tobacco products other than cigarettes and assesses the level of substitution (measured by the cross-price elasticity of demand) among tobacco products.

Studies using US data are of particular importance due to the extensive subnational and temporal variation in taxes and prices. Research evidence from other high-income countries is less common due to limited price variation within a single country.

The evidence from low- and middle-income countries is primarily based on household expenditure data. However, the quality of data and the appropriateness of methods used in these studies vary.

Research on the attitudes and perceptions of adults towards increasing cigarette prices/taxes is also discussed in Chapter 5.

Chapter 6. Tax, price and tobacco use among young people

Economic theory predicts that tobacco use among young people would be more responsive to changes in prices/taxes compared to adults, due to youth's lower disposable income and their lower level of addiction thanks to shorter smoking history. The effect of peer pressure is also expected to increase the responsiveness of youth to tobacco prices/taxes.

Chapter 6 summarizes the literature on the demand for tobacco products among young people and presents the results by country income groups. It contrasts total price elasticity of demand, price elasticity of smoking prevalence and price elasticity of smoking intensity with results from studies on older population subgroups. The effects of price on youth smoking uptake, smoking initiation, smoking cessation, and on demand of other tobacco products are discussed as well. Of particular interest is the literature on youth smoking initiation, since different types of data seem to lead to different conclusions. The quality of the data and the measurement error inherent in retrospective information lie at the heart of this discussion. The chapter points to the gap in research evidence when it come to stages of youth smoking uptake, peer and family influences on tobacco use among youth people, and the impact of price/tax on youth smoking cessation.

Chapter 7. Tax, price and tobacco use among the poor

There are at least three links between tobacco use and poverty. First, spending on tobacco has an opportunity cost when resources from other goods and services are diverted to obtaining tobacco. Lower-income households are particularly vulnerable to this diversion, as tobacco may replace food and other essential products and services (e.g. health care, education) for the entire family. Second, tobacco use prevalence is higher among the low-income, low-education groups in the majority of countries (with the exception of some upper middle-income countries). This means that tobacco excise taxes could be disproportionately collected from people with lower income, and therefore would be labelled as regressive. Third, the health impact of consuming tobacco increases medical expenditures and reduces labour productivity. This puts pressure on the budgets of low-income families and reduces their income-generating potential due to morbidity and premature mortality.

Chapter 7 presents the evidence on the demand for tobacco products among the poor and compares it with the demand among more affluent segments of the population. It points to differences in the price elasticity of tobacco demand among high- and low-income populations within a country, compares and contrasts the evidence from low-, middle- and high-income countries, and discusses the factors that influence the extent of differences in price elasticity across different socioeconomic groups.

Lower disposable income among the poor would suggest that they are more sensitive to changes in prices and taxes compared to more affluent populations. In that case, tax increases would be progressive and help the poor to reduce their tobacco tax expenditures. However, the evidence as far as the relative magnitude of the price elasticity is mixed and varies from country to country. For example, in settings where there is ready access to low-taxed or untaxed and inexpensive tobacco products, low-income tobacco users may be less sensitive to changes in prices due to the low cost of substitution. Future data collection efforts may need to provide more information on tobacco tax regressivity to address this important public policy issue.

Chapter 8. Tax avoidance and tax evasion

Chapter 8 starts by defining what is considered tax evasion and what is merely tax avoidance. The literature review indicated that there is much confusion and improper use of these terms. Tax avoidance refers to legal methods of circumventing tobacco taxes, and tax evasion refers to illegal methods of circumventing tobacco taxes. Illicit trade includes both legally produced products illegally traded across borders (smuggling) and illegally manufactured products. Most tax avoidance activities include the payment of some tobacco taxes. Tax evasion involves both small and large quantities of tobacco products, and usually no taxes are paid. These activities may involve criminal networks or other large-scale operations.

Chapter 8 categorizes tax evasion and tax avoidance activities into various types and discusses their determinants based on the most recent empirical evidence. It focuses in particular on the role of tobacco tax/price differentials, tax administration, enforcement, and degree of punishment in motivating these two types of activities. In addition, Chapter 8 examines the role of tax evasion and tax avoidance in health disparities and the role of these activities in undermining other tobacco control measures.

Next, the chapter presents estimates of the extent of tax evasion globally, regionally, and in key countries, as well as the impact of this activity on tax revenues and public health. The authors also contrast the scale of tax evasion with the scale of tax avoidance. This is particularly challenging due to the illegal nature of these activities. Various research methodologies trying to overcome these challenges are discussed, as well as their strengths and weaknesses.

Despite the underground nature of these activities, effective strategies and policies to control tax avoidance and tax evasion exist. These address both the supply side and the demand side of the market. A review of country experiences with these policies and case studies of countries that have successfully implemented an integrated set of actions to curb both tax avoidance and tax evasion conclude this chapter.

Chapter 9. Economics and health impact of tobacco taxation

Higher tobacco taxes/prices can be expected to have a large impact on society's well-being. The most important is their impact on heath status, life expectancy, labour productivity and overall economic performance. Additional benefits include lower smoking-related healthcare expenditures. Further health and productivity gains can be expected through reductions in secondhand smoke exposure and reduced maternal smoking.

The extent to which tobacco product taxes and prices contribute to these health economic gains on the population level is summarized in Chapter 9. The chapter starts with a brief discussion of a conceptual framework for describing the impact tobacco taxes have on lives saved and disease incidence (in smokers and secondhand smokers) and on healthcare cost savings. Chapter 9 examines not only the direct impact of lower tobacco use, but also considers the association between tobacco use and alcohol, tobacco use and illicit drug abuse, and between tobacco use and obesity.

The chapter further presents evidence on the effects of higher tobacco taxes on tobacco industry employment (including tobacco farming) as well as on non-tobacco industry employment, on government revenue, on tobacco tax revenue, and on the Consumer Price Index.

The pros and cons of earmarking tobacco tax revenue are also discussed based on the experiences of jurisdictions that have earmarked revenues for tobacco control and/or health promotion programs.

Summary of findings of the Handbook

For each chapter the Working Group examined all the evidence, assessing the quality of the data and appropriateness of the methods employed to generate the results, and then voted on the strength of the evidence presented in the Evaluation chapter.

The scale for the quality of evidence ranged from “sufficient” to “strong” to “limited” to “inadequate or no evidence” and “evidence suggesting a lack of an effect.” For 12 of 18 conclusions in this volume, the strength of the evidence was at the highest level, while four concluding statements were supported by “strong evidence” and two remaining statements were supported only by “limited evidence”. There is sufficient evidence that higher tobacco excise taxes and prices reduce overall tobacco consumption and prevalence of tobacco use. This is achieved by the impact price/tax has on promoting cessation among current users, preventing initiation and uptake among young people, and lowering consumption among continuing tobacco users.

The consensus among the members of the Working Group on the strength of the evidence resulted in several public health and research recommendations. The most effective tobacco tax public health policy would promote a relatively simple tobacco excise tax structure that emphasizes specific tax and involves regular tax increases that outpace growth in general price levels and incomes. A portion of tobacco tax revenues should be used to fund comprehensive tobacco control programs and other health promotion activities, given that such programs lead to further reductions in tobacco use and associated improvements in population health. The WG also recommends the implementation of a multinational surveillance and monitoring system so that data on tobacco use, tobacco taxes and prices, price-reducing marketing and lobbying efforts of tobacco companies, tax avoidance and evasion, and tax administration and enforcement activities can be collected regularly. Such targeted tobacco control data collection efforts would improve the quality of the research evidence gathered to date, particularly for low- and middle-income countries. The full recommendations of the Working Group are detailed in the Recommendations chapter.

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Chapter 2
Overview to tobacco taxation

Introduction

Taxes are usually raised to provide revenues for government expenditure. These taxes take many forms—for example, income taxes, payroll taxes, customs duties, excise taxes, sales taxes or value-added taxes (VAT). Indirect taxes are taxes levied on the consumption of specific goods (for example, excise taxes on tobacco or alcohol) or on practically all goods (VAT). The interest in raising taxes on products such as tobacco is based on their potential to raise large amounts of revenues relatively easily, but also because they enable correcting for the negative externalities tobacco use generates (negative health impact of both tobacco consumption and exposure to tobacco smoke) and discourage its use because of its destructive impact. The rationale behind raising taxes on products such as tobacco lies in the particular aspects of the product: i) production is dominated by a few companies, which makes supervision and tax collection by the government relatively easy; ii) the demand for this product is relatively inelastic – tobacco users are addicted to the products and therefore have little sensitivity towards a price change; iii) the product is not considered a basic necessity; and iv) the product produces negative externalities (McCarten and Stotsky 1995; World Health Organization, 2010).

This chapter provides an introduction to the different types of taxes applied on tobacco products, with a special focus on excise taxes. The reasons behind levying such taxes are then discussed, including the political, social and economic arguments often used against tobacco tax increases when the issue is discussed by policymakers. The different approaches to excise taxation are then reviewed, with a description of the structures applied on tobacco products and the pros and cons of each one of them. The impact of taxes on the price of tobacco products is also considered briefly. An overview is made of the levels of taxation globally (with a focus on cigarettes because of better availability of data). The issue of earmarking or dedicating tobacco taxes for specific programmes, particularly health-related programmes, is also discussed. Finally, the last section highlights the main issues covered in the chapter.

Description of taxes

Taxes on tobacco products can be classified into two general categories: consumption taxes and customs duties.

Consumption taxes

Consumption taxes are taxes on spending on goods and services. The term refers to a tax system with a taxable base of consumption. The main consumption taxes are value added tax (VAT) or retail sales taxes and excise duties. These are indirect taxes, meaning that they are not levied directly on the income of the consumer or earner. These taxes are due to the revenue authorities by the supplier of the goods or services; however they are ultimately borne by the final consumer. They are called regressive because they are not based on the ability-to-pay principle.

Consumption taxes apply to all supplies or releases for consumption on the territory of a jurisdiction and, normally, also to imports of tobacco products. Tobacco products that are exported are normally not subject to consumption taxes.

VAT, retail sales taxes and excise duties have different characteristics: Value added tax is a general consumption tax that applies, in principle, to all commercial activities involving the production and distribution of goods and the provision of services. It is charged as a percentage of price, which means that the actual tax burden is visible at each stage in the production and distribution chain. It is collected fractionally, via a system of partial payments whereby taxable persons (i.e. VAT-registered businesses) deduct from the VAT they have collected the amount of tax they have paid to other taxable persons on purchases for their business activities. This mechanism ensures that the amount of tax will be the same, independent of the number of intermediate transactions before the final supply to the consumer. VAT is due to the revenue authorities by the seller of the goods, who is the "taxable person," but it is actually paid by the buyer to the seller as part of the price.

VAT is a multistage sales tax that applies at several stages of the production/distribution chain for a product or service. However, a few countries have single-stage sales taxes that apply only at one stage. The most common single-stage tax is the retail sales tax which is charged only on the sale of an item to its final end user (e.g. the United States).

Multistage taxes ease the enforcement of higher tax levels (rates), as the taxes are collected fractionally. Norway, Denmark, Sweden and Hungary have the highest VAT rate at 25% (http://ec.europa.eu/taxation_customs/taxation/vat/how_vat_works/rates/index_en.htm). More and more, conventional sales taxes are being replaced by more broadly-based value added taxes.

Most countries around the world levy a VAT or another broad-based consumption tax on tobacco products. Only a few countries do not apply such a tax on tobacco products (e.g. Yemen, Egypt, Maldives, Fiji, the Comoros, and Grenada) (World Health Organization, 2010). In contrast to VAT, excise duties are usually levied at the stage of production or importation—and not distribution—and they target the consumption or the use of specific products. The most commonly applied excise duties are those on alcoholic beverages, manufactured tobacco products and energy products (motor fuels and heating fuels, such as petrol and gasoline, electricity, natural gas, coal and coke).

Excisable goods have the following common characteristics: demand is price inelastic; production, distribution and sales can be closely supervised by the government; and they are associated with negative externalities (e.g. health or environmental) or are considered luxury goods.

There are two types of excise duties on tobacco products: specific and *ad valorem*. A specific excise duty is a fixed monetary amount of tax per quantity, volume, or weight of tobacco products (e.g. per piece, pack, carton, kilogram). An *ad valorem* excise duty, on the other hand, is levied as a percentage of some measure of value of the tobacco products (e.g. the manufacturer's price or the retail selling price).

Excises on tobacco are levied in most countries around the world. Only a few countries do not levy an excise on tobacco products (e.g. Benin, Cook Islands, Maldives, Saudi Arabia, Grenada) (World Health Organization, 2009). However, the type (specific versus *ad valorem*), rates and base of the tax vary considerably across countries.

Other, supplementary taxes on tobacco products are named differently in different countries; however they may act as excise duties despite their names (e.g. the stamp duty in Brazil). Some countries levy several additional taxes on tobacco products. Often they aim to finance various programmes through earmarking but nonetheless act as excises (e.g. the health tax on tobacco products in Romania).

Customs duties

Customs duties (also called tariffs) are taxes levied on imports of goods (and, sometimes, on exports) by the customs authorities of a country, mainly to raise state revenue, and/or to protect domestic industries from more efficient or predatory competitors from abroad. Again, the duty may be specific or *ad valorem*. Specific customs duties are based upon the weight, dimensions, or some other criteria of the item (such as the size of the engine in the case of automobiles). The *ad valorem* customs duties are levied on importer's CIF (cost, insurance and freight) value, as opposed to *ad valorem* excise duties which are levied on the manufacturer's price or the retail selling price. Consequently the impact of a customs duty on the final consumers' price will be less than that of an excise duty, because the CIF value at importation can be considerably lower than the e.g. the final retail selling price. For example, total tax as percentage of retail price is 50% in Saudi Arabia, Bahrain, and Qatar despite 100% import duties (World Health Organization, 2010).

Almost all countries levy – usually an *ad valorem* – tariff on imported tobacco products. Again, the practice varies greatly among countries, with rates for example of 100% in Guyana and 83% in Egypt (World Health Organization, 2010).

Customs duties aim to raise state revenue, and/or to protect domestic industries and not to influence the consumers' price/behaviour. Moreover, relying on higher import duties as a way of generating revenues or increasing the price of tobacco products may not be an appropriate policy given the trade liberalization and the bilateral, multilateral or global trade agreements which provide for a phasing out of such duties.

Description of taxed products

In principle, excise duties are levies on manufactured tobacco and not on raw tobacco leaves. Manufactured tobacco includes products which are entirely or partly made of tobacco for the purpose of smoking, sniffing, sucking or chewing. It includes rolls of tobacco such as cigarettes; bidis, kreteks, cigars and cigarillos; loose smoking tobacco such as fine-cut tobacco, pipe and water pipe tobacco, as well as smokeless tobacco such as snus (for sucking), nasal snuff (for sniffing) and chewing tobacco.

In most countries, the various categories of manufactured tobacco carry different levels of taxation, reflecting differences in the fiscal policy objectives as well as in the perceived tax-bearing capacity of the different product categories. In particular, hand-made or more labour intensive products, products made mainly by small- and medium-sized enterprises, as well as products predominantly consumed by consumers in the lower income groups, often benefit from preferential tax treatment (World Health Organization, 2010).

Rolls of smoking tobacco

Cigarettes are basically rolls of tobacco wrapped in paper tubes capable of being smoked as they are. Manufacturing cigarettes is a capital-intensive, fast-paced and highly automated process. Machines may produce between 8000 and 20 000 cigarettes every minute.

Cigarettes are the most consumed tobacco product. Worldwide cigarette consumption accounts for approximately 80% or more of the total production of tobacco leaves (http://www.fao.org/docrep/006/Y4956e/y4956e04.htm). In the European Union, cigarettes account for approximately 92% of the total sales of tobacco products (European Commission, 2010a). However, in some areas such as southeastern Asia, substitutes like bidis and kreteks have a more important market share.

Bidis are the Indian-southeastern Asian version of cigarettes. They are made by rolling a dried, rectangular piece of tendu or temburni leaf (plants native to Asia) with sun-dried, flaked tobacco (approximately 0.2–0.3 g) into a conical shape and tied with a piece of thread. The bidi industry has a large number of small-scale industries, with a significant share of bidis being handmade. Bidis account for around 85% of total smoking tobacco consumption in India, with the remainder consisting of cigarette consumption (John *et al.*, 2010). Historically, excises on bidis have been close to zero. A lobbying argument of the bidis industry is that a tax increase will affect employment and tobacco-related trade (Ray and Gupta, 2009).

Kreteks, sometimes referred to as clove cigarettes, are the Indonesian version of cigarettes and by far the most widely-smoked form of tobacco in Indonesia. They typically contain a mixture of approximately 60–80% tobacco, 20–40% ground cloves, clove oil and other additives.

Cigars and cigarillos are rolls of tobacco with an outer wrapper of natural tobacco or rolls with a threshed, non-cut, blend filler and with an outer wrapper of the normal colour of a cigar, of reconstituted tobacco, covering the product in full. Cigars are handmade or machine made but at lower speed and higher cost compared to cigarettes. This is reflected in the taxation regime, whereby cigars or cigarillos are often taxed at a considerably lower level than cigarettes. However, new products have appeared over the last years (e.g. “eco cigarillos” in the EU, “small cigars” in the US) which are manufactured at low cost and marketed as alternatives for cigarettes but taxed at a sometimes considerably, lower rate.

Loose smoking tobacco

Fine-cut tobacco is loose tobacco which consumers primarily use to make cigarettes, either by rolling it by hand into cigarette paper (roll-your-own, RYO) or using fabricated filter tubes and a making device (make-your-own, MYO).

Although worldwide fine-cut tobacco (together with pipe tobacco) is estimated to be only around 1% to 2% of the tobacco market, in some regions it has a more important market share (Euromonitor International, 2009). Fine-cut tobacco comprises approximately 8% of the total sales of tobacco products in the European Union (European Commission, 2010a). The core markets in the EU are Germany, the Netherlands, Belgium, Luxembourg, France and the United Kingdom, covering in volume 80% of the EU fine-cut market. In Luxembourg and the Netherlands, fine-cut even accounts for more than 50% of total consumption of tobacco (European Commission, 2010a).

The fine-cut tobacco manufacturing process is relatively labour-intensive as compared to cigarettes. There are many small- and medium-sized, often family-owned, enterprises producing fine-cut tobacco. In addition, fine-cut tobacco is predominantly consumed by consumers in the lower income groups. Historically, it has been taxed at a significantly lower level than cigarettes.

Pipe tobacco is loose tobacco processed in a different way to make it capable of being burned in a pipe. In many countries, it is a niche market product with low and steadily declining volumes. Because of its generally more traditional and more labour intensive manufacturing processes, inter alia, it often has an even lower tax level than fine-cut tobacco. Pipe tobacco is taxed as «other smoking tobacco» (European Commission, 2010a). As a result, also in this market, new products have appeared which are taxed as pipe tobacco, but are marketed as, and in direct competition to, fine-cut tobacco.

Water pipe tobacco is another form of smoking tobacco widely used in southwestern Asia and the eastern Mediterranean area. However, its consumption is increasing in other regions, such as the EU (Unpublished data from Internal Reports from Member States to the EC; Knishkowy and Amitai, 2005). Recent data published by the Eurobarometer indicate that 9% of smokers use water pipes occasionally (European Commission, 2010b). Little information is available with regards to excises on tobacco products for water pipes. The tax rates seem to vary widely, from 2% of the producer price in Libyan Arab Jamahirya, to 15% in Syrian Arab Republic, to 58% of retail price in Turkey and 108% in Lebanon (World Health Organization, 2010). In the EU, water pipe tobacco is taxed like pipe tobacco (European legislation Directive 2010/12; see «other smoking tobacco» in European Commission, 2010a).

Smokeless tobacco products

Taxation of smokeless tobacco products has received comparatively little attention in most countries. Smokeless tobacco is a major consumer's choice in some markets such as Sweden, Norway and India, and is widespread in countries such as the USA (IARC, 2007). Basically, there are three major forms of oral smokeless tobacco products:

Tobacco alone with aroma and flavouring includes products that are sucked, chewed or both. For example, snuff, which is chopped into particles like large coffee grounds and moistened, is used by holding between gum and cheek. Swedish snus, which is a variant of snuff processed differently and typically moister, is sucked. Snus exists in two packaging formats, loose snus and portion-packed snus. Chewed products, shredded like short cut grass, generally mildly acidic, are intended to be chewed throughout the day as desired, for example loose-leaf.

Tobacco with other components includes products that contain lime, sodium bicarbonate, ash or other additives and which can be either chewed or sucked, for example chimó and shammah.

Betel quid with tobacco includes areca nut, slaked lime, catechu, and tobacco, and comprises products that can be chewed or/and sucked, such as gutka.

The tax treatment of smokeless tobacco differs widely among countries; often it is not taxed, while some countries apply differential rates for, e.g., snuff and chewing tobacco (World Health Organization, 2010).

Smokeless tobacco is becoming a more important policy issue because of the appearance of new smokeless tobacco products. These new smokeless products include a variety of dissolvable tobacco products and snus, in addition to the more traditional moist snuff and chewing tobacco products. The issue of how to tax all these products remains an open question for further study.

Finally, to avoid loopholes, countries may also tax other manufactured tobacco, such as tobacco refuse put up for retail sale or all other tobacco which has been cut, split, twisted or pressed and is capable of being smoked without further industrial processing.

Objectives of tobacco taxation

In many countries tobacco is taxed more heavily than other goods. There are at least three reasons for this.

Revenue objectives

Historically, revenue generation has been the primary aim of tobacco taxation of most, if not all governments. Taxes on tobacco products are a very efficient revenue raiser given the large sales volumes, the relatively inelastic demand (consumers are not price-sensitive due to addiction) and the lack of close substitutes. They satisfy the so-called "Ramsey Rule" for economically efficient consumption taxes—because of the relative inelasticity of demand, they can generate considerable revenues while creating fewer distortions in the market than would result from taxes on goods and services with more elastic demand. Moreover, given the small number of producers and the large sales volumes, tobacco taxes are relatively easy to collect, at low administration and enforcement cost, in particular as compared to general consumption taxes and income taxes. Table 2.1 shows the share of excises on tobacco as a percentage of total tax revenues in countries in the EU.

Given the size of total revenues in some countries, even a share of 1–2% represents a significant source of revenue in absolute monetary amounts. However, to date, and in particular in more developed economies, VAT and other general sales taxes have the capacity to raise much larger revenues from a more widely spread tax base. Therefore the retention and the increase of excise duties on tobacco products are also justified by reasons other than budgetary.

Health objectives

To discourage consumption of the product

Tobacco use is the leading cause of preventable death, and is estimated to kill more than 5 million people each year worldwide. If current trends persist, tobacco will kill more than 8 million people worldwide by the year 2030, with 80% of these premature deaths in low- and middle-income countries (World Health Organization, 2008). It is the biggest single form of avoidable death and one of the leading causes of illness and mortality.

Taxation forms part of an overall strategy of tobacco use prevention and dissuasion that also includes other measures intended to reduce demand, such as protection from exposure to tobacco smoke, advertising bans, regulation of the contents, etc. Price increases of tobacco are considered to be the most effective and cost-effective single measure to prevent and reduce tobacco use. Over one hundred studies have examined the impact of tobacco taxes and prices on overall tobacco use. While these studies have produced a wide range of estimates of the magnitude of the effects of price on overall tobacco consumption, it is clear that a price increase will lead to a reduction in consumption (see Chapter 4 for the value of these estimates). More importantly, the impact of higher prices is likely to be greatest on young people, who are more responsive to price rises than older people. In addition, price increases are an effective policy tool to prevent people from taking up smoking (especially among young people), encourage smoking cessation, reduce the number of ex-smokers who resume the habit, and reduce in the long run the average cigarette consumption among continuing smokers.

Article 6 of the World Health Organization's Framework Convention on Tobacco Control (WHO FCTC) recommends tax policies so as to contribute to health objectives aimed

Table 2.1. The share of excises on tobacco as a percentage of total tax revenues in the EU Member States and two other selected countries in 2005

Country	Share of tobacco excise
Sweden	0.7%
Slovenia	0.8%
Denmark	0.9%
Finland	1.2%
Netherlands	1.5%
Belgium	1.8%
Lithuania	1.8%
Ukraine	1.8%
Austria	2.0%
France	2.1%
United Kingdom	2.2%
Italy	2.3%
Latvia	2.3%
Ireland	2.6%
Germany	2.8%
Spain	2.9%
Hungary	3.2%
Estonia	3.4%
Cyprus	3.6%
Portugal	3.7%
Slovakia	4.0%
Czech Republic	4.0%
Poland	4.8%
Malta	4.9%
Greece	5.6%
Romania	5.8%
Bulgaria	6.8%
Luxembourg	7.3%
Indonesia (2007)	8.4%

Source: European Commission (2008a) *(SEC/2008/2266)*; see tobacco products legislation; impact assessment at reducing tobacco consumption (World Health Organization, 2005). More and more countries or jurisdictions are using tobacco taxes as a way to promote public health by reducing tobacco use and the death and disease it causes (e.g. the EU, Norway, New York and California in the United States, Pakistan, etc.). A health-driven taxation policy aims to increase the overall tax and price levels of tobacco products, increase in particular the tax and price levels of the cheaper brands, and reduce the price gap between low-priced and premium brands to discourage down-trading (smokers switching to cheaper brands as a result of tax and price increases).

To recoup what economists call "negative externalities."

Negative externalities are the costs borne by society collectively, or by individuals other than the individual tobacco consumer. Theories suggest that these external costs associated with the consumption of tobacco, such as the costs to treat smoking-related diseases, warrant supplementary taxes on tobacco. Generally, these costs are not reflected in the price of the tobacco products. The purpose of externality taxation is to confront the individual decision-maker with the external costs of their decision, on the same basis as if these costs were private costs (so-called "internalisation"). Because the consumer pays for the societal cost, he is assumed to make a more economically efficient decision on whether and how much tobacco to consume.

Negative externalities fall into three broad categories. The first consists of direct externalities experienced by other individuals, including the adverse health effects experienced by those exposed to environmental tobacco smoke (passive smoking). The second comprises collectively-borne costs, such as the cost of publicly-funded medical treatment for smoking-related conditions, and other public expenditure costs. The third category of externalities is, in effect, a tax revenue externality, namely the loss of income and consumption taxes as a result of reduction in the consumer's income and expenditure, especially through premature death and a higher rate of sickness absence. The consequences or the costs for the individual consumer's own health, income, and so on, are no externalities.

Most estimates distinguish between the gross costs of smoking (higher costs of medical treatment, etc., as a result of conditions caused by smoking), and the net costs, which offset against the gross costs a range of cost savings (mainly public expenditure effects, such as savings on retirement pensions) arising because of the premature death of smokers. Some literature suggests that in high taxing countries smokers pay their way—in other words, that the supplementary taxes on tobacco overcompensate the net external cost (Cnossen, 2006; Manning *et al.*, 1989). However, this is a controversial area, inter alia, because of the treatment of costs borne by family members. Family members of a smoker may experience considerable costs, including ill health, and pain and distress as a result of the illness and premature death of the smoker. This harm inflicted on family members—which is hardly quantifiable—is often not considered as an external cost (Smith, 2007), as family members are assumed to care for each other's welfare to the extent that the welfare of the household can be considered as a single entity.

Political, social and economic considerations

In principle, the three aforementioned objectives are complementary. Increases in tobacco taxes aiming to raise additional revenue will contribute to a reduction in consumption and in the external cost of smoking. Vice versa, given the inelastic demand and the high share of the tax in the retail price, tax policies aimed at reducing tobacco consumption or at recouping externalities will, all other things being unchanged, entail revenue increase.

Nonetheless, when determining their taxation policy governments will take into account other, at times competing, considerations. This section does not aim to list exhaustively all political, social or economic considerations that may be taken into account in determining a taxation policy, but focuses briefly on the most frequently used arguments against tax increases.

Poverty

Concerns about the affordability of cigarettes, in particular for the poor, are arguments for those who oppose tobacco tax increases. Consumption taxes are regressive because they are not based on the ability-to-pay principle. Assuming equal consumption patterns, tobacco taxes will account for a greater share of income for the poor than for the rich (see Chapter 7). This regressivity will be more pronounced in countries where the tobacco consumption is greater among lower than among higher incomes. A "pro-poor policy" can keep taxes on tobacco low in general, but can also keep taxes low on the products/brands most widely used by the poor while more heavily taxing more expensive products or brands (e.g. fine-cut tobacco versus cigarettes).

However, a policy aimed at keeping tobacco affordable for lower incomes is likely to end up with a disproportionate share of the health and economic burden of tobacco consumption on the poor. On the other hand, although the initial tax is regressive, tax increases can be progressive (Chaloupka *et al.*, 2000). To the extent that lower incomes are more sensitive to price increases than higher incomes, tax increases will entail a higher reduction in consumption among this population while having less of an impact on higher-income populations. Consequently, the burden of the actual supplementary taxes paid as a result of a tax increase will be greater on those with higher incomes. In the long run the poor benefit from an increase in the quality of their health and economic welfare.

Inflation

Consumption taxes may have an inflationary effect. At times the inflationary impact of increases of tobacco taxes is raised as an argument to oppose increase of tobacco taxes, in particular where government policy is to keep inflation low. However, as opposed to broad-based consumption taxes, the relative weight of expenditure on cigarettes in the consumer price index should not be overestimated, and in general the impact on inflation of an increase of tobacco taxes will be relatively small (see Chapter 9). To the extent that concerns about the impact on inflation are a barrier to tax increases, excluding tobacco products from the baskets of goods used in developing key price indices used for the indexation of wages and pension payments, such as for instance in France, Belgium and Luxembourg, would greatly reduce these concerns (World Health Organization, 2010).

Employment

In general, only jobs in tobacco farming, leaf processing, warehousing and manufacturing are fully dependent on tobacco. Other sectors, such as retailers who sell tobacco among many other products are only partly and indirectly involved. To date, tobacco manufacturing is a capital-intensive sector and is relatively small in terms of numbers of people employed, e.g. 60 000 in the EU-25 in 2003 (Commission Staff Working Document Impact Assessment Accompanying the Proposal for a Council Directive amending Council Directive 95/59/EC, 92/79/EEC and 92/80/EEC on the structure and rates of excise duty applied to manufactured tobacco (SEC/2008/2266)).

In general, any tobacco-dependent job lost in response to the reduced demand for tobacco products will be offset by new jobs in other sectors because the money spent on tobacco will be shifted to more labour-intensive goods and services (see Chapter 9). To address employment concerns in tobacco-dependent sectors, programs have been adopted to ease the transition to another economic activity, e.g. crop diversification for tobacco farmers or product diversification for retailers. At times, the employment argument has been used to justify reduced rates on products other than cigarettes, which are perceived as being more labour intensive (e.g. handmade kreteks; bidi rolling, fine cut tobacco).

Protection of domestic tobacco growers and manufacturers

Some countries levy a lower tax on local tobacco products to protect domestic tobacco growers and tobacco manufacturers from outside competitors. This can be done by directly applying different excise rates to tobacco products depending on the source or type of tobacco contained in the product or on other product characteristics, or indirectly by applying an *ad valorem* excise duty where foreign brands are more expensive than local. This can be an infringement of Article III (2) of the General Agreement on Tariffs and Trade legal text referred to as GATT, 1947 (http://www.wto.org/english/docs_e/legal_e/gatt47_01_e.htm#articleIII), now embedded in the World Trade Organization, according to which internal taxes shall not be applied to protect domestic production, or of similar provisions laid down in regional free trade arrangements.

Other constraints for tax and price increases

As aforementioned, the health and budgetary objectives are to a large extent complementary. Decision-makers will also take into account other considerations, such as the impact on inflation, employment, affordability and the interests of the domestic tobacco growers and manufacturers. However, the ability to increase prices and revenues by means of tax increases has certain constraints, as any tax increase may entail a change in other variables affecting the expected revenue increase or reduction in consumption. The most pertinent ones are the manufacturers' pricing policy, the consumers' behaviour and the share of the non-domestic duty paid consumption in total domestic consumption.

The share of the non-domestic duty paid consumption (NDDP): tax evasion and tax avoidance

A part of the tobacco market will escape domestic taxation because of illicit trade and cross-border shopping. Cross-border shopping in neighbouring low-taxing countries or jurisdictions is legal as long as the quantitative restrictions laid down in the traveller allowances are respected. Illicit trade covers mainly smuggling, illicit manufacturing and counterfeit. Smuggling refers to products illegally traded across borders. Large-scale organized smuggling involves the illegal transportation, distribution and sale of large consignments of cigarettes and other tobacco products. Small-scale smuggling involves the purchase, by individuals or small groups, of tobacco products in low-tax jurisdictions in amounts that exceed the limits set by customs regulations, for resale or just use in high-tax jurisdictions. Illicit manufacturing refers to the production of tobacco products contrary to taxation laws or other laws (such as licensing or monopoly-related laws) that restrict the manufacture of tobacco products. Counterfeit tobacco production is a form of illegal manufacturing in which the manufactured products bear a trademark without the consent of the owner of the trademark. Counterfeit and illegally manufactured products can be sold on the domestic market or smuggled into another jurisdiction (see Chapter 8).

Significant differences in taxes and prices of tobacco products between countries and jurisdictions have created an environment for tax-induced cross-border shopping and illicit trade. Worldwide illicit trade is estimated at 11.6% of the global cigarette market in 2007 (Joossens *et al.*, 2009).

Manufacturers' pricing policy

Manufacturers may absorb the tax increase, partly or completely, by reducing their profit margin. Consequently, the tax increase will not result in the expected price increase and related reduction of consumption. Moreover, in the case of *ad valorem* duties, this may even affect the expected revenue increase (see further and Chapter 3).

Consumer behaviour

As cigarettes may be sold at different price points (low, medium-priced, premium), consumers may switch to cheaper cigarettes or to other tobacco products (e.g. fine-cut instead of cigarettes) as a result of a tax increase. For example, a Klynveld Peat Marwick Goerdeler (KPMG, 2005) study commissioned by the European Commission concluded that the market share of cheap cigarettes has soared in most EU Member States as a result of tax hikes triggering less tax revenue and/or mitigating the downward the effect on the consumption of cigarettes. Again, an *ad valorem* structure will make price and tax policies more vulnerable to changes in consumer behaviour (see further).

Structure of the taxes

There are two types of excise taxes: specific and *ad valorem*. A specific excise tax is a fixed monetary amount of tax per quantity, volume, or weight of tobacco products. An *ad valorem* excise tax is levied as a percentage of the price of the tobacco products. Countries may have either an *ad valorem* or a specific structure. Specific and *ad valorem* taxes have different effects on prices, profits and competitive positions of tobacco producers, tax revenues, quality and variety of products, administration and distribution of income. They will contribute in a different way to the achievement of health objectives. The relative merits depend on the objective that a country wants to achieve with the tobacco tax, and in part on whose perspective is being used to evaluate their effects (revenue, health, manufacturers, consumers). To have the best elements of both, it is possible to combine an *ad valorem* with a specific tax. A so-called mixed structure applies an *ad valorem* and specific duty to all tobacco products. Mixed systems can give preference to more *ad valorem* or to more specific duties depending on the desired effects.

Ad valorem excise duties can also be combined with a minimum tax floor. Minimum excise duties are similar to specific excise duties, and are a fixed monetary amount per quantity or volume that applies if the *ad valorem* excise falls below a minimum floor. In other words the *ad valorem* cannot be less than the minimum tax floor; lower-priced products will be taxed at the specific minimum rate, and higher-priced products will be taxed at the *ad valorem* rate. The effects of a minimum tax floor are similar to those of specific duties. Finally, more complex taxation systems may even combine a mixed structure with a minimum duty.

In summary, this leads to five structures:

1) Purely specific; with a tax base per unit, e.g. per 1000 cigarettes; per 1 kg tobacco.

2) Purely *ad valorem*; the tax base is the value of the products (e.g. ex factory price; retail price).

3) Mixed; a combination of both *ad valorem* and specific duty.

4) A combination of an *ad valorem* duty for medium-priced and/or premium brands and a specific duty for cheaper brands. The *ad valorem* excise applies on the value of the products; however, if the *ad valorem* excise falls below a minimum floor, a specific tax applies.

5) A combination of a mixed duty for medium priced and/or

premium brands and a specific duty for cheaper brands. A mixed excise applies; however if the mixed excise falls below a minimum floor, a specific tax applies.

Only 55 countries rely on specific duties only; most (108) apply at least to some extent an *ad valorem* duty (see Table 2.2) (World Health Organization, 2009). No complete data are available as concerns the number of countries applying a minimum tax. Twenty-four EU Member States (European Commission, 2010a) as well as the Russian Federation and the Ukraine combine a mixed structure with a minimum tax. Turkey applies an *ad valorem* system combined with a minimum tax (World Health Organization, 2010).

The preference of countries for a particular structure shows similarities by income groups. Most low-income countries rely on *ad valorem* taxes. Conversely, almost all high-income countries apply purely specific or mixed systems. Within the high-income countries, the European Region (except Norway) relies on a mixed system, and almost all other countries on a purely specific system (inter alia, the United States of America, Canada, Australia, New Zealand, Japan, Singapore).

Table 2.2. Excise structure for cigarettes in 2008

Structure	Number of countries (total 182)
Purely specific system	55
Purely *ad valorem* system	60
Mixture of both excises	48
No excise	19

Source: World Health Organization (2009). WHO report on the Global Tobacco Epidemic 2009: implementing smoke-free environments. Geneva, World Health Organization

There are also similarities by region. Most countries in Latin America and the Caribbean region as well as in Africa apply purely *ad valorem* systems. North America and a large number of countries in the East Asian and Pacific region rely on purely specific systems. Mixed systems are mainly applied in Europe, and in China, Indonesia, Pakistan, Malaysia and Thailand (World Health Organization, 2009).

Countries applying a mixed structure may rely mainly on *ad valorem* or mainly on specific duties. In the EU, Member States must apply a mixed structure (Fig. 2.1). The specific component may not be less than 5% or more than 55% of the amount of the total tax burden (proportional and specific excise duty plus VAT). As from 1 January 2011, the specific component of the excise duty on cigarettes may not be more than 76.5% of the amount of the total tax burden and as from 1 January 2014, the specific component of the excise duty on cigarettes may not be less than 7.5% (Council Directive 2010/12/EU of 16 February 2010 amending Directives 92/79/EEC, 92/80/EEC and 95/59/EC on the structure and rates of excise duty applied on manufactured tobacco and Directive 2008/118/EC). The upper limit has been increased, allowing Member States relying more on specific duties in the context

Figure 2.1. Share of *ad valorem* and specific taxes in total excise duties: EU27

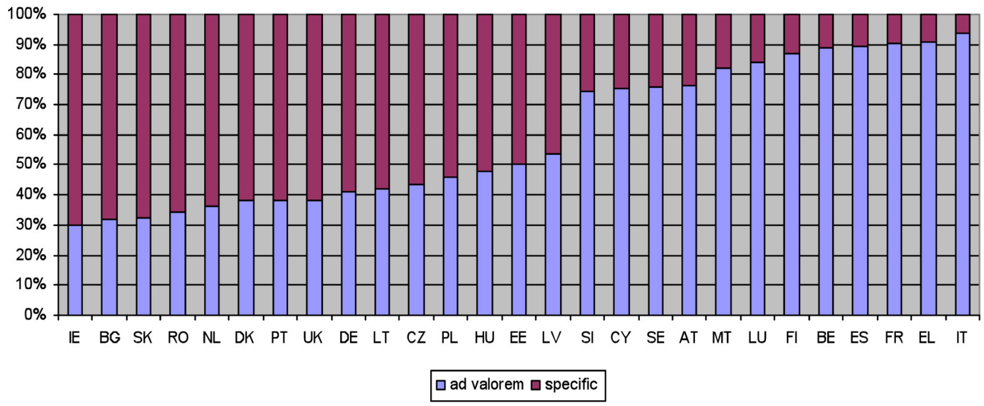


Figure generated by the Working Group based on data published in the excise duty tables in European Commission (2010a). Excise duty tables 2010, Part III- Manufactured Tobacco. Brussels, European Commission. *http://ec.europa.eu/taxation_customs/taxation/excise_duties/tobacco_products/rates/index_en.htm)*. Abbreviations: AT, Austria; BE, Belgium; BG, Bulgaria; CY, Cyprus; CZ, Czech Republic; DE, Germany; DK, Denmark; EE, Estonia; EL, Greece; ES, Spain; FI, Finland; FR, France; HU, Hungary; IE, Ireland; IT, Italy; LT, Lithuania; LU, Luxembourg; LV, Latvia; MT, Malta; NL, Netherlands; PL, Poland; PT, Portugal; RO, Romania; SE, Sweden; SI, Slovenia; SK, Slovakia; UK, United Kingdom.

of a health-driven taxation policy. To maintain a minimum level of harmonization of the tax structure, the lower limit should, in theory, have been increased to the same extent. However, due to strong opposition of several countries applying high *ad valorem* duties, a compromise was reached at only 7.5%. As a consequence, there is flexibility resulting in widely differing practices, reflecting the differing objectives that the countries want to achieve by means of tobacco taxation.

Within these systems different tax rates may apply for different products (e.g. filtered and unfiltered cigarettes, cigarettes versus fine-cut tobacco) which render the tax structures very complex.

There are many factors that can influence the choice of one structure over another. Regulators will consider the effects on tax revenues, prices, profits and competitive positions of tobacco producers, quality and variety of products as well as the ability to administer the tax.

Because specific duties are the same for all cigarettes, independent of the price, they will reduce the relative price differentials between high- and low-taxed cigarettes. This may lead consumers to switch to higher-priced cigarettes, assuming that more expensive cigarettes are considered to be of a higher quality (and thus more appealing). They have an upgrading effect that favours high quality, which may lead to a higher average price.

Ad valorem duties are a percentage of the price of cigarettes and will maintain the relative (pre-tax) price differentials between high- and low-taxed cigarettes. Consequently there will be more price competition under an *ad valorem* system, which may entail a lower average price. They have a multiplier effect that favours low quality.

Specific duties may have several merits as concerns their impact on prices, consumption and revenues.

Changing an *ad valorem* structure to a more specific structure

Objectives may change over time. Where an *ad valorem* structure was preferred in the past, specific duties may now fit better to achieve revenue and health objectives. However, a change from an *ad valorem* structure into a specific will have a certain cost: the tax burden on the lower-priced cigarettes would be increased, but the change to specific taxation would result in a reduction of the tax burden on higher priced brands. This might have undesired effects on consumer prices of premium brands and on the profits and competitive positions of tobacco manufacturers. Producers of premium brands would get a tax subsidy, while their competitors would potentially face a significant increase of the tax burden on their products. To avoid these effects, a switch to a more specific tax structure could be done in the context of tax increases, i.e. by increasing the specific element while leaving the *ad valorem* unchanged. Another option is the introduction of a minimum tax floor that does not affect the tax burden on higher priced brands.

Tax rates

Overview

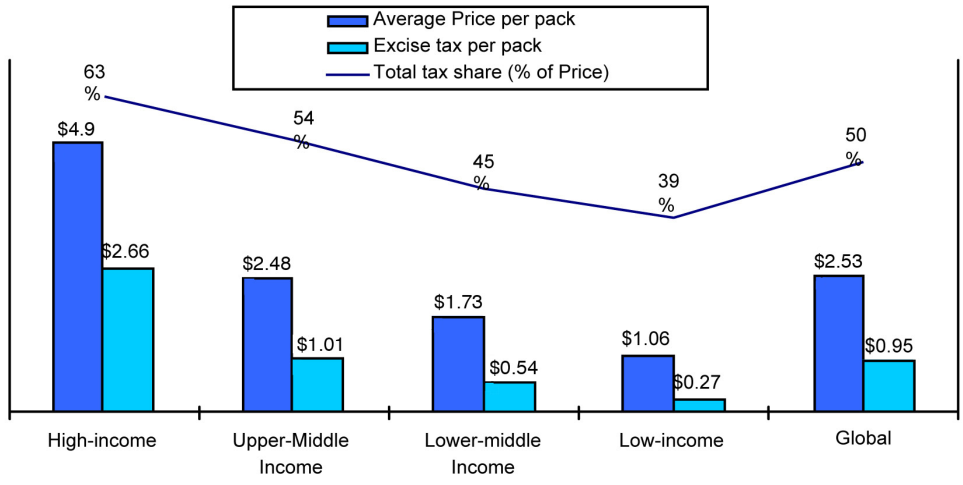
Tax rates vary greatly across countries, ranging from countries with no excise imposed on tobacco products (e.g. Benin, Cook Islands, Grenada, Maldives, Saudi Arabia) to an excise tax representing more than 75% of the retail price of a pack of the most sold brand of cigarettes (e.g. Cuba, Fiji, Poland and Seychelles) (World Health Organization, 2010). However, rates do cluster by income groups, and some common features can be seen on an average level when moving from one income group to another. Figure 2.2 shows the average levels of the price, tax amount and tax share of the price of the most-sold brands of cigarettes by income groups based on World Bank classification in 2008 (http://data.worldbank.org/about/country-classifications/country-and-lending-groups). There is a clear downward trend in the tax and price level as the level of income of countries goes down. At the extremes the total tax rate for low-income groups is almost 40% lower than the tax rate of high-income groups.

Figures 2.3 and 2.4 show details of tax levels by countries and by WHO region. The rates shown in Figure 2.3 apply to the most-sold brand; those rates of course vary within a country when price differentials are large among brands and particularly when differential excise tax rates are applied on different brands and products. For example, in Bangladesh, the total tax share of the retail price is 47% for the cheapest brand pack of 20 cigarettes and 87% for a pack of Marlboro cigarettes. In the Philippines the total tax share of the cheapest brand pack of cigarettes is 54%, and goes up to 76% for the Marlboro brand (World Health Organization, 2010).

Differential taxation between tobacco products

Most countries apply different rates on tobacco products, either to protect their domestic industry (e.g. India where much lower taxes are applied on bidis compared with cigarettes), or because of the perception that the products are of a different nature (e.g. cigars, water pipe tobacco, chewing tobacco versus cigarettes).

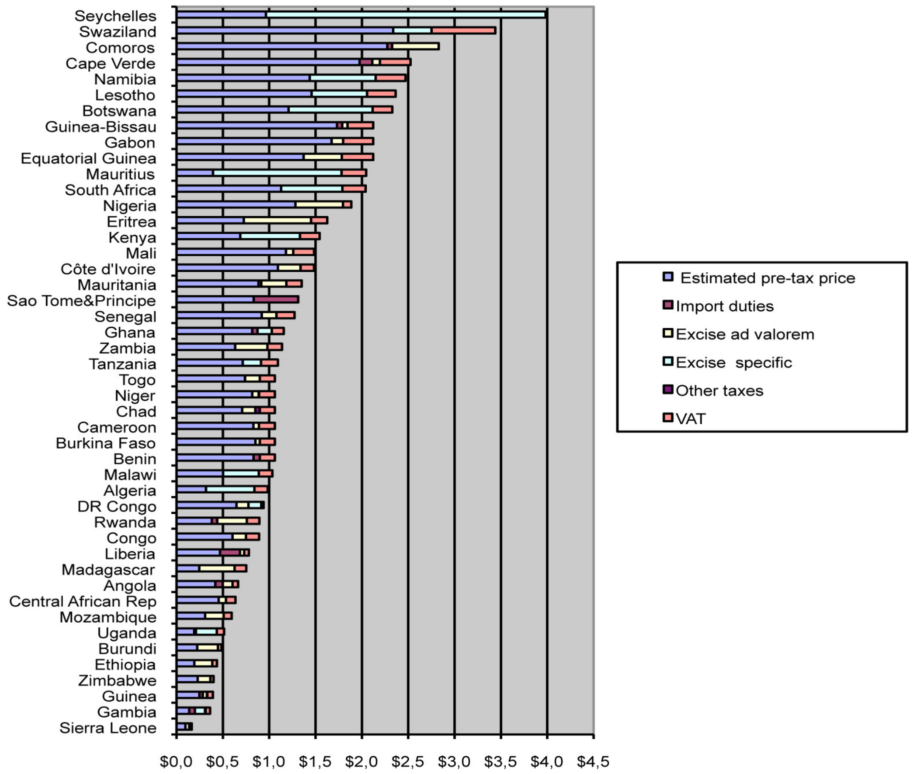
Figure 2.2. Price and tax average for a pack of the most-sold brand of cigarettes by income groups, 2008§



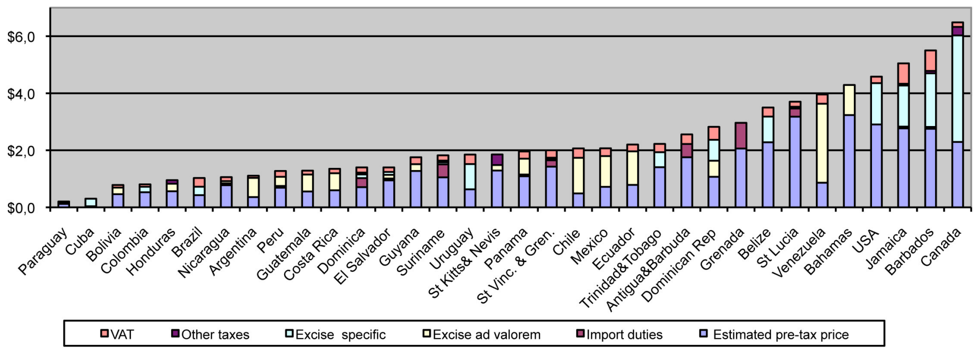
Source: Adapted from World Health Organization (2009). WHO report on the Global Tobacco Epidemic 2009: implementing smoke-free environments. Geneva, World Health Organization.
§July 2008 World Bank classification of countries by income

Figure 2.3. Cigarette price, excises, and other taxes as in 2008, by region

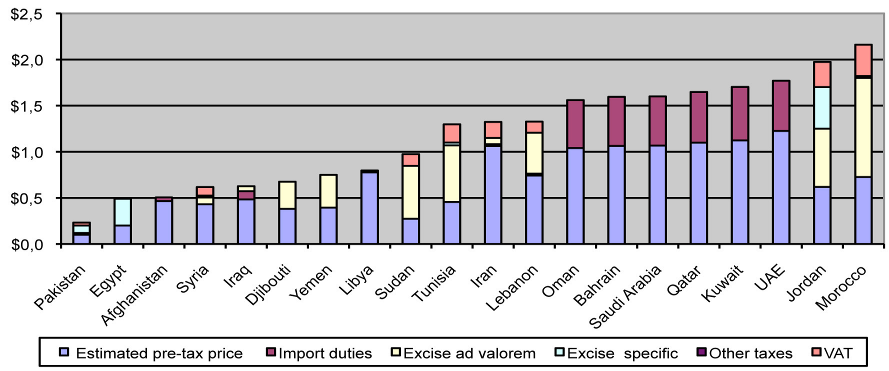
WHO African Region (AFRO)



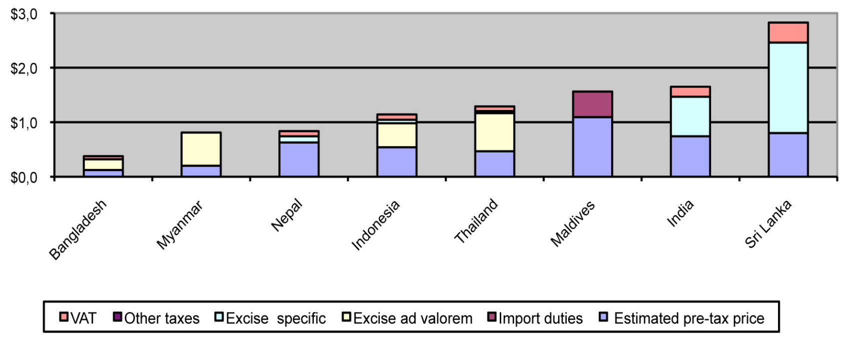
WHO Region of the Americas (AMRO)



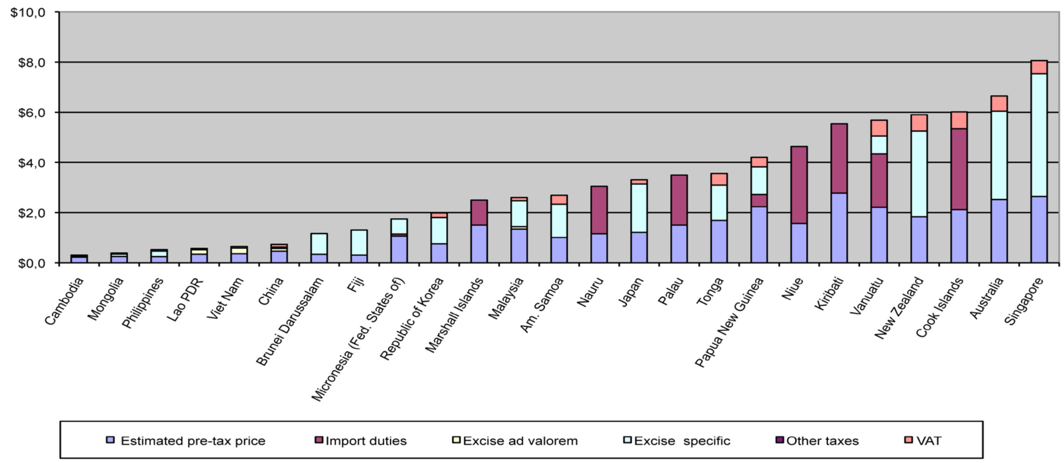
WHO Eastern Mediterranean Region (EMRO)



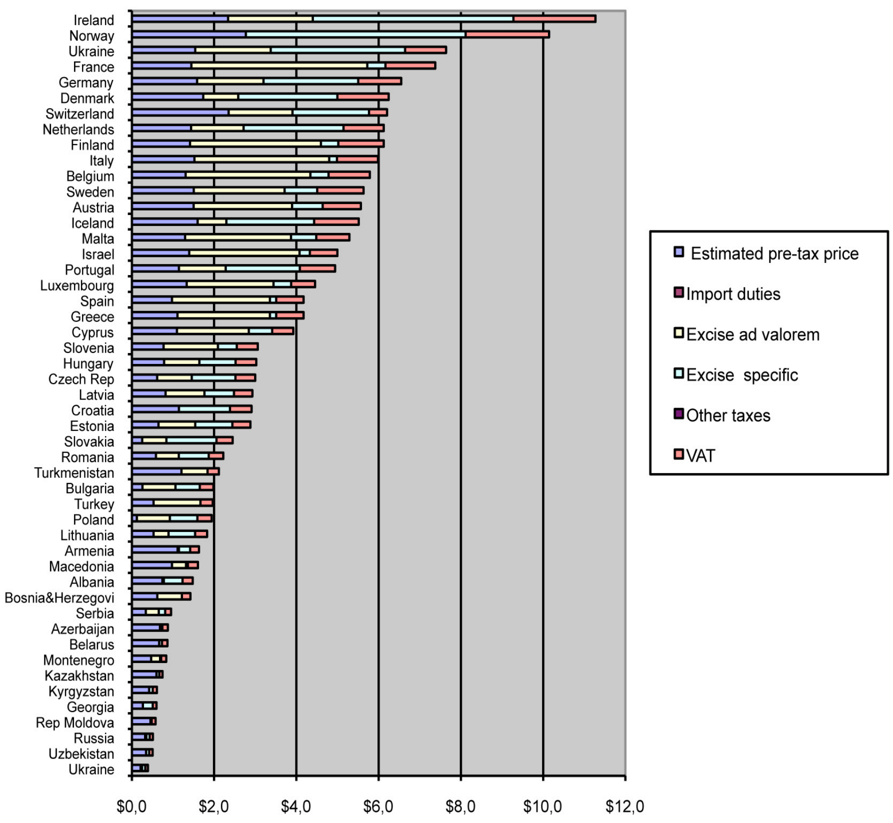
WHO South-East Asia Region (SEARO)



WHO Western Pacific Region (WPRO)



WHO European Region (EURO)



Source: World Health Organization (2009). WHO report on the Global Tobacco Epidemic 2009: implementing smoke-free environments. Geneva, World Health Organization.

Notes: Price of the most sold brand in the country converted into US dollars using official (principal or market) exchange rates at end of time period; total tax share includes specific excise, ad valorem excise, value added tax (VAT), imported tax duty (if the most popular brand in the country is imported), and others (if applicable); un-weighted arithmetic average.

Figure 2.4. Taxes on cigarettes in the European Union - *1 January 2010*

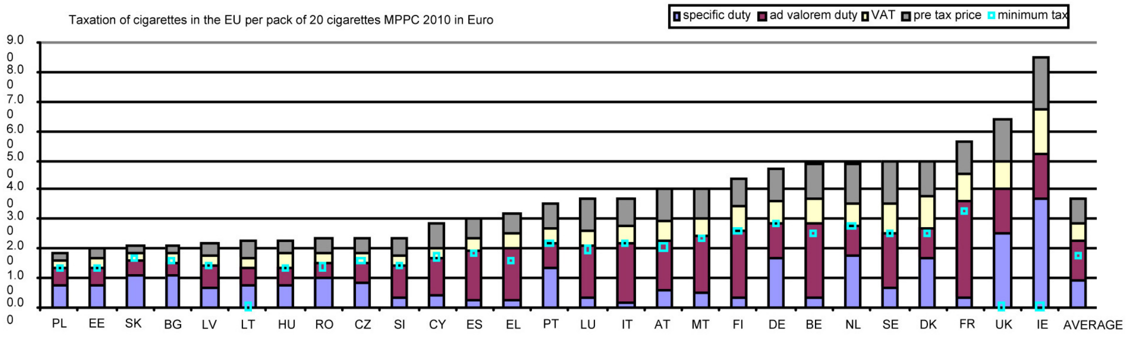


Figure generated by the Working Group based on data published in the excise duty tables in European Commission (2010a). Excise duty tables 2010, Part III- Manufactured Tobacco. Brussels, European Commission (data from 2010 used to produce the graph available upon request);
http://ec.europa.eu/taxation_customs/taxation/excise_duties/tobacco_products/rates/index_en.htm).
Abbreviations: AT, Austria; BE, Belgium; BG, Bulgaria; CY, Cyprus; CZ, Czech Republic; DE, Germany; DK, Denmark; EE, Estonia; EL, Greece; ES, Spain; FI, Finland; FR, France; HU, Hungary; IE, Ireland; IT, Italy; LT, Lithuania; LU, Luxembourg; LV, Latvia; MT, Malta; NL, Netherlands; PL, Poland; PT, Portugal; RO, Romania; SE, Sweden; SI, Slovenia; SK, Slovakia; UK, United Kingdom.

Little data is collected on the tax rates applied on products other than cigarettes on a global scale. Data collected by the WHO Reports on the Global Tobacco Epidemic can provide some examples of tax rates for some countries and some tobacco products (World Health Organization, 2009). Table 2.3 provides tax rates of roll-your-own (RYO) tobacco and chewing tobacco as well as cigarettes for selected countries (where data was available). For comparison purposes, the tax rate was applied for the price of 20 g of RYO and chewing tobacco, assuming that a pack of 20 cigarettes would weigh 20 g (1 g of tobacco per cigarette). For RYO, tax rates seem to be similar to those for cigarettes but can also vary widely, with the rates on cigarettes being higher (e.g. Georgia, Mongolia, Thailand and the United Kingdom). In the EU, the minimum rates for fine-cut are around 50% of the minimum rates for cigarettes. The gap between the level of taxation of cigarettes and fine-cut tobacco gives rise to product substitution. Mainly as a result of increased taxation, the quantities of cigarettes released in the EU-25[1] decreased by around 14% between 2002 and 2008. Conversely, the quantities of fine-cut tobacco increased in the same period by around 18% (European Commission, 2010a).

Moreover, in contrast to ready-made cigarettes, which are taxed on a per-stick basis, specific duties on fine-cut tobacco are levied on a per-kilogram basis. The conversion rate between kilogram and sticks is a controversial issue. Traditionally, 1 kg is supposed to correspond to 1000 sticks. However, the average weight of a cigarette is estimated to be around 0.75 gr. Moreover, new products called "volume tobacco" have gained a significant market share. Each kilo of "volume tobacco"[2] used can yield a savings of at least a half-kilo of cut filler. Consequently, the real tax burden as well as the increase in volumes of fine-cut tobacco may be underestimated.

On the other hand, chewing tobacco is almost always taxed at a significantly lower rate than cigarettes (e.g. Algeria, Bangladesh, Guatemala, Nigeria, Pakistan, Sri Lanka and the Bolivarian Republic of Venezuela). To the extent that these products can be substituted for cigarettes, tobacco taxation can be rendered ineffective if other products remain taxed at a much lower rate.

Differential taxation within the same tobacco products

Several countries also apply differential tax rates within the same tobacco product. For example, about 20% of countries that collect excise taxes on cigarettes impose different rates on the cigarettes consumed in the local market. The differential rates vary depending on different characteristics of cigarettes: this is usually the retail price level, but can also be the production volume, the sales volume, the type of cigarette

[1] No full data available for RO and LT
[2] In contrast to classical fine-cut tobacco, the raw material undergoes an expansion process which leads to an increase of the tobacco volume. One expansion process is called DIET (dried ice expanded tobacco), but there are other processes/patents (IMPEX, IMCON) with comparable effects on the volume of the tobacco. All expansion processes fall under the generic term "volume tobacco."

Table 2.3. Tax share of the price of 20g of RYO, chewing tobacco and 20 cigarettes, selected countries, 2008

Country	Cigarettes	RYO (20g)	Chewing tobacco (20g)
Paraguay	19%		19%
El Salvador	31%		61%
Nigeria	32%	32%	5%
Mongolia	37%	13%	
Malaysia	48%	46%	
Pakistan	52%		14%
Georgia	55%	15%	
Eritrea	55%		55%
India	55%		33%
Guatemala	57%		11%
Australia	62%	67%	
Swaziland	62%	20%	
Samoa	63%	64%	
Japan	63%		20%
Thailand	64%	15%	
Thailand	64%		25%
Canada	65%	24%	
Uruguay	66%	77%	
Bangladesh	67%		15%
Madagascar	67%		44%
Algeria	68%		15%
New Zealand	69%	68%	
Sri Lanka	72%		13%
Norway	73%	78%	
Italy	75%	45%	
Myanmar	75%		25%
Netherlands	76%	38%	
Venezuela	78%		8%
Czech Rep	79%	77%	
UK	80%	55%	

Source: World Health Organization, unpublished data

(with or without filters, hand or machine made), the packaging (hard/soft), the cigarette length, etc. (World Health Organization, 2010). Tax rates can vary substantially. For example, in Indonesia tax rates vary by tobacco product but also within the same product depending on the retail price and production capacity of manufacturers. In the case of kreteks (machine- and hand-made), the rate varied between 65 to 310 Rupiahs per stick in 2010. In Brazil, the excise tax varied between 0.764 to 1.397 Reals per pack of 20 cigarettes depending on the size of the cigarettes and the type of package (unpublished data received from governments reporting their tax rates). These differential rates lead to price gaps within the same type of products and can easily encourage substitution of consumption to lower-taxed products when a tax is increased instead of reduction in consumption or quitting, thereby defeating the purpose of tax policies from a public health perspective. From a tax administration's perspective, applying differential tax rates to the same type of product is not advisable because it makes it more difficult for tax collectors to assess the manufacturer's tax liability, and it provides incentives for manufacturers to avoid taxation by making sure their products fall in the lower end of the tax rate.

The impact of tax rates and tax structure

Impact on prices

If public health is a concern in the tobacco tax policy, policy-makers need to know if the tax increase will actually lead to a price increase and to a consequent reduction in consumption.

Under perfect competition the consumer price cannot increase by more than the amount of tax increase. However, under imperfect competition taxes may be under or over-shifted; that is, the consumer price may rise by less or more than the amount of the tax. While either specific or *ad valorem* may be over-shifted, this is more likely to happen with specific (Delipalla and Keen, 1992). For empirical evidence, see Chapter 3.

The tobacco industry works like an oligopoly with a large number of consumers and a few producers. Seventy percent of the world's cigarette market is controlled by 4 multinationals (Euromonitor International, 2009). In China, however, the market is controlled by only one company owned by the government. In these non-competitive markets, instead of absorbing a tax increase and reducing its profits, the industry can easily pass it on to consumers (leading to an increase in price) without fears that this would lead to a switching to cheaper products offered by a competitive company. In addition, with the growing support to tobacco control policies and the expected decrease in consumption in the future, some suggest that the industry will tend to raise prices now and save its profits instead of keeping prices low to stimulate future consumption (Becker *et al.*, 1994).

Of course, such industry behaviour leads to larger increases in the price of cigarettes, which is good for public health. However, this means more revenues and power to the tobacco industry, revenues that would be more useful if they ended up in the coffers of the government instead.

In the case of the China National Tobacco Co. (CNTC) government-owned monopoly, the relation between taxes and prices is very different. The tax policy is not used as an instrument to influence price, since the government determines both the tax and price levels.

If we compare data at the global level, the average price of a pack of the most-sold brand of cigarettes is higher in countries relying only on specific excise (2.46 US$) than in countries relying only on *ad valorem* (1.29 US$). The same is true for countries applying a mixed system but relying more on specific (3.87 US$) than on *ad valorem* (3.14 US$). Similar conclusions hold also if we account for the income level of countries (World Health Organization, 2010). This is not meant to hold as an empirical justification for the above statement, but it indicates that specific excises seem to lead to higher prices.

Impact on revenues (budgetary stability)

Both excises may have an impact on prices; increases in *ad valorem* duties are likely to decrease prices, and vice versa for specific duties. Since specific duties are independent of changes in price, they generally produce a more stable stream of revenue. Revenue from *ad valorem* duties is dependent on prices, and may vary over time depending on the consumer and producer behaviour. Moreover, forecasting revenue in an accurate way may be very difficult as one must predict changes in consumer and producer behaviour.

In conclusion, specific duties may entail higher prices and more stable revenues but tend to favour higher priced and more appealing brands.

Conversely, *ad valorem* taxes have several merits concerning their impact on product quality and variety, the share of tax in the retail price, and their ability to keep pace with inflation.

Chapter 9 provides an in-depth analysis of the impact of tax rates on tax revenues.

Adjustment of taxes for inflation

The real value of a specific tax will be eroded by inflation and therefore must be periodically adjusted. Conversely, as they are value-based, the real value of *ad valorem* taxes will be preserved, as the tax will increase to the extent that tobacco prices follow inflation. An advantage of a minimum tax floor (which is similar to a specific duty) is that it will be automatically adjusted for inflation if it is set as a percentage of the excise due on a premium price category subject to *ad valorem* taxation (e.g. the most popular price category (MPPC) in most EU Member States).

Impact on variety of products

Specific duties provide incentives for more appealing and higher-priced products as well as a greater variety of products. Upgrading effects of specific taxes will reduce the relative tax burden on high quality products, which provides incentives for higher quality and greater variety of products. Conversely, the multiplier effect under *ad valorem* duties provides a disincentive to costly quality improvements. From a tobacco control and prevention perspective, a higher quality and greater variety of products are not desirable, as these increase the attractiveness of tobacco products.

Industry profits and the share of taxes in the retail price

The theory suggests that profits are relatively higher under specific taxation (Delipalla and Keen, 1992). Specific duties will entail a relatively lower tax burden on premium brands as compared to cheaper brands. *Ad valorem* duties ensure the same tax burden for all price categories. In particular in premium markets, specific duties may entail a lower average price/tax ratio. In high-income countries with similar price levels, countries relying on specific duties have on average a lower share of tax in the retail price. On average, the pre-tax prices are in all income groups the highest in countries with specific duties only, and the lowest in countries with mixed systems. Countries with mixed systems have, apart from the low-income economies, the highest share of tax in the retail prices.

Tax authorities may prefer *ad valorem* duties to maximize the share of tax in the retail price. Assuming identical price levels, this would lead to higher tax revenues. However, *ad valorem* duties may render price and tax policies more vulnerable to industry pricing policies and changes in consumer behaviour.

Other considerations: industry characteristics

Specific duties tend to favour more expensive products. Conversely *ad valorem* duties will entail a higher absolute amount of tax for premium market segments as compared to cheaper brands. The relative price differentials between pre-tax prices will under *ad valorem* systems be better reflected in the tax-inclusive consumer prices. Depending on the industry characteristics, governments may prefer one tax over the other. In particular in highly concentrated markets, where around 80% of the price of cigarettes consists of tax (excise and VAT) and where there is to a large extent a ban on product advertising, a certain level of *ad valorem* duties will contribute to a more competitive environment, usually translated into lower pre-tax prices. To balance the tax burden on the different market segments, countries may opt for a mixed system.

However, the appropriate balance is a very controversial issue. In some countries *ad valorem* duties are advocated to protect the cheaper domestic brands against more expensive but more attractive international brands. Others countries with plants manufacturing international brands will for a similar reason prefer specific duties. Moreover, the current tax structure is often a holdover from a past when tobacco manufacturing played a more important role (e.g. the southern EU Member States still rely mainly on *ad valorem* duties, although, apart from Greece, the domestic production has disappeared over time).

Administration and enforcement

If the administrative capacity of a country is weak, specific duties may have the advantage that it is easier to determine the physical quantity (number of cigarettes, weight of the tobacco) than the value of the products. *Ad valorem* duties require some monitoring of prices for reasons of tax collection. In some countries (e.g. Philippines and the Russian Federation), *ad valorem* duties have involved valuation problems because manufacturers had the potential to sell their products to a related wholesale company at artificially low prices (transfer pricing) to reduce excise duties (World Health Organization, 2010). However, in these countries *ad valorem* duties were levied on ex factory prices. In the EU, where *ad valorem* duties are levied on the maximum retail selling price to the final consumer, such problems have not been reported.

On the other hand, under specific taxation the manufacturer can manipulate the length of the cigarette or the size of the pack to reduce the excise duties. For example, in the EU, to reduce the excise duties on cigarettes, new products have been marketed consisting of rolls of 18 cm and separate filter tubes (Commission of the European Communities, COM(2008) 460/2) (European Commission, 2008b). The rolls are subsequently cut into three pieces by the consumer and inserted in the filter tubes; as for tax purposes the maximum length of cigarettes is 9 cm, three cigarettes are taxed as two. Moreover in many countries, in reply to tax increases, manufacturers have reduced the number of cigarettes per pack (e.g. 17, 18 or 19 instead of 20 pieces) to maintain the same price per pack (unpublished data: Internal Reports from EU Member States to the EC).

The choice between *ad valorem* duties and specific duties is a long-standing and controversial issue. To have the best elements of both, it is possible to combine an *ad valorem* with a specific tax. A so-called mixed structure applies an *ad valorem* and a specific duty to all tobacco products. Mixed systems can give preference to more *ad valorem* or to more specific duties depending on the desired effects. The more the structure relies on the specific duties, the more the upgrading effect will come into play. The more the structure relies on *ad valorem* duties, the more the multiplicator effect will come into play and the more excise duties will be automatically adjusted for inflation.

Ad valorem excise duties or mixed excise duties can also be combined with a minimum tax floor. Minimum excise duties are similar to specific excise duties and are a fixed monetary amount per quantity or volume that ensures a minimum tax floor. The effects of a minimum tax floor are similar to specific duties; however they tend to apply only to lower- and medium-priced brands. Premium brands will remain taxed at the *ad valorem* rate or mixed rate, which ensures a higher tax burden as compared to a purely specific system and a disincentive for quality improvements. Over the last decade, 24 EU Member States have introduced such a minimum tax floor. In most cases they are a percentage (in general between 95% and 105%) of the taxes due on the weighted average price or on the most popular price category (unpublished data: Internal Reports from EU Member States to the EC). If these reference prices change, the minimum tax floor will be adjusted. As the *ad valorem* duty will apply to these reference prices, the minimum tax floor will at least partly be adjusted for inflation.

In conclusion, provided the minimum tax floor is set at an appropriate level, this structure will combine a high price and tax level for lower- and medium-priced brands with a relatively high tax price ratio for premium brands.

Table 2.4 summarizes the differences between structures of excise duties and their impact.

Earmarking of tobacco tax revenues

With the challenges governments of low- and middle-income countries face to finance their health systems, and the additional problems the recent financial crisis has imposed, developing innovative means of financing has become an essential issue to address to ensure sustainability and autonomy of health care. Earmarking or dedicating tobacco taxes for health programmes is a promising efficient way of raising resources internally.

Earmarked taxes are general or special taxes committed to support, or fully fund, pre-specified expenditure items (Gwilliam and Shalizi, 1996). Earmarking can be weak (purely a formal undertaking to make the system more transparent and to inform the taxpayer of the cost of a service) or strong (revenue determines expenditure), wide (covering a whole spending programme) or narrow (specific project within a programme) (Wilkinson, 1994).

Countries around the world earmark part or all of their tobacco taxes to a specific programme or activities (e.g. Ecuador, Egypt, Estonia, Finland, Korea and Thailand). This is also the case for several US states like Arizona, California, Massachusetts and Oregon. More than 20 countries specifically use their tobacco taxes for health programmes, mainly for tobacco control or health promotion. Chapter 9 provides an overview of studies of the effectiveness of earmarking on tobacco use and health improvement.

Recently, the Taskforce on Innovative International Financing for Health Systems—established from 2008 to 2009 and chaired by United Kingdom Prime Minister and World Bank President—recommended exploring the technical viability of solidarity levies on tobacco. Assuming that a broad range of countries would participate in the increase of tobacco taxes, the revenues generated would be substantial (Taskforce on Innovative International Financing for Health Systems, 2009). This demonstrates the increasing political support for such type of financing and the importance of tobacco taxation, particularly for countries with limited resources. The benefit of such practices will be double: reducing consumption and funding health systems, both leading to improved public health.

Conclusions

Worldwide different types of taxes apply to tobacco products, with different tax levels (rates) contributing to significant price differentials. Historically, revenue generation has been the primary aim of tobacco taxation. However, more and more the retention and the increase of excise duties on tobacco products aims to improve public health by reducing tobacco consumption and the external cost of smoking. Nonetheless, when determining taxation policy, governments will take into account other, at times competing, political, social or economic considerations. These considerations are often reflected in the applicable tax structure and rates.

Moreover, the tax levels are in general directly related to the income levels, with high-income countries having high taxes and vice versa. Simultaneously, high-income countries tend to favour specific excise tax structures, while low- and middle-income countries rely more on *ad valorem* excise taxes.

Given the structure of tobacco market globally, specific excise taxes generally result in higher tobacco product prices. In these markets, specific excises can increase tobacco companies' pricing power, raise profits and increase market concentration.

Some countries have designed more complex taxation structures in an attempt to find a balance between budgetary, health and competition objectives.

About 75% of the world's tobacco product market is accounted for by cigarettes. However, in some countries tobacco products other than cigarettes have an important, sometimes significant, market share. Tax levels are often much lower on these products as compared to cigarettes. Differential rates are applied on different tobacco products and even sometimes within the same product category, resulting in price gaps and opportunities for product substitution to lower-taxed products. Applying a similar tax level would reduce the incentive for substitution and increase the effectiveness of taxation policy in reducing tobacco use.

Given their important revenue-generating potential, in some countries, parts or all of tobacco tax revenues have been used to fund health or tobacco control activities. This practice can be adopted in low-resource countries as a way to strengthen existing health systems, as proposed by the Taskforce on Innovative International Financing for Health Systems (2009).

Table 2.4. Comparison of structures for excise duties

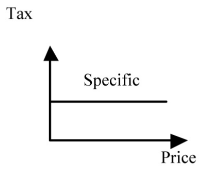
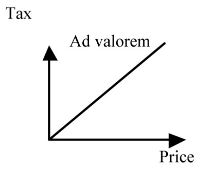
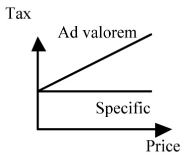
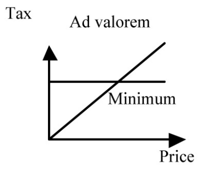
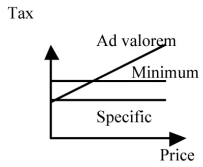
Effect on prices	*Specific excise*	*Ad valorem*	*Mixed*	*Ad valorem with a specific minimum floor*	*Mixed with a specific minimum floor*
Tax/price structure					
Impact on prices	Tends to entail relatively higher prices Tax increases may lead to "over shifting" or upwards product substitutability	Relatively lower prices compared to specific Tax increases may entail down trading or price reductions ("under shifting")	The effect will depend on which element (*ad valorem* or specific) prevails	The minimum tax functions as a specific duty and ensures a relatively higher price level for low- (and medium-) priced products	
Inflation	Real value will be eroded by inflation, unless adjusted in line with inflation	The real value will be preserved as prices increase to the extent that tobacco prices follow inflation	Real value of the specific element will be eroded by inflation	Real value of the minimum floor will be eroded by inflation The minimum floor may be (partly) adjusted for inflation if it is a percentage of the excise due on WAP or of a premium price category subject to *ad valorem* taxation (e.g. the MPPC in most EU Member States).	Real value of the specific tax and the minimum floor will be eroded by inflation
Consumers: quality and variety	*Specific excise*	*Ad valorem*	*Mixed*	*Ad valorem with a specific minimum floor*	*Mixed with a specific minimum floor*
Impact on product quality and variety	Upgrading effects tend to reduce the relative tax on high quality products, which provide an incentive for higher quality and greater variety of products	The multiplier effect provides a disincentive to costly quality improvements	The effect will depend on which element (*ad valorem* or specific) prevails	The multiplier effect of the *ad valorem* element provides a disincentive to costly quality improvements	The multiplier effect of the *ad valorem* element provides a disincentive to costly quality improvements
Revenue	*Specific excise*	*Ad valorem*	*Mixed*	*Ad valorem with a specific minimum floor*	*Mixed with a specific minimum floor*
Budgetary stability/ ability to forecast	More stable as compared to *ad valorem*. Easy to forecast	Vulnerable to changes in consumers and producers' behaviour Difficult to forecast	More specific or a minimum tax floor will entail more budgetary stability		
The real value of taxes and prices	The excise needs to be periodically adjusted for inflation	The excise may have to be periodically adjusted for down trading or price reductions	The excise may have to be periodically adjusted for inflation, down trading or price reductions	The excise may have to be periodically adjusted for inflation, down trading or price reductions	The excise may have to be periodically adjusted for inflation, for down trading or price reductions

Table 2.4. Comparison of structures for excise duties

Revenue	*Specific excise*	*Ad valorem*	*Mixed*	*Ad valorem with a specific minimum floor*	*Mixed with a specific minimum floor*
			The more the structure relies on specific or minimum duties the less vulnerable it becomes for down trading or price reductions; but the more the tax can be eroded by inflation		
Reduction of tax induced cross-border operations (private imports and illicit trade)	With the same tax level at WAP, a situation of purely specific taxation in one country/jurisdiction and purely *ad valorem* taxation in a neighbouring country could result in cross-border flow for premium brands from one country to a second country, with cheap brands flowing in the opposite direction		Mixed tax structures and tax structures including a minimum floor are less vulnerable to cross-border flow induced by the tax structure		
Administrative requirements	Low as compared to other indirect taxes (e.g. VAT, sales tax).				
	No price monitoring required for tax purposes; only the volume or weight has to be ascertained	Requires price monitoring	Requires price monitoring	Requires price monitoring	Requires price monitoring
Manufacturers	*Specific excise*	*Ad valorem*	*Mixed*	*Ad valorem with a specific minimum floor*	*Mixed with a specific minimum floor*
Impact of taxes on the profits of the tobacco producers	Will entail a higher tax/price ratio for cheaper market segments and higher profits for the manufacturer	Will entail a higher absolute amount of tax for premium market segments, because any increase in the producer price will be taxed	The gap between tax/price ratio for the cheaper and the premium market segments will be smaller as compared to a purely specific system	The minimum may ensure a high absolute amount of tax and consequently a high tax/price ratio for cheaper market segments. The *ad valorem* ensures the desired tax/price ratio for premium market segments (equal to the *ad valorem* rate)	The minimum floor ensures a high tax/price ratio for cheaper market segments. The *ad valorem* element will apply to premium market segments
Market shares – Protection of domestic producers	Tends to favour premium brands	May protect the cheaper domestic brands against more expensive international brands	More specific or a minimum tax floor tend to favour more expensive brands		

WAP: Weighted Average Price; MPPC: Most Popular Price Category

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Chapter 3
Tobacco industry pricing, price-related marketing and lobbying

Introduction

The effectiveness of tobacco taxation and other price-related policies depends in large part on how tobacco companies respond through both their lobbying efforts to prevent tax increases or influence excise policies and their pricing and price-reducing marketing strategies. In general, tobacco product tax increases will lead to increases in the price of these products, with the extent of the price increase varying based on how much or little of the tax increase the industry decides to pass on to consumers (which may vary brand by brand within the same market) and whether it raises prices on top. Two 2009 tax increases illustrate this clearly. In April 2009, the federal cigarette excise tax in the United States was increased by US$0.6167 per pack, with US cigarette companies passing on the full amount of the tax increase and raising prices further (e.g. Philip Morris USA raised prices on its leading brands by US$0.71 per pack and on other brands by US$0.78 per pack). In contrast, in May 2009, China modified its tax structure and increased taxes on most cigarette brands, but the State Tobacco Monopoly Administration and Chinese National Tobacco Co. kept retail cigarette prices at the same level as they were before the tax increase.

In addition to its direct pricing strategies, tobacco companies can influence price through a variety of price-reducing marketing efforts. These include: the distribution of free samples of their products, the distribution of coupons through print advertising and direct mail, on packaging, and via their web sites; retail value-added promotions that involve free cigarettes (e.g. buy-one-get-one-free offers); and direct price discounts implemented through payments to distributors and retailers (e.g. through "buy-downs" trade programs). In addition, other marketing techniques provide added value at the same price and can be thought of as price-reducing marketing, broadly defined. These include: retail value-added promotions that involve non-tobacco items (e.g. a free lighter with the purchase of two packs of cigarettes); and specialty item distribution (e.g. giveaways of various branded or unbranded products upon redemption of coupons or other proof of purchase, as in the "Marlboro Miles" and "Camel Cash" programmes). From the tobacco companies' perspective, such price-reducing marketing efforts have advantages over direct pricing strategies in that they can be more narrowly targeted to particular segments of the market. For example, price-reducing promotions can be used subnationally to reduce the immediate impact of subnational tax increases, can be applied to a limited number of brands (e.g. those used by populations of particular interest, such as young people), or directed to more price-sensitive consumers (e.g. distribution of coupons via direct mail to selected users).

Finally, tobacco companies can use their political influence to lobby policymakers to oppose tobacco tax increases or support tax rollbacks, alter tax structures in a way favourable to at least some companies, resist earmarking of tobacco tax revenues for tobacco control programs, and/or minimize the use and impact of other policies that aim to increase tobacco product prices. Similarly, tobacco companies work behind closed doors with Ministries of Finance and others to provide guidance on tax levels and tax structures, as well as other aspects of tax administration (Gilmore *et al.*, 2007). Such overt and covert activities can weaken the effectiveness of tax and price policies in reducing tobacco use and its consequences.

This chapter provides a review of these issues. The first section provides a discussion of industry pricing strategies generally and of how tobacco product prices change in response to changes in tobacco taxes specifically. This is followed by a review of the variety of price-related marketing strategies used by tobacco companies, and the limited empirical evidence on the use of price-reducing promotions in response to tax increases and other tobacco control policies. We then turn to a discussion of industry lobbying efforts to shape policy decisions concerning tobacco excise taxes, providing a systematic review of the limited empirical evidence on these activities between 1985 and 2010. The final section discusses interventions to reduce industry-related price manipulation and lobbying.

Methods

A systematic approach was taken to searching for literature relevant to this chapter. In total, 13 electronic databases were searched between October 2009 and March 2010. These covered academic research and grey literature (i.e. manuscripts, reports, technical notes or similar documents produced and distributed by governmental agencies, academic centers or other non-commercial publishing entities). Full details of the electronic databases and web sites, and the keywords, and terms used to drive searches are available in **Appendix**.

We also consulted several key experts in the field (many of whom are involved in authoring this volume) and put a call on GLOBALink, the most commonly used information-exchange point for tobacco control researchers and practitioners, to identify other papers. Although our search strategy should have captured most studies that explore the issues covered in this chapter in any detail, it is possible that some references have been missed, particularly those in languages other than English.

While we had aimed to limit the evidence to scientific publications obtained via the search strategies above, the evidence base, particularly in relation to parts (a) (tobacco industry pricing strategies), (b) (price-related marketing) and (d) (interventions to reduce industry price manipulation and lobbying), was limited, with most of the empirical studies limited to the USA and a few other high- or high-middle income countries. For this reason, the first two sections explain industry behaviour using theory and observation before turning to the empirical evidence, and the fourth section outlines policy options, highlighting any relevant academic literature.

Tobacco industry pricing strategies

Background: Market structure

Historically, industry pricing strategies have varied considerably across countries given the significant differences in the structures of tobacco product markets in different countries. Many markets were controlled by a domestic, often government-run, tobacco monopoly whose primary objective may not have been profit maximization. Others were more fragmented, with several smaller companies competing more aggressively with others. Still others were oligopolistic, dominated by a few large firms that together controlled nearly the entire market. As a result, pricing strategies varied widely, with more competitive markets likely to see lower prices and more price competition than more concentrated markets.

Over the past two decades, the markets for tobacco products have become increasingly concentrated and globalized as a result of privatization of government-run tobacco monopolies, reduced barriers to trade in tobacco and tobacco products, increased direct investments by multinational tobacco companies, and consolidation through mergers and acquisitions. Together, worldwide, the top five cigarette companies (Chinese National Tobacco Co. (CNTC), Philip Morris International (PMI), British American Tobacco (BAT), Japan Tobacco (JT), and Imperial Tobacco Group (ITG)) account for more than 80% of global cigarette production and consumption (Euromonitor International, 2009). Excluding CNTC, which operates almost entirely in China with little competition from other companies, the top four companies account for about 70% of global production and consumption. As shown in Table 3.1 for leading cigarette markets globally and in Europe, in most countries cigarette markets are dominated by some combination of these four companies. The 3-firm concentration ratio illustrates the highly concentrated nature of these markets—other than in Indonesia, just three firms control at least 80% of the market, and in many markets the top three firms account for more than 90% (Gilmore *et al.*, 2010).

Table 3.1. Cigarette market shares (%) by global brand owner for the major cigarette markets, 2008

Company	Brazil	Canada	China	Germany	India	Indonesia	Italy	Japan	Russian Federation	UK	USA
Philip Morris International Inc	9.7	21.3	0.1	36.2	12.1	22.6	52.9	24.4	25.4	6.3	
British American Tobacco Plc	86.3	59.0	0.6	20.0		2.7	24.1	10.2	19.6	8.1	
Japan Tobacco Inc		10.8	0.2	5.0	1.3		16.2	64.9	36.9	38.8	0.4
Imperial Tobacco Group Plc				25.6			2.9		9.2	43.9	4.0
China National Tobacco Corp (CNTC)			98								
ITC Group*					58.3						
Golden Tobacco Ltd					10.9						
VST Industries Ltd					9.2						
Godfrey Phillips India Ltd**					0.4						
Gudang Garam Tbk Ltd**						28.3					
Djarum PT						13.8					
Bentoel Internasional investama Tbk PT						5.9					
Nojorono Tobacco Indonesia PT						5.5					
Philip Morris USA Inc											48.4
Reynolds American Inc*											26.5
Lorillard Inc											10.1
Liggett Vector Brands Inc											1.8
Societé industrielle des Tabacs du Cameroun SA	1.4										
Donskoi Tabak OAO									3.7		
Private label				9.9						1.7	
Others	2.6	8.9	1.2	3.3	7.8	21.2	4	0.5	5.2	1.3	8.8
Total	100	100	100	100	100	100	100	100	100	100	100
No. of companies with market share >10%	1	3	1	3	3	3	3	3	3	2	3
No. of companies with market share over 25%	1	1	1	2	1	1	1	1	2	2	2
3-firm concentration ratio (cumulative share of market of 3 biggest companies by market share)	97.4	91.1	98.8	81.8	81.3	64.7	93.2	99.5	81.9	90.8	85

Table reproduced with permission from Gilmore *et al.*, 2010. Source: Euromonitor International from trade sources/national statistics. Data obtained: 23 September 2009

Data given for the world's largest cigarette markets (China, Russia, USA, Japan, Indonesia, Ukraine, Brazil, India), plus the 2 largest European markets (Italy and Germany) and the UK
NB – where companies other than those listed have a market share of 1% or less, their share has been added to the «other» category
*Part owned by BAT. **Part owned by Philip Morris International

This market concentration gives the tobacco companies greater pricing power and profitability, which in turn may present problems to public health as further explored below (Gilmore *et al.*, 2010).

Similar patterns are emerging in markets for other tobacco products, although to a lesser extent than in cigarette markets and with greater variability across countries. Globally, non-cigarette product markets are becoming increasingly concentrated, and distinctions between cigarette companies and other tobacco product companies are disappearing as major cigarette manufacturers have acquired leading smokeless tobacco product manufacturers (e.g. Altria's (parent company for Philip Morris USA) acquisition of US Smokeless Tobacco Co. in 2008 and Reynolds American's acquisition of Conwood in 2006) and have begun using the same brands across product lines (e.g. Marlboro and Camel cigarettes and snus) (McNeill and Sweanor, 2009). The acquisition of independent smokeless manufacturers will, by reducing competition between cigarettes and smokeless products, increase the market power (their ability of to set prices) of the resulting multiproduct tobacco companies. However, in some countries, where a much wider variety of tobacco products is available, the markets for non-cigarette tobacco products remain fragmented and highly competitive (e.g. India, where there are thousands of small bidi producers).

Background: Individual company interests

Different companies vary in their brand portfolios and thus in their preference for excise structures. This is illustrated through industry lobbying on tobacco taxes in Europe, where different Member States must agree on a shared excise framework. Historically the southern European countries had state monopolies or small national industries and thus sought *ad valorem* systems to both protect their cheaper cigarettes made using domestic tobacco and to enable them to compete with higher-priced premium brands from the larger producers (Gilmore and McKee, 2004a). By contrast, the transnationals favoured a wholly specific system to help protect their more expensive brands. A similar pattern continues to this day with, for example, PMI (whose high-price brand Marlboro is the leader in many markets) favouring a fully specific system, Imperial Tobacco (which has a mixed portfolio) favouring a mixed *ad valorem* and specific system, and the small Greek companies lobbying for a fully *ad valorem* system. This issue is covered further in the third section.

Tobacco industry pricing strategies

In general, tobacco product markets that have large numbers of producers producing slightly differentiated products will see a relatively high degree of price competition, with prices largely reflecting the costs of production and distribution (including taxes). At the other extreme, markets that are entirely or nearly monopolized by a single, profit-maximizing firm will see prices well above costs and relatively little price competition. However, most tobacco product markets in most countries are at neither extreme, but are instead highly concentrated with a small number of highly profitable companies accounting for most sales (see Table 3.2). As a result, the nature of price competition can vary widely, both across countries and over time, although globally competition is tending to decrease with the trend toward greater industry consolidation described above.

Unfortunately, there has been little research to date on pricing strategies in tobacco product markets, with the exception of some limited research largely from the USA but also covering Jamaica, Europe and South Africa on the relationships between tobacco taxes and prices (discussed below). Instead, a few stylized facts emerge from observations of pricing strategies in various countries, from industry analyst and market reports and from internal tobacco company documents released following a series of litigation cases in the USA, which led to several major tobacco companies being required to make internal documents public.

Limited price competition. The oligopolistic nature of most tobacco product markets (Table 3.1) tends to result in relatively stable prices with limited price competition, particularly in more mature markets in high-income countries where companies are better established. This appears less true for markets in low- and middle-income countries, particularly where the transnational tobacco companies are relatively new players in the market and more likely to use price as one strategy for gaining market share for their brands (Vateesatokit *et al.*, 2000; Szyilágyi and Chapman, 2003). However, as companies become more established, the extent of price competition appears to diminish, particularly in countries where incomes are rising more rapidly and consumers, influenced by industry marketing, increasingly switch to higher-priced brands. To the extent that price competition does remain, it tends to appear in the form of multiple price tiers (e.g. premium, mid-priced and economy brands). The existence of multiple price tiers, more likely in

Table 3.2. Profitability (measured using EBITA Margin (%)) for Europe's two major tobacco companies and comparator European consumer staple companies

Company	2004	2005	2006	2007	2008*	2009*	2010*	2011*
Tobacco companies								
British American Tobacco	24.0	28.1	28.7	30.0	30.7	31.1	32.1	33.7
Imperial Tobacco Group	40.2	41.5	42.9	45.0	28.2	37.7	39.4	39.5
Food companies								
Cadbury	15.6	15.9	14.4	13.5	12.0	13.0	13.8	14.9
Danone	12.7	13.1	13.3	12.1	14.4	16.9	15.7	15.9
Nestle	12.7	12.9	13.5	14.0	14.3	14.4	13.0	13.2
Premier Foods	12.9	13.7	13.8	12.5	11.9	12.0	11.9	11.7
Consumer products companies								
Unilever NV	15.5	14.8	14.3	14.5	14.6	14.7	14.9	15.1
Henkel	9.4	9.7	10.2	10.5	10.3	9.0	10.6	11.6
L'Oreal	15.3	15.6	16.4	16.6	15.5	14.3	14.9	15.5
Reckitt Benckiser	19.3	20.1	21.5	22.6	23.4	23.9	23.2	23.6
Beverage companies								
Heineken NV	13.6	13.1	13.0	14.8	13.2	13.5	14.0	14.4
SABMiller	18.1	20.2	16.9	16.8	16.6	16.8	17.3	18.5
Carlsberg	8.8	8.7	9.6	11.5	13.2	16.0	16.3	17.1
Diageo	28.7	29.0	28.2	28.3	28.5	28.9	31.5	31.8

Table reproduced with permission from Gilmore *et al.*, 2010
* Estimated values

markets with wholly *ad valorem* or mixed tax systems (as explained in Chapter 2), will facilitate downtrading to cheaper brands, which may be of particular importance in markets at the end stage of the tobacco epidemic when smoking increasingly becomes a habit of the more economically deprived. However, in oligopoly markets, companies tend to have brands in every price tier; thus the existence of multiple price tiers will not necessarily result in genuine competition.

Price leadership. In more concentrated, oligopolistic markets, pricing strategies tend to be characterized by price leadership, with one firm (usually the firm with highest market share) initiating a change in prices and others almost immediately matching that change. As Chaloupka (2007) describes, cigarette pricing in the USA has been characterized by this type of strategy for the past century, with the "leader" changing over time, but the strategy staying constant. This is further described in a 1976 report on "Pricing Policy" from Philip Morris' Business Planning and Analysis division:

> "The cigarette industry is characterized by economists as a 'kinky oligopoly'. This charming term implies that the general price level is determined by a small number of firms (price leaders); that no economic advantage can be obtained by any one firm pricing below the general price level; and that major disadvantages accrue to a firm which attempts to price above the general level. In short, the general price level results from some sparring among the potential price leaders, after which the rest of the industry accepts the resulting price structure."

The report goes on to describe how Philip Morris had historically been one of the followers in the US cigarette marketing, matching the price changes initiated by American Tobacco Co. or R.J. Reynolds, but noting that by the 1970s, Philip Morris had become the leader:

> "We no longer follow the market; whether we initiate a price increase or not, our decision is a key factor in establishing a new industry price level, and we must examine any price move in light of our own judgement of the appropriate level."

The report further describes how the relative absence of price competition in the market allowed prices to remain above competitive levels, generating high profits which were then used to support the other marketing activities through which US cigarette companies competed more directly.

A similar pattern of price leadership, limited price competition and high profitability is seen in Europe, although markets where PMI is the market leader (most markets in western Europe) tend to differ from the United Kingdom and Irish markets because PMI is less prepared to lose market share by increasing prices, and thus price increases have traditionally been lower in these markets than the United Kingdom and Ireland (Spielman and Loveless, 2008a). This makes the United Kingdom market particularly interesting as a case study of industry attempts to maximize short-term profitability, as outlined below. A further issue worth noting is that of price-fixing, recently documented in the United Kingdom. The Office of Fair Trading recently fined two tobacco manufacturers and ten leading retailers £225m for price-fixing, decisions which are being appealed. The tobacco manufacturers involved were Imperial Tobacco and Gallaher, who jointly account for around 80% of the United Kingdom market (see Table 3.1). Each manufacturer had a series of individual arrangements with each retailer whereby the retail price of a tobacco brand was linked to that of a competing manufacturer's brand (Office of Fair Trading. http://www.oft.gov.uk/shared_oft/press_release_attachments/Parties_and_fines.pdf; http://www.guardian.co.uk/business/2010/apr/16/oft-levies-225m-for-cigarette-price-manipulation).

Prices below short-run, industry profit maximizing level. While prices in highly concentrated tobacco product markets are above the competitive level, they have historically been well below the level that would maximize short-run industry profits. This is likely to be explained by two factors. First, prices well above competitive levels would create opportunities for new firms to gain a foothold in the market by selling cigarettes at relatively low prices. As Chaloupka (2007) describes, this happened in US cigarette markets in the 1930s, when the leading companies at the time (American Tobacco Co., R.J. Reynolds and Liggett & Myers) set prices well above competitive levels (US$0.14–0.15 per pack), using profits to compete primarily through their advertising campaigns. This created an opportunity for new firms to enter the market and for existing small firms to gain market share by selling at considerably lower (but still profitable) prices. Many did so with their "ten-cent" brands before the industry leaders responded by cutting their prices. The ensuing price war drove most of the new firms from the market, but two – Philip Morris and Brown & Williamson – survived, going on to become major players in the US cigarette market.

More recently, the tobacco transnationals attempted to gain market share in newly opened markets (e.g. Thailand and Hungary in the 1990s) by price discounting (Vateesatokit *et al.*, 2000; Szyilágyi and Chapman, 2003). In addition, there were numerous new entrants to the US market after the 1998 Master Settlement Agreement (MSA) in part because loopholes in the agreement created opportunities for non-participating companies to enter the market and undercut prices. In most established markets, however, marketing restrictions make it increasingly difficult for new market entrants to compete effectively with established brands, and reputational and litigation risks provide further barriers to market entry (Gilmore *et al.*, 2010).

A second factor explaining price levels below the short-run industry profit-maximizing level, and one perhaps more relevant currently in at least some declining markets, is the trade-off between short-run and long-run profitability. As Becker and his colleagues (1994) describe, the greater price sensitivity of young people (as discussed below in Chapter 6) and the addictive nature of tobacco use may lead companies with market power to set prices lower than the short-run profit-maximizing level to "get more consumers 'hooked' on the addictive good" so that long-run profits will be higher than they would be if prices were set higher in the short run and fewer young people took up tobacco use. To the extent that tobacco product markets are on the decline in some countries (e.g. in response to adoption and implementation of effective tobacco control strategies, including higher taxes), it becomes more likely that industry prices will rise to nearer the short-run industry profit-maximizing level as future prospects grow dimmer and companies try to profit more from the existing pool of users in the short run.

This pattern is, for example, observed in western Europe where competition in most markets is limited (see Table 3.1), giving the industry considerable pricing power and making these markets the industry's most profitable globally (Spielman, 2008a, 2008b; Euromonitor International, 2009). The United Kingdom market, as outlined above, is one of the most interesting, and analyst reports suggest that the industry has been able to increase prices sufficiently to offset both volume declines and negative mix (downtrading to cheaper brands) (Spielman, 2008a, 2008b). The fact that this may have been facilitated by tax policies is further outlined below.

Furthermore, by virtue of having diverse brand portfolios in multiple price tiers, companies can utilize both strategies—keeping some brands cheap to "hook" new smokers while maintaining prices on higher-end brands to offset the negative mix and maintain profits. It would appear such practices may be occurring in the United Kingdom, for example, because despite a marked growth in discount brands (Devlin *et al.*, 2003, Talking Retail, 2006) the industry is managing to grow its profits, and the United Kingdom market is among the most profitable (Spielman *et al.*, 2008a, 2008b).

Tobacco tax increases and prices

The effectiveness of tobacco tax increases in reducing tobacco use and its consequences depends, in part, on how increases in taxes are passed on to users in price increases. The extent to which prices rise following a tax increase depends on multiple factors, most notably industry structure and tax structure. With respect to industry structure, economic theory suggests that tobacco taxes will be fully passed on to users through an equivalent price increase in a perfectly competitive market with constant long-run costs of production. At the other extreme, a profit-maximizing monopolist will pass on only part of the tax in price, with the pass-through greater as demand is more inelastic.

In an oligopolistic market, however, how much or little of the tax is passed through can vary based on how the industry reacts. Harris (1987), for example, suggests that companies in a highly concentrated tobacco product market can use a tobacco tax increase as an opportunity for a coordinated price increase that leads to an overshifting of the tax, with prices rising by more than the amount of the tax. Using data from the years around the doubling of the US federal cigarette excise tax (from US$0.08 to US$0.16 per pack) on 1 January 1983, Harris observed that industry prices rose by more than manufacturing costs in the months leading up to the tax increase, with the rise in industry prices starting after the tax increase was announced. In the end, he concludes that prices rose by more than twice the amount of the tax increase.

Harris' (1987) hypothesis appears to be confirmed by internal industry documents. When asked for his thoughts about how to pass on an anticipated additional increase in the US federal cigarette tax in 1987, Philip Morris economist Myron Johnston recalled the industry's pricing strategies around the 1983 increase (Johnston, 1987):

> "Last time, of course, we increased prices five times between February of 1982 and January of 1983. In less than a year, the price went

> from $20.20 to $26.90 per thousand ($2.70 more than the tax), and this fact was not lost on consumers, who could legitimately blame the manufacturers for the price increases. While price increases of this magnitude might have been tolerated during the rapid escalation in the overall inflation rate between 1977 and 1981, the increase in the price of cigarettes in 1982-83 was made even more dramatic by the fact that the overall rate of inflation was slowing considerably."

Industry reactions, particularly by the dominant firm, however, can vary with circumstances. In the same memo, Johnston goes on to note how the overshifting of the 1983 tax increase had a particularly negative impact on Philip Morris because of its greater impact on smoking among young people, where Marlboro's market share was greatest. This led him to write (Johnston, 1987):

> "I have been asked for my views as to how we should pass on the price increase in the event of an increase in the excise tax. My choice is to do what I suggested to Wally McDowell in 1982: Pass on the increase in one fell swoop and make it clear to smokers that the government is solely responsible for the price increase, advertise to that effect, suggest that people stock up to avoid the price increase, and recommend that they refrigerate their cigarettes 'to preserve their freshness.'... Then when people exhaust their supply and go to the store to buy more, they will be less likely to remember what they last paid and will be less likely to suffer from 'sticker shock.' As a result, they should be less likely to use the price increase as an incentive to stop smoking or reduce their consumption."

Experiences with several federal tax increases in the 1990s and early 2000s show that wholesale cigarette prices rose by the amount of the tax increases or, at times, being absorbed by the industry (e.g. the US$0.05 increase in 2002). Most recently, however, the much larger (US$0.6167 per pack) 1 April 2009 increase in the US federal cigarette excise tax did lead to some overshifting; Philip Morris, for example, raised prices on its 'growth and support brands' (including Marlboro) by US$0.71 per pack and on its 'non-support brands' by US$0.78 per pack. Given its role as the market leader in the USA over the past few decades, other US cigarette companies have generally followed Philip Morris' lead in responding to the US tax increases.

The limited empirical evidence on this issue, almost entirely from high-income countries, reflects this variability. Older US studies found that cigarette taxes led to less-than-comparable price increases (Sumner and Ward, 1981; Bishop and Yoo, 1985; Ashenfelter and Sullivan, 1987); others found that taxes were fully passed on (Sumner and Wohlgenant, 1985); and still others found that prices rose by more than the tax (Barzel, 1976; Johnson, 1978; Sumner, 1981). Most recent US-based analysis, however, find that cigarette taxes are overshifted in the USA, leading to increases in retail cigarette prices greater than the tax (Barnett *et al.*, 1995; Keeler *et al.*, 1996; Hanson and Sullivan, 2009; Sullivan, 2010). van Walbeek (2010) observes similar overshifting of tax increases in South Africa (since 1994) and Jamaica (in 2005), while Delipalla and O'Donnell (2001) found undershifting of cigarette taxes in 12 European Union countries in the early 1990s, particularly in markets that were less concentrated.

Although there are no recent empirical studies in the European Union, as noted above the market has seen considerable consolidation in recent years (Hedley, 2007), and other evidence suggests that the undershifting observed in the 1990s (Delipalla and O'Donnell, 2001) has reversed (Spielman and Loveless, 2008b). Although the countries in eastern Europe are in general at a different stage of the tobacco epidemic with volumes of consumers and tobacco sold still increasing, profits are also increasing as a result of industry price increases and consumers trading up to more expensive brands (Euromonitor International, 2009).

With regards to tax structure, both theoretical and empirical evidence suggest that specific excise taxes tend to increase consumer prices relatively more than *ad valorem* excises, and hence lead to relatively higher reductions in consumption (Delipalla and Keen, 1992; Delipalla and O'Donnell, 2001; Chaloupka *et al.*, 2010). The higher impact of specific excise taxes on consumer prices is consistent with a greater possibility of overshifting of specific taxation relatively to *ad valorem* (Delipalla and Keen, 1992). Under specific taxation, any increase in producer price will go to the producer as revenue and therefore would increase producers incentive to raise price. Economic theory also shows that industry profits are relatively higher under specific taxation (Delipalla and Keen, 1992). Moreover, a tax increase may lead to an increase in profits when tax overshifting takes place: as a higher tax increases consumer price and reduces demand, for profits to rise, the after-tax mark up must rise.

All this suggests that relying heavily on specific excise taxation is likely to increase market concentration and industry profits in the long run. With respect to the public health perspective, while specific taxes offer greater public health benefits, there is a danger that the greater industry profits that emerge may in turn be used to damage public health, because these profits can be used to increase industry marketing, or fund lobbying or litigation efforts to challenge public health policies. For this reason, along with increases in the specific tax (and its associated great effect on price), governments may find they need to implement other policies to counteract the tobacco industry's increased market power.

As described in the previous chapter, this hypothesis is supported by descriptive data on taxes and prices globally, with prices higher on average in countries that rely on specific taxes than in those relying on *ad valorem* taxes (World Health Organization, 2010). Chaloupka and colleagues (2010), in their empirical analysis using data from EU countries over the period from 1998 through 2007, provide additional support for this hypothesis. They conclude that average cigarette prices are higher in EU countries relying more heavily on specific cigarette excises than on *ad valorem* excises.

Tobacco industry price-related marketing efforts

Background

In addition to directly setting prices to tobacco products, tobacco companies can engage in a variety of marketing activities that lower the price of or otherwise add value to their products. These activities are clearly defined by the US Federal Trade Commission (FTC) in its annual reports to the US Congress on cigarette and smokeless tobacco company marketing activities (Federal Trade Commission, 2009a, 2009b); as defined for cigarettes, these include:

• Price discounts: price discounts paid to cigarette retailers or wholesalers to reduce the price of cigarettes to consumers, including off-invoice discounts, buy-downs, voluntary price reductions and trade programs, but excluding retail-value-added expenditures for promotions involving free cigarettes and expenditures involving coupons.

• Sampling: sampling of cigarettes, including the cost of the cigarettes, all associated excise taxes, and increased costs under the Master Settlement Agreement, and the cost of organizing, promoting, and conducting sampling. Sampling includes the distribution of cigarettes for consumer testing or evaluation when consumers are able to smoke the cigarettes outside of a facility operated by the Co., but not the cost of actual clinical testing or market research associated with such cigarette distributions. Sampling also includes the distribution of coupons for free cigarettes, when no purchase or payment is required to obtain the coupons or cigarettes.

• Specialty item distribution, branded: all costs of distributing any item (other than cigarettes, items the sole function of which is to advertise or promote cigarettes, or written or electronic publications), whether distributed by sale, redemption of coupons, or otherwise, that bears the name, logo, or an image of any portion of the package of any brand or variety of cigarettes, including the cost of the items distributed, but subtracting any payments received for the item. The costs associated with distributing non-cigarette items in connection with sampling or retail-value-added programmes are reported in those categories, not as specialty item distribution.

• Specialty item distribution, non-branded: all costs of distributing any item (other than cigarettes, items the sole function of which is to advertise or promote cigarettes, or written or electronic publications), whether distributed by sale, redemption of coupons, or otherwise, that does not bear the name, logo, or an image of any portion of the package of any brand or variety of cigarettes, including the cost of the items distributed, but subtracting any payments received for the item. The costs associated with distributing non-cigarette items in connection with sampling or retail-value-added programmes are reported in those categories, not as specialty item distribution

• Retail-value-added, bonus cigarettes: Retail-value-added expenditures for promotions involving free cigarettes (e.g. buy two packs, get one free), whether or not the free cigarettes are physically bundled together with the purchased cigarettes, including all expenditures and costs associated with the value added to the purchase of cigarettes (e.g. excise taxes paid for the free cigarettes and increased costs under the Master Settlement Agreement).

• Retail-value-added, non-cigarette bonus: Retail-value-added expenditures for promotions involving free non-cigarette items (e.g. buy two packs, get a cigarette lighter), including all expenditures and costs associated with the value added to the purchase of cigarettes.

• Coupons: All costs associated with coupons for the reduction of the retail cost of cigarettes, whether redeemed at the point-of-sale or by mail, including all costs associated with advertising or promotion, design, printing, distribution, and redemption. However, when coupons are distributed for free cigarettes and no purchase or payment is required to obtain the coupons or the cigarettes, these activities are considered to be sampling and not couponing.

The Federal Trade Commission (2009b) defines similar marketing activities for smokeless tobacco products in the USA; the reporting of these marketing expenditures is required by federal legislation in the USA. Canadian legislation also requires tobacco companies to report to the federal government on their promotional expenditures (http://laws-lois.justice.gc.ca/en/SOR-2000-273/FullText.html); however, such mandated reporting is rare and the detailed information contained is rarely made publicly available.

These and other marketing practices are prohibited in some countries. Globally, WHO Report on the Global Tobacco Epidemic (World Health Organization, 2009) data indicate that 79 countries, including many LMICs, have implemented some form of restriction on price-based marketing. For example, a 2003 EU Council Recommendation (2003/54/EC) recommended that Member States adopt various tobacco control measures including those to prohibit "the use and communication of sales promotion, such as a discount, a free gift, a premium or an opportunity to participate in a promotional contest or game." A subsequent evaluation (SEC(2009)1621) suggested that most Member States had implemented the recommended measures but failed to specify the proportion implementing. However, few countries have comprehensive enough bans to cover all forms of price-based promotions (an issue explored in a later section). Various of the marketing techniques outlined above may therefore be used throughout much of the world. For example, the United Kingdom Tobacco Advertising and Promotions Act (which was fully implemented in 2005) bans, inter alia, the use of voucher schemes and direct consumer communication. However, recent evidence indicates both that tobacco companies still provide display cabinets and incentives for displaying their products (Rooke *et al.*, 2010), and that the use of price-based marketing has increased following full implementation of this legislation (Moodie and Hastings, 2009). Although price-based, this marketing is not necessarily price-reducing and includes, for example, price-marked packaging for discount brands visible from the display cabinets (Moodie and Hastings, 2009).

Unfortunately, with the exception of the USA, detailed data on how extensively the industry uses these price-related marketing strategies is virtually non-existent. However, trends in the use of price-related marketing strategies in the USA are informative given that these illustrate how tobacco companies have adapted their marketing strategies over time in response to new evidence on the impact of price on tobacco use and to implementation of restrictions on other marketing activities.

Figure 3.1 illustrates trends in cigarette company marketing expenditures in the USA from 1975 through 2006, as well as changes in the composition of these expenditures over time. Two striking trends are apparent from this figure. First, overall cigarette company marketing expenditures in the USA have risen dramatically, from just over US$491 million in 1975 to a peak of over US$15.1 billion in 2003, before declining to about US$12.5 billion in 2006. This rise in marketing spending is even more dramatic when one considers that US cigarette sales during this period fell by over 43%.

Second, price-related marketing has gone from accounting for a minor share of overall cigarette company marketing expenditures in the 1970s to accounting for most of marketing spending in the 1990s and 2000s. In 2006, for example, spending on marketing activities that directly reduced cigarette prices (price discounts, coupons, retail value added promotions involving free cigarettes, and distribution of free samples) amounted to more than 85% of total cigarette company marketing expenditures, as compared to an estimated less than 19% in 1975. In contrast, spending on promotions involving merchandise (non-cigarette retail value added promotions and specialty item distribution) rose from a minimal share of total spending in the 1970s to a peak of about 18 percent in 1994, before declining to less than 2% in recent years (largely as a result of the limits on this type of marketing included in the Master Settlement Agreement of 1998).

Price-related marketing and tobacco use among young people

In his testimony on price-related marketing as part of the US tobacco litigation (USA v. Philip Morris *et al.*), Chaloupka (2004) described how the shift in tobacco company marketing strategies towards increased use of price-reducing and other price-related promotions accelerated following the publication of early economic research on the influence of price on smoking behaviour, particularly among young people (Lewit *et al.*, 1981; Lewitt and Coate, 1982). In their review of internal industry documents (now available online at http://legacy.library.ucsf.edu/), Chaloupka and colleagues (2002) describe how the two studies by Lewit and colleagues generated considerable attention among leading US cigarette companies. Of most interest were the findings on the greater price sensitivity of smoking among young people, given the importance of youth and young adults to future profitability. For example, in a 1982 memo, Diane Burrows, a market researcher at R.J. Reynolds, wrote about the short and long-run impact of cigarette price increases based on the findings from the Lewit and colleagues studies (Burrows, 1982a):

> "In terms of the immediate impact, the effect of price on males 35+ is the most important. Half (50%) of the total drop in industry volume is attributable to males 35+, compared to 24% from younger adult males and 7% from teenagers. But, the loss of younger adult males and teenagers is more important to the long term, drying up the supply of new smokers to replace the old. This is not a fixed loss to the industry: its importance increases with time. In ten years, increased rate per day would have been expected to raise this group's consumption by more than 50%."

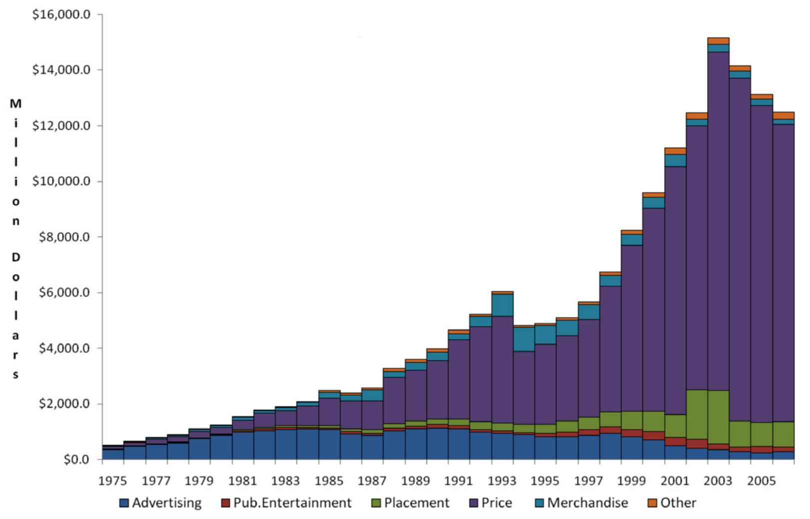
In related memos and reports, Burrows (1982b, 1984) discussed the marketing implications of the greater price sensitivity and importance of imagery to young people. For example, in a 1984 Strategic Research Report, Burrows wrote:

> "Tactically, extended periods of closely targeted pack promotions (B1G1F (buy-one-get-one-free), sampling) in selected sites (e.g., convenience stores, military exchanges, special events) could lead to brand loyalty from repeated trials. This should be considered an investment program." (Burrows, 1984).

As Chaloupka and colleagues (2002) describe, the combination of price-reducing promotions with more traditional advertising campaigns played a key role in the growth of R.J. Reynolds' Camel brand among young people (most notably young males) in the late 1980s and early 1990s. For example, a 1986 memo reported on the effectiveness of these efforts, which included 'six pack' promotions (buy-three-get-three-free), the "Camel Cash" program, and other retail value added promotions:

> "The major factor contributing to CAMEL's dramatic growth among Mid-West 18–24 year old males appears to be the increased level of Mid-West promotional support, and in

Figure 3.1. Cigarette company marketing expenditures, by category, 1975-2006



Sources: Federal Trade Commission, 2009a; Working Group's calculations.
Notes to Figure 3.1:

• Advertising includes: newspapers and magazines, outdoor and transit, and point-of-sale (reported separately beginning in 1975).

• Public Entertainment includes: general audience and adult-only public entertainment, reported in a single category in earlier years and reported separately beginning in 2002.

• Placement includes promotional allowances paid to retailers, wholesalers, and others, reported separately beginning in 2002 and estimated for earlier years based on the percentage of the combined promotional allowances category accounted for by these categories in 2002.

• Price includes: price discounts and retail-value-added bonus cigarettes (reported separately beginning in 2002); coupons (reported separately beginning in 1997); and sampling distribution. Estimates for earlier years are based on shares in the previously aggregated categories that included these in the first years data are reported for disaggregated categories.

• Merchandise includes: branded and non-branded specialty item distribution (reported as a single category before 2002 and separately beginning in 2002); and retail-value-added non-cigarette bonus (reported separately in 2002 and estimated for earlier years based on the share of combined retail-value added as reported in 2002).

• Other includes: all other categories reported by FTC, including direct mail, telephone, Internet (company websites and other), and other; in earlier years, a portion of the FTC-reported other and direct mail expenditures are allocated to other categories (e.g. coupons and retail value added) based on shares of expenditures in the first year that expenditures in more disaggregated categories are reported.

> particular, CAMEL's targeted promotions (which were implemented the same time as the boost in CAMEL's share and completed just prior to the downward trend)." (Creighton, 1986).

The changes over time in the composition of cigarette marketing expenditures (shown in Figure 3.1) suggest that the importance of price-related marketing efforts described in these selected documents was recognized throughout the industry.

Tobacco company price and price-related marketing and tobacco control

Feighery *et al.* (2004) examined the extent and impact of retailer participation in industry incentive programmes in 468 stores in 15 US states. They found that cigarette companies engaged approximately two thirds of tobacco retailers in an incentive program. The study shows that stores that participate in cigarette company incentive programmes may have cheaper cigarette prices (and more prominent placement of cigarettes and advertising) than do stores that do not participate. Although participation in a Philip Morris incentive programme was not significantly related to the price of (Philip Morris brand) Marlboro cigarettes, the price of Lorillard's Newport cigarettes was significantly lower in stores participating in a Lorillard incentive programme. The study was however somewhat limited in its ability to detect links between incentive programmes and price reductions because the questions were limited to participation in company- rather than brand-specific incentive programmes.

Limited research from the USA documents tobacco companies' use of price and price-related marketing to at least partly offset the impact of tax increases and other tobacco control efforts. Based on their review of internal documents, Chaloupka and colleagues (2002) described how companies increased distribution of coupons and use of multipack promotions to soften the impact of state and federal tax increases, with some of the print ads used to distribute coupons referring to them as "tax relief." Similar efforts were observed after the April 2009 federal tobacco tax increases, with Philip Morris, for example, contacting smokers to let them know that they were increasing prices because of the tax increase but that they could "register at Marlboro.com to become eligible for cigarette coupons and special offers."

Similarly, Ruel and colleagues (2004), using observationally collected data on cigarette marketing, and Loomis and colleagues (2006), using scanner-based data, documented the increased prevalence of various price-reducing promotions following the significant price increases resulting from the pass-through of costs associated with the MSA and the subsequent implementation of the marketing restrictions included in the agreement. Similarly, researchers have used observationally collected and scanner-based data to conclude that price-reducing promotions are more prevalent in states where more is spent on comprehensive tobacco control programmes than in states spending less (Slater *et al.*, 2001; Loomis *et al.*, 2006). Finally, Keeler and colleagues (1996) found that cigarette companies price-discriminated by setting lower prices in states with stronger state and local tobacco control policies.

Tobacco industry tax-related lobbying efforts

Background

In addition to the systematic searches for relevant literature, we also took a systematic approach to reviewing studies included in this section. Hence, we tried to identify all empirical studies (qualitative and quantitative) focusing significantly on tobacco industry tax-related lobbying activities, and then applied inclusion/exclusion criteria to potentially relevant studies (see Figure 3.2).

Of the 2638 abstracts/titles located for this chapter overall, 2443 were excluded from this section on the basis of the title and abstract alone. The remaining 195 papers were retrieved for full paper analysis to assess their relevance to this section, at which stage 164 further studies were excluded. Full analysis was conducted on the 31 remaining studies that met the full inclusion criteria.

Figure 3.2. Inclusion and exclusion criteria

To be included in this section, studies had to:

- Significantly focus on tobacco industry lobbying activities that related to taxation (studies were included that did not primarily focus on this issue, but they had to focus on it significantly and meet the other inclusion criteria; studies in which tax-related lobbying activities were only a minor/tangential issue were excluded);
- Draw on empirical evidence to support any claims made about tobacco industry tax related lobbying;
- Be written in English or another language spoken by a member of the IARC review team;
- Be concerned with lobbying from 1985 onwards (studies which were only concerned with a period prior to 1985 were excluded; studies which concerned periods both before and after this date were included).

The data from these studies were extracted and the studies were critically appraised using critical appraisal criteria for qualitative papers, adapted from Rees *et al.* (2006) and the United Kingdom Public Health Resource Unit (2006) (see Figure 3.3). The appraisal and inclusion/exclusion criteria, were piloted by two reviewers on five relevant papers and then revised accordingly.

As is common practice with reviews of qualitative data (Smith *et al.*, 2009), the critical appraisal criteria were used for descriptive purposes only and to highlight variations in the quality of studies (i.e. no quality score was calculated but this assessment allows us to comment on the quality of the included studies). Narrative synthesis was performed to combine the qualitative and quantitative evidence. Results are tabulated (see Table 3.3) as well as summarized in the following text.

Figure 3.3. Critical appraisal criteria

These criteria were used to assess all of the included studies. The results of this process are presented under the critical appraisal section of the results in Table 3.3.

1) How clear is/are the research question(s) and/or aim(s)?

2) Was the methodology appropriate for addressing the stated aims of the study?

3) Where applicable, was the recruitment/search strategy appropriate and/or was an adequate sample obtained to support the claims being made (i.e. was the data collection adequate and appropriate)?

4) Were the methods of data analysis appropriate to the subject matter?

5) Is the description of the findings provided in enough detail and depth to allow interpretation of the meanings and context of what is being studied? [Are data presented to support interpretations, etc?]

6) Are the conclusions justified by the results?

7) If applicable, are the theoretical developments justified by the results?

8) Have the limitations of the study and their impact on the findings been considered?

9) Do researchers discuss whether or how the findings can be transferred to other contexts or consider other ways in which the research may be used?

10) If the answer to 9 is ‘yes’, do you agree these suggestions are appropriate, based on the research?

Source : Rees *et al.* ; 2006 ; United Kingdom Public Health Resource Unit

Results

The majority of 31 studies identified focused on North America (22 focused on the USA, or states within the USA, and two focused on Canada), although it should be noted that several of the studies concerning state-level excise propositions related to the same policy development (Table 3.4). The rest covered a diverse set of countries (Table 3.5). We found no studies relating to tobacco industry tax-related lobbying in South America, South Asia, Australasia or Africa or examining influence on supranational (e.g. European Union) tax policy.

The studies covered two main topics. The majority (27) discussed tobacco industry efforts to counter proposed excise tax increases (Begay *et al.*, 1993; Moon *et al.*, 1993; Koh, 1996; Traynor and Glantz, 1996; Heiser and Begay, 1997; Bialous and Glantz, 1999; Goldman and Glantz, 1999; Balbach *et al.*, 2000; Givel and Glantz, 2001; Morley *et al.*, 2002; Yerger and Malone, 2002; Szilágyi and Chapman, 2003; Alamar and Glantz, 2004; Levenstein *et al.*, 2005; Balbach *et al.*, 2006; Givel, 2006, 2007; Gilmore *et al.*, 2007; Nakkash, 2007; Campbell and Balbach, 2008, 2009; Balbach and Campbell, 2009; Lum *et al.*, 2009; Raebeck *et al.*, 2009) or, in some cases, to lower existing taxes (Joossens and Raw, 2003; Breton *et al.*, 2006; Kelton and Givel, 2008). Of these, only four covered policy influence outside North America (Joossens and Raw, 2003; Szilágyi and Chapman, 2003; Gilmore *et al.*, 2007; Nakkash, 2007). As Table 3.3 summarizes, most of the US studies focused on policy proposals that included plans to substantially increase taxes and to earmark (hypothecate) all or most of the revenue raised by these tax increases for tobacco control programmes. This means it is difficult to ascertain to what extent the industry was concerned about tax increases per se, as opposed to being concerned about significant tax increases which would be used to fund tobacco control activities. Nevertheless, we can distinguish arguments and strategies used to counter the increases from those use to counter/undermine the proposed earmarking.

The other main topic (covered in seven studies) concerned tobacco industry efforts to influence excise structures (O’Sullivan and Chapman, 2000; Szilágyi and Chapman, 2003; Gilmore and McKee, 2004b; Gilmore *et al.*, 2005; Delnevo *et al.*, 2007; Gilmore *et al.*, 2007; Nakkash, 2007), and these have a very different geographic profile (Table 3.5). As there are far fewer studies on this issue, and as this is not the main focus of most of these studies, the picture that emerges is far less clear than that relating to industry activities to influence excise rates. Nevertheless, between them, these studies provide some important insights into how different companies have sought to influence tobacco excise structures to their advantage.

Table 3.3. Summary of studies concerning tobacco industry (TI) tax-related lobbying. Closely related studies are assessed together. Numbers in the column "CA criteria met" represent the quality criteria that each study met; see* at the end of the table for further details.

Study	Methods	CA criteria met*	Key findings			
			Aim of TI	**Arguments used**	**Mechanisms employed**	**Success of TI**
Studies concerned with tobacco industry efforts to influence tobacco tax rates (and, where applicable, associated plans for earmarking of taxes)						
Begay *et al.*, (1993)	- Analysis of reports by the California Fair Political Practices Commission, statements filed with the California secretary of state's Political Reform Division, and data on Proposition 99 expenditures from various official budget documents. - Also conducted "a multivariate simultaneous equations statistical analysis of data on campaign contributions from the tobacco industry to legislators in the 1991-1992 election, their records on tobacco control policy as scored by tobacco control advocates, members' personal characteristics, and constituents' attitudes towards tobacco control."	1-3,6,9, 10	To prevent a significant tax increase being proposed in the McCain bill	Not specified in this article	- Found the TI was investing heavily in the Californian legislature, spending political money more intensively there than in the US Congress. - Powerful individuals in the legislature seem to have been particularly targeted, e.g. "In 1991-1992, the Speaker received $221 367, making him the largest single legislative recipient of tobacco industry contributions in the United States" (explains the Speaker of the Assembly, the single most powerful member of the legislature and second only to the governor in influence). - TI lobbying expenditures grew 10-fold from 1985–86 to 1987–88, when Proposition 99 passed. - The TI also reorganized its lobbying efforts, hiring large, private firms to lobby legislators and state officials since Proposition 99 passed, rather than relying on organizations like the Tobacco Institute, as they previously had. Some of the firms hired also worked for medical groups which TI wanted to side with in efforts to divert revenue. - "In 1989, the Tobacco Institute offered to	- Proposition 99 passed in 1988, so the TI failed to prevent it, but did experience success in diverting funds. - Claims "Although there is little evidence showing that the tobacco industry has «bought» legislators' votes, early research strongly suggests that tobacco industry's campaign contributions are influencing the behaviour of California legislators in matters related to tobacco policy-making, independent of constituents' support for tobacco control." Notes the multivariate simultaneous equations statistical analysis of data on campaign contributions from the tobacco industry to legislators indicated that the TI had "a statistically detectable effect on legislative behaviour". - "Only 14.7% of revenues were spent on tobacco education and prevention, not the mandated 20%. The underfunding amounts to $174.7 million redirected to medical care programs from fiscal years 1989-1990 through 1993-1994, despite clear language in Proposition 99 specifying how the

Study	Methods	CA criteria met*	Key findings			
			Aim of TI	Arguments used	Mechanisms employed	Success of TI
Begay *et al*., (1993) (contd)					contribute $250 000 to the California Medical Association to divert Health Education Account funds to medical care programmes through a Medical Association-sponsored ballot initiative."	money should be spent."
Moon *et al*., (1993)	Methodology is not described but the article appears to be based on an analysis of various data sources, including media coverage of the issue and other academic articles	1,9,10	To prevent a proposal for a state-wide tobacco tax initiative in Montana, USA, which would have added an extra $0.25 to cigarettes, with money to be dedicated to TC programmes	- The tax was framed as «a trap set by 'special interests' to subsidize those people who live in cities". - TI highlighted that passage of the initiative would give Montana the highest cigarette tax in the nation. - Undertook advertisements during the last week of the campaign, which built on above (informing voters that although they could not do anything about outrageous property taxes, they could vote against the "selective sales tax increase")	- Opponents to proposal 'operated under the name «Citizens Against More Tax and Bureaucracy»' and they 'had $1.47 million at their disposal.' '[M]ore than 88% of the money came from Philip Morris, R. J. Reynolds, Brown & Williamson, and the Tobacco Institute.' - While the initiative was still in draft form, opponents conducted numerous telephone tracking surveys to measure the possible impact of various campaign themes. Increased state taxes and bureaucracy emerged as pivotal issues, and extensive television, radio, and newspaper advertisements emphasized these concerns.' - Linked the proposed increase tobacco tax with proposed property tax increases in rural areas that were happening at the same time (so framed as part of broader debates about tax rises); - Brochures were sent to businesses asking whether the business could afford the increase.	On November 6, 1990, Montana voters defeated Initiative 115 by 59% to 41%, so the TI succeeded.

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Study	Methods	CA criteria met*	Key findings			
			Aim of TI	Arguments used	Mechanisms employed	Success of TI
Moon *et al.*, (1993) (contd)					- Multiple mailings were sent to voters from a Helena tobacco retailer portraying the increased tax as «a trap set by 'special interests' to subsidize those people who live in cities».' "The Montana Alliance for Progressive Policy (MAPP), a liberal group opposing the increase as an unfair tax on poor people, received $22,500 from a tobacco industry lobby group to produce and send brochures to its 50,000 members urging rejection".	
Koh (1996)	Methodology is not described but the article appears to be based on an analysis of various data sources, including media coverage of the issue, personal correspondence with some key players and other academic articles	1,9,10	To prevent the passage of Question 1, a proposal to raise the tobacco tax in Massachusetts by $0.25 to fund tobacco education programmes	- The tax was unfair and regressive, disproportionately affecting people with low incomes - On that basis, it would contribute to class warfare (argued the tax pitted upper middle class liberals – mostly white – against lower middle class working people – mostly minority). - Warned that tax-generated monies would be diverted from their intended purposes, as had occurred in California. - Argued the tax would harm small business in the state by motivating people to buy cigarettes outside the state.	- The TI outspent the Coalition for a Healthy Future by 10:1. - TI put forward an alternative, compromise proposal. - TI legally challenged earmarking of funds. - TI organised and funded a group to lobby against the tax increases, called 'The Committee Against Unfair Taxes' - An ultra-conservative, out of state Catholic organisation working with the EU to distribute thousands of letters claiming that the Q1 funds would be used to fund abortion counselling and condom distribution in schools. Unclear if/how TI connected.	- TI failed to disrupt the signature gathering (two rounds). In round one, the sheer volume put TI off questioning signatures. - TI alternative proposal ignored. - TI legal challenge on earmarking failed. - The proposition passed so TI failed to prevent it. - Overall, state-wide tobacco consumption subsequently declined by more than three times the national average. - However, TI political pressure led to governor and legislature diverting more than $220 million out of the tobacco education account, prompting a subsequent round of lawsuits.

Study	Methods	CA criteria met*	Key findings			
			Aim of TI	Arguments used	Mechanisms employed	Success of TI
Koh (1996) (contd)				- Claimed the tax was unfair on smokers	- TI stepped up its media campaign in final weeks before vote. - TI focused on tax as a generic category, rather than specifically discussing tobacco taxes. - Employed a key former legislator	
Traynor and Glantz, (1996)	Analysis of published reports, public documents, personal correspondence, internal memos, polling data, and interviews with representatives form organizations that participated in the Proposition 99 campaign.	1,2,5-7,9,10	- To defeat Proposition 99 in California (which proposed to add $0.25 to state cigarette tax and use 20% of the revenue on tobacco education and prevention programmes); - Once Proposition 99 had based, the aim was to divert earmarked funds away from tobacco control activities/programmes.	- Tried to move the issue away from smoking by focusing on generic increased taxation arguments. - Emphasised government mismanagement of tax money - Suggested $0.25 was too much of an increase on a single product. - Claimed the increased tax would lead to increased smuggling and small-scale smuggling. - Built on this to claim police attention would be diverted away from other business and that more money would be spent on guns and drugs. - Argued tobacco tax was just another way for special interests, such as physicians, to become richer. - Framed tobacco tax as a regressive tax that would negatively affect blue-collar workers. - Argued Proposition 99 violated California's 1978 property tax-cutting initiative and other tax rules.	- TI invested significant resources into lobbying Californian legislature. Worked with healthcare organisations to ensure funds were diverted away from TC programmes to medical care programmes. - Hired a political consulting firm and formed the Californians Against Unfair Tax Increases (CAUTI). - CAUTI circulated its own petition in 1988, as the pro Proposition 99 effort was underway to gather supportive signatures, called 'The Tobacco Tax Ripoff'. This was not official and was merely used as a way of reducing the pool of available paid signature-gatherers (by paying them more) and to confuse voters about Prop 99. - CAUTI held a press conference to present its argument that the proposed tobacco tax was just another way for special interests, such as physicians, to become richer.	- TI's legal challenge failed. - But polls indicated the TI's ads did have an effect, reducing public support for the initiative. - However, various factors undermined one of TI's most popular arguments, that concerning smuggling and police work, including an official report that concluded the effect on smuggling was likely to be negligible, which criticized CAUTI's ads. Police groups which had supported the TI position subsequently dropped their support. In addition, it was revealed that the 'undercover policeman' in the TI's most effective ad had nothing more than a desk job for the policy and was also a part-time actor. All of this largely destroyed the small-scale smuggling/crime arguments the TI was using. - In the end, Proposition 99 passed in 1988, so the TI failed to prevent it.

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Study	Methods	CA criteria met*	Key findings			
			Aim of TI	**Arguments used**	**Mechanisms employed**	**Success of TI**
Traynor and Glantz, (1996) (contd)					- TI, through CAUTI, saturated TV, radio and print media with paid ads to promote TI position. Their most effective ad featured an alleged undercover police officer discussing the crime implications arguments (more time would be spent on smuggled cigarettes, hence less time on other issues, and the increased criminal money from smuggling, etc would be spent on drugs and guns). - TI legally challenged Proposition 99 on the basis it violated California's 1978 property tax-cutting initiative and other tax laws. - CAUTI secured the endorsements of the Californian Sheriffs' Association and the California Peace Officers' Association, which gave credibility to their crime/smuggling related arguments.	- However, the TI was influential in helping ensure the subsequent underfunding of tobacco education and prevention program.
Heiser and Begay, (1997)	Analysis of internal memos, meeting minutes, newspaper articles, other internal documents, letters, newsletters, news and press releases (many of which were provided	1-3,5,9,10	To challenge/undermine the development, then implementation of, Question 1, a proposal to raise the tobacco tax in Massachusetts by $0.25 to fund tobacco education programmes, in order to reduce smoking related deaths in the state	- Cigarette tax is regressive; - The proposed tax would hurt the state economy because it would increase cross-border shopping; The legislature would use the extra money raised for purposes other than those intended (e.g. to balance budget);	- Legally challenged the draft proposal, on basis it violated the state constitution, and filed subsequent legal challenges at later stages. - Used a signatures expert to try to disqualify signatures supporting the ballot proposal;	- Legal challenges failed. - Signatures expert was unable to disqualify enough signatures to challenge the ballot. - TI ad campaign was effective, however, in shifting public opinion, according to poll data.

Study	Methods	CA criteria met*	Key findings			
			Aim of TI	Arguments used	Mechanisms employed	Success of TI
Heiser and Begay, (1997) (contd)	through the American Cancer Society). Also used available polling data and undertook some interviews (although these are not discussed in the Methods section)			- The proposal was not legal	- During the second required signature drive, the TI tried to disrupt matters by offering two compromises – both of which involved smaller tax increase, with fewer funds being allocated to tobacco control programmes; - Funded a Committee Against Unfair Taxes to oppose the initiative; - Undertook a major advertising initiative (TV, radio and direct mail) to garner public support for opposing initiative	- Q1 nevertheless passed so TI failed to prevent it. However, funds were subsequently diverted, with only just over 25% being spent on tobacco education, apparently justifying one of the TI's arguments (article does not make any specific claims about TI's influence over this diversion).
Bialous and Glantz, (1999)	Case study using data from semi-structured interviews "with key players in the initiative" and written records (documentary data gathered from written records and newspaper clippings).	1-3,5-7,9,10	To prevent Proposition 200 in Arizona and then divert funds away from TC programmes (NB the Proposition aimed to increase the cigarette excise tax by US$0.40, with proportional increases in the tax on other tobacco products. Increased revenues were earmarked: 23% for tobacco prevention/ education programs, 5% for tobacco-related diseases and prevention research, 70% to provide medical care for the poor, and 2% to offset future loss of tobacco tax revenues by the Arizona Department of Corrections)	- Framed initiative as an attempt by proponents to divert large amounts of taxpayer money to their own benefit. - Used the diversion of health education funds into medical services by the California legislature as an example of how the tobacco tax funds were going to benefit only the hospitals.' - Claimed that California's tobacco control programme was misusing public funds	- Used front-groups - "Enough is Enough" and "No More Taxes", which were 99.96% financed by Philip Morris and the Tobacco Institute, respectively, to campaign against the initiative. - Increased lobbying of the state legislature, with the number of paid tobacco industry lobbyists rising from approximately four to 18. - Once Proposition had been passed, the TI legally challenged some of the contracts agreed with health education funds. - Threatened local level boards with legal action over tobacco control programs. - Tried to pass pre-emptive legislation to limit local TC programs	- The Proposition passed so TI failed to prevent it. - The TI also failed to divert funds away from TC programmes. - However, the tobacco education programme experienced a range of other problems and was never fully implemented as planned. Authors suggest TI lobbying played a role in this

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Study	Methods	CA criteria met*	Key findings			
			Aim of TI	Arguments used	Mechanisms employed	Success of TI
Goldman and Glantz, (1999)	Interviews with key informants and analysis of public documents, internal memoranda, and news reports	1-3,5-7,9,10	- To prevent Measure 44 becoming law, notably by preventing it from gaining a majority public vote. Ballot Measure 44 was a proposal to raise cigarette taxes in Oregon by US$0.30 per pack and to use the funds to support an Oregon Health Plan and tobacco control (it proposed a dedicated 10% of the revenues would be used for tobacco control). - Once Measure 44 had passed, to prevent the funds from being spent on tobacco control programmes	- Taxing smokers to pay for healthcare for everyone is unfair. - Measure 44 contained no controls on how money would be spent and were likely to be wasted on bureaucracy, etc, rather than being spent on health care and health education; - Healthcare providers and insurance companies were being greedy in wanting these taxes; - The Measure would allow cuts in spending on programmes that were currently funded by tobacco tax [NB authors say this was incorrect]	- Legally challenged the initiative on various grounds (language used; failure to specify all the types of taxes that would be raised; and a misleading summary). - "While signatures were being collected to qualify Measure 44 for the ballot, the tobacco industry began contributing money to a different ballot measure campaign", which the authors suggest was designed "to disrupt the signature-gathering process and to dilute support for Measure 44" and "to divert the energy and financial resources of the health insurers away from Measure 44." The money the industry gave to this alternative campaign, meant the signature-gatherers could be paid significantly more than those for Measure 44, which enabled more signature-gatherers to focus on the other campaign and the tobacco control lobby, eventually, to have to pay more for signatures. - TI formed and funded a registered campaign committee, called Fairness Matters to Oregonians Committee (FMOC). Of the US$4 614 292 in cash contributed to FMOC to fight for Measure	- The legal challenge initially met with some success but was eventually ignored as submitted late. - Other TI lobbying efforts also initially met with some success but later failed. - Although TI outspent Measure 44's supporters 7 to 1, the initiative passed with 56% of the vote. - TI also failed to divert tobacco control funds to other uses or limit the scope of the program. - Nevertheless, only 10% of the revenues were devoted to tobacco control activities, even though public health groups provided 37% of the campaign money (notes that this was partly because public health groups were not involved in the early phases of the tobacco tax effort and therefore missed an opportunity to affect the allocation of funds). Overall, article concludes: 'Despite being outspent more than 7 to 1, Measure 44 passed with 56% of the vote on 5 November 1996. 'The end result was an 11% decline in per capita cigarette consumption in Oregon since 1996 and a decline of 35 000 in the number of Oregonians who smoke'.

Study	Methods	CA criteria met*	Key findings			
			Aim of TI	Arguments used	Mechanisms employed	Success of TI
Goldman and Glantz, (1999) (contd)					39 and against Measure 44, all but US$30 came from the Tobacco Institute. - Much of the above money was used to run ads on radio, TV and via direct mail (TI significantly outspent the public health campaigners on advertising). - TI hid its involvement in some advertising campaigns (though advertisers were eventually required to declare this). - TI hired a former Oregon governor. - Used the support of a dentist (i.e. medical care worker). - Once measure had been passed, TI lobbied legislators about how the money should be spent, hoping to weaken the anti-tobacco ad programme. This included lobbying a Subcommittee which consisted of three senators and which had to (by majority) had to approve the budget	- Philip Morris concluded they ought to use third parties more heavily in future campaigns in order to make voters 'more persuadable' of their views
Balbach *et al.*, (2000)	Analysis of relevant documents (published reports, public documents, personal correspondence, newspaper accounts, press releases, internal memos and some industry documents). Files made available by various public health / tobacco control groups, and lawsuits in 1994 and	2-7, 9,10	- To defeat Proposition 99 in California (which proposed to add US$0.25 to state cigarette tax and use 20% of the revenue on tobacco education and prevention programmes); - Once Proposition 99 had based, the aim was to divert earmarked funds away from tobacco control activities/programmes	- Not made clear in this article, which merely notes that the TI built on anti-tax, anti-regulation and freedom-of-choice themes	- Direct lobbying of legislature (investing huge financial resources). - Worked with private healthcare and groups representing medics to ensure funds were diverted away from tobacco control education programmes and towards medical care programmes (which went against the specifications of the public	Proposition 99 passed in 1988, so the TI failed to prevent it. - However, the tobacco education and prevention programmes which had been earmarked for receiving 20% of the revenue did not receive their full allocation, which was instead diverted (largely to healthcare organizations).

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			Aim of TI	Arguments used	Mechanisms employed	Success of TI
Balbach *et al.*, (2000) (contd)	1995. Interviews were also undertaken with 38 "key participants" (although TI refused to be interviewed)				ballot). This provided 'crucial political coverage for the tobacco industry and the politicians that supported it' - Helped establish the Californians for Smoker's Rights (CSR) group to promote TI arguments and target tobacco control programmes. - Paid key officials (money often went via advertising agencies and law firms so did not appear to be TI money)	- Following lawsuits by public health groups, and extensive media coverage of the issue, the health education account finally received its full allocation in 1996
Givel and Glantz, (2001)	Analysis of tobacco industry documents, plus reviewed existing case studies of TI state level lobbying, plus data from on the status of state tobacco control legislation from the US Centers for Disease Control and Prevention, National Center for pre-emption data Chronic Disease Prevention and Health Promotion, Office of Smoking and Health. Also used 1990 Coalition on Smoking or Health pre-emption data	1-3,6,9,10	Oppose all tobacco excise tax increases proposed at state level in USA	No arguments are mentioned specifically in relation to taxation but study notes tendency of TI to frame issues as important because they impact on public / other sectors, rather than because they impact on the TI itself	For many of the lobbying tactics/mechanisms outlined, it is unclear if they are related to taxation. On the issue of tobacco excises specifically, the following are highlighted: - work with and fund anti-tax groups - contribute funds to "national groups not directly related to tobacco that make policy recommendations, which can effect state legislation while allowing the tobacco lobby to remain behind the scenes", e.g., funding for Women Involved in Farm Economics (WIFE) and the National Taxpayers Conference (NTC). Both of these groups "assisted the tobacco lobby […] to fight tobacco excise tax increases"	Found that 20 states had low rates of tobacco excise taxation (less than US$0.25 per cigarette pack). Concludes that this suggests TI has been able to maintain a "favorable market."

Study	Methods	CA criteria met*	Key findings			
			Aim of TI	Arguments used	Mechanisms employed	Success of TI
Givel and Glantz, (2001) (contd)					- Forming relationships with minority and women's political caucuses "to build coalitions to counter tobacco excise taxes and promote smokers' rights legislation". - Lobbying via National Smokers' Alliance (TI-funded front group)	
Morley *et al.*, (2002)	Analyzed TI expenditures by state, using data from tobacco industry document websites, and TI publication the *Tax burden on tobacco.* Also collected cigarette excise tax rates per pack for each state for 1991 and 1997, to rank states on the basis of an increase in excise tax rate over this	1-6,8	Not assessed in this article, which examines Tobacco Institute lobbying, but findings suggest the industry was particularly concerned about policy developments that were likely to lead to increased cigarette taxes and earmarked cigarette taxes in 1990s	Not assessed in this article	The findings from this study support the hypothesis that in the 1990s tobacco control activities such as raising cigarette excise taxes, attracted TI resources to undermine these efforts. - California and New York were ranked highest in average Tobacco Institute spending, and Minnesota, Arizona and Massachusetts also ranked highly (all states that had had public ballots on raising tobacco excise taxes and dedicated some of the increased revenue to TC). On the whole, study finds Tobacco Institute spending correlated with state efforts to introduce higher (and often earmarked) tobacco excise taxes as well as to introduce other tobacco control measures such as public smoking restrictions (relationship was stronger for TI activities relating to tobacco tax than smoking restrictions, which authors suggest may be because the TI relied more on third parties to lobby against	Not assessed in this article (although authors note the Tobacco Institute was disbanded in 1998, which suggests it was not seen as successful at this point)

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			Aim of TI	Arguments used	Mechanisms employed	Success of TI
Morley *et al.*, (2002) (contd)					smoking restrictions than it did on tobacco excise issue)	
Yerger and Malone, (2002)	Analysis of tobacco industry documents and relevant secondary data sources including newspaper and journal articles	1-3,5-7,9,10	To avoid any significant tobacco tax increases	Argued excise taxes were regressive and disproportionately unfair, particularly to minorities	- African American groups with which the TI had ties were used to oppose tobacco tax increase. For example, the Congressional Black Caucus (CBC) shifted its 1981 support for a 10% increase in the tobacco excise tax to help restore funding for social programmes to a position opposing increasing tobacco excise taxes in 1984 (for undetermined reasons). - The TI then "sought to leverage the caucus' changed position." - Many other African American groups were also identified as being willing to support this position. - CBC commissioned a task force to review the impact of excise taxes on the poor, blacks, and other minorities. The task force issued a 1987 report, which was used to lobby politicians with (and which the TI helped promote). - TI produced economic studies to support its claims about taxes. - TI relied on support of Congress reps who received TI money	The success of the TI in avoiding significant tax increases is not made clear in this study but the authors imply that it was successful in influencing the position on this issue of African American groups and leaders

Study	Methods	CA criteria met*	Key findings			
			Aim of TI	Arguments used	Mechanisms employed	Success of TI
Joossens and Raw, (2003)	Analysis of tobacco industry documents plus draws on figures concerning smuggling that are quoted in published articles, in data provided by customs, tax and health authorities	2,5-7,9,10	To maximise profits, both tough legal and illegal markets, whilst using the spectre of smuggling as an argument for keeping taxes low	- Tobacco smuggling is caused by market forces, i.e. the price differences between countries, which create an incentive to smuggle cigarettes from cheaper to more expensive countries	- TI lobbies governments to reduce tobacco tax on the basis that doing so will solve smuggling problems and increase government revenues	Does not assess success in detail, although notes that taxes were lowered in Sweden and Canada, following concerns about smuggling. Notes this did not adequately deal with smuggling
Alamar and Glantz, (2004)	Analysis of tobacco industry documents.	1-3,5-7, 9,10	- To prevent a significant tax increase being proposed in the McCain Bill.	- Attempted to frame the bill as the ''largest tax increase in history'' and a bureaucratic mess. - Claimed the increase would lead to increased levels of illicit trade and associated law and order problems.	- Used Wall Street analysts to present arguments about smuggling (TI briefed analysts, who then presented themselves as independent)	- TI was successful (McCain Bill was defeated in June 1998)
Levenstein *et al.*, (2005)	Analysis of tobacco industry documents and union publications, newspapers, and other general publications relevant to the case study, plus examined New York case law and legislative history, and analysed interviews with key personnel (unclear if interviews were already undertaken as part of other project or if were part of this study)	1,2,5-7,9,10	To prevent the passage of two types of legislation – excise taxes on tobacco products and workplace smoking restrictions. It aimed to prevent questions on these issues from qualifying for ballot and to defeat those proposals that made it to the ballot	Tobacco excise taxes were framed as unfair and regressive	- TI set up the LMC - From mid-1980s to late-1990s, the LMC "worked to elicit support in New York by framing issues in terms that made them salient to unions." - The unions sided with TI in hope "that such cooperation would be of advantage to them in their efforts to protect and strengthen their organisation. The TI and LMC did their homework, understood the concerns of labor, and appeared ready to champion these concerns." This included assisting unions even on issues of "no concern to the TI".	- The LMC was "generally successful in gaining labour support in New York for positions on excise taxes and, especially, worksite smoking restrictions. However, by the late 1990s, the support had largely evaporated, with trade unions in New York either in support of, or at least neutral on," both issues. From 1985, tobacco excise tax 'increased only slowly and marginally' but in 1999 it was doubled. - LMC succeeded in dividing public health and labor for a while. - However, the LMC largely failed to attract support from public sector

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Study	Methods	CA criteria met*	Key findings			
			Aim of TI	**Arguments used**	**Mechanisms employed**	**Success of TI**
Levenstein *et al.*, (2005) (contd)					- The TI's focus was on the leaders of unions / labour groups, rather than their members as it was these people who had political influence. - The LMC lobbied and briefed elected officials at all levels of government, and worked to discourage liberal and labour coalitions from taking anti-tobacco positions, built support for industry positions throughout the labour movement, and provided general public communications	unions in New York state as they were dependent on state budgets so could not be counted on to resist any action that might help replenish state coffers. Hence, "While regularly siding with the LMC on the issue of smokefree worksites," the New York public sector unions did not tend to denounce proposals for cigarette tax increases. - The TI eventually gave up trying to win public sector union support on this issue, which authors decide was a "fatal error". - "By the late 1990s […] most of labor in New York had shifted to support for anti-tobacco policies." Shift in support started with excise but then moved on to other TC issues
Balbach and Campbell, (2009) and Balbach *et al.*, (2006)	Analysis of tobacco industry documents and other related documents (CLUW News, the in-house newspaper of CLUW)	1-7, 9,10	- Overall aim was to prevent tobacco excise increases. Intermediate aims included discouraging liberal and labour groups from taking anti-tobacco positions (including on tobacco excise) and shifting the focus of the debate away from the effects of tax increases on cigarette consumption and onto the effects on the people paying cigarette taxes	- That cigarette taxes are regressive and that regressive and unfair to working women	- In 1984, the Tobacco Institute established the Labor Management Committee (LMC), which was composed of the Institute and five unions representing tobacco industry employees. The LMC's functions included: (i) Lobbying and briefing elected officials at all levels of government; (ii) discouraging liberal and labor coalitions from taking anti-tobacco positions, including on tobacco excise taxes;	- TI was successful in influencing CLUW's position on tobacco excise taxes (CLUW did campaign against such increases & against earmarking). - Authors acknowledge "it is difficult to know how much or if the CLUW's involvement in the policy process made a difference," but say "there are indications that organized labor was important in federal level policy making".

Study	Methods	CA criteria met*	Key findings			
			Aim of TI	Arguments used	Mechanisms employed	Success of TI
Balbach and Campbell, (2009) and Balbach *et al.*, (2006) (contd)					(iii) building support for industry positions throughout the labor movement; and (iv) facilitated general public communication on relevant issues. - The TI provided financial (at least $221 500 between 1988 and 1996) and in-kind support to the *Coalition of Labor Union Women* (CLUW) in order to engage CLUW's interest in smoke-free worksite legislation and tax increases. - The Tobacco Institute facilitated its relationships with CLUW (and similar groups) by working via the LMC. - The Institute supported the production of a series of studies by labour groups, including CLUW, which demonstrated the regressive nature of tobacco taxes. - The Institute monitored press coverage and advised CLUW on how to promote study messages to the media. - CLUW and similar organizations were encouraged to oppose earmarked tobacco taxes, such as those proposed in Clinton universal healthcare proposals. - The TI was aware many labour organizations, including CLUW, were generally supportive of higher taxes so they encouraged them to	

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Balbach and Campbell, (2009) and Balbach *et al.*, (2006) (contd)					push for higher taxes on corporations, rather than cigarettes. This included assisting the Citizens for Tax Justice group with the promotion of its annual examination of ''corporate freeloaders'' – those corporations that pay no, or little, taxes. - TI framed tobacco taxation as part of generic consumer excise taxes (which also including petrol and alcohol)	
Breton *et al.*, (2006)	Analysis based of: (i) 569 articles from four Québec daily newspapers published between 1986 and 1998; (ii) 28 semi-structured interviews with key informants, and (iii) more than 200 government documents/ transcriptions of parliamentary debates relating to the problem of smoking	1,2,5,6,8	To reduce tobacco excise taxes: "When the cost (in constant dollars) of tobacco caught up in 1984 with its 1970 level, the tobacco industry and union leaders representing workers in this sector began to challenge decisions to increase the taxes." (So initial aim was to avoid further tax increases). However, "In early 1992, a plea for a drastic reduction in tobacco taxes emerged.''	Initially, TI challenged tax increases primarily on economic grounds, with arguments concerning the industry's profitability. - Also argued taxes were unfair on smokers. - Later focused on arguments that the tax increases were fuelling smuggling (including high economic cost of this to government and retailers, and failure to help control tobacco use). - Argued against export taxes and better policing as solutions to the smuggling problem. - Presented taxes as excessive and TC groups as having dominated policy. - Following tax decreases, the TI argued smoking rises in young people were unrelated to the change in price	- Various groups supported the TI position (retail sales sector and journalists). Unclear how much the TI was linked to groups/individuals in these sectors. The Québec Food Retailers Association was a particularly active group, which called a press conference in 1992 and demanded "a 70% reduction in tobacco taxes to put an end to smuggling". Authors claim TI was involved in funding this group. - A group specifically campaigning on this issue, the *Mouvement pour l'abolition des taxes réservées aux cigarettes* (MATRAC), was set up but authors do not comment on whether TI was involved in funding/ establishing this group.	- Initially, the TI and its allies had little influence – the TI was seen to be in decline anyway in Canada. - However, framing the issue as a 'contraband problem' succeeded in winning support from a broad coalition, including retailers, media commentators and the representatives of employers' organizations. - The health lobby received less media coverage and was subject to criticism that they had an 'extremist' stance. - Eventually, "a massive reduction in the Québec and federal taxes" was achieved, not just in Québec but also 'in the taxes levied by five other provinces, including Ontario' and also at a federal level.

Study	Methods	CA criteria met*	Key findings			
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Breton *et al.*, (2006) (contd)					- Claims the TI was able to mobilize union representatives and its employees. - TI helped organize small retailers, whose comments quoted in the media gained public sympathy. - Ran an "effective media strategy". - Managed to get police support on smuggling issue. - Disseminated the findings of surveys on different facets of the problem. - Arguments were presented as being on behalf of citizens, not the TI	- This led to an increase in smoking rates amongst young people. - Political elites responded to this by implementing a range of strong TC strategies (although they did not re-raise the tobacco tax). - Concludes, the TI's success was mixed: "the smuggling crisis was an event that, despite its unfortunate repercussions on tobacco taxes, helped put the tobacco problem in Québec, especially among young people, on the government's agenda."
Givel, (2006)	Analyzed data from the State Tobacco Activities Tracking and Evaluation System, Tobacco Map Reports created by the U.S. Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office of Smoking and Health (CDC). Supplemented this with data from the Coalition on Smoking or Health, American Lung Association, and Federation of Tax. Also appears to also use some TI documents (although this is not mentioned in description of methods)	1,2,5-7	To avoid tobacco excise increases	Argued tobacco use is a matter of individual choice and it is therefore reasonable to expect freedom from excessive government regulations and taxes	Study only highlights TI mechanisms/tactics generally so the following do not only concern tax-related lobbying: - Ongoing employment of well established contract lobbyists, who are managed and coordinated in a top-down manner by TI. "The state contract lobbyists often have decades of experience and expertise in working with state legislatures to advance or block legislation." - Direct and indirect campaign contributions; - gifts and honoraria to legislators; - occasional alliances with other allied interest groups (such as the hospitality industry to counter clean	- "From 1990 to 2003, there was a sharp mobilization by health advocates in all states and a significant rise in new legislation to control tobacco use. The tobacco industry, nevertheless, was able to generally keep state tobacco taxes low and counter significant regulatory threats to tobacco sales." - Concludes "the policy monopoly favoring the tobacco industry did not significantly change, despite the symbolic appearance of punctuation in the policy system."

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Givel, (2006) (contd)					indoor air ordinances); - The development of front groups allowed the tobacco industry and its political allies to act without being publicly, including the National Smokers Alliance (primarily funded by Philip Morris). - Tactics of the front groups often included orchestrated grassroots advocacy campaigns through the mail or phone calls to pressure policy makers. - Providing testimony before legislative bodies	
Givel, (2007)	Analysis of tobacco industry documents, plus relevant newspaper reports (Lexis Nexus), all relevant articles from the Americans for Nonsmokers' Rights database (http://www.tidatabase.org/), magazine articles, web pages, journal articles, and books	1–3, 5–10	- To keep tobacco taxes low and avoid undue regulations (avoid altogether or keep weak), which formed part of broader efforts to "maintain, enhance, and protect the industry's profits and market shares"	- The NSA (TI front group – see next cell) argued that adult tobacco use should not be hindered by rigorous regulatory controls or higher tobacco taxes. - Called into question the potential health effects of tobacco use and the viability of proposed tobacco tax increases. - Presented smoking as socially acceptable for adults	- In 1993, TI established the National Smokers Alliance (NSA), "a public relations created front group funded by the tobacco industry, which operated nationally from 1994 to 1999 to advocate for adults using tobacco products without vigorous regulation or increased tobacco taxes." - Burson-Marsteller, the PR firm, helped set this up for Philip Morris (with some subsequent financial assistance from other TTCs) and some Burson-Marsteller staff worked for the NSA. - The NSA worked to "to ''generate'' the appearance of public support through public,	- "Despite the use of traditional lobbying in conjunction with the use of public relations efforts, attempts by the NSA to dominate public policy to weaken or neutralize stronger tobacco regulations and taxes were effective only for some campaigns." - "From January 1994 to June 1999, the NSA's record of political victories and shaping of public policies was mixed. At the national level, the NSA played an important supporting role in winning four major campaigns and losing one. At the state level, the NSA played an important supporting role in losing three campaigns

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Givel, (2007) (contd)					relations, through the engineering of consent theory, by using editorials newspaper articles, and pro-tobacco columns that called for the free use of tobacco." - Also organized national and regional press conferences, issued press releases, monitored media coverage of tobacco, made radio talk show appearances, issued alerts to NSA members, provided public speakers, issued advertisements, and corresponded with legislators. - Wrongly targeted University of California–San Francisco tobacco control researcher and Professor of Medicine Stanton Glantz, alleging, but not proving, Glantz misused grant funds for illegal political purposes and lobbying. - Filed a Senate ethics complaint against Sen. John McCain, alleging he had used "his Senate franking privilege to bolster his run for the presidency" (PM disagreed with this and withdrew financial assistance for NSA over this issue)	and winning one. At the local level, the NSA played an important supporting role in winning 19 campaigns and losing 12." (Not all campaigns concerned tax increases). - "[T]he NSA was unable to successfully discredit tobacco control researcher Stanton Glantz."
Campbell and Balbach, (2008)	Analysis of tobacco industry documents.	1-3,5-10	To challenge policy interest in significantly raising tobacco taxes by turning labour and middle-class opinion against prospective excise	Tobacco taxes are regressive	- TI created and funded the Consumer Tax Alliance (CTA) in 1989 to build opposition to excise taxes. The CTA focused on garnering support from	- In exchange for funding, various labour/progressive groups did publicly take positions against increasing tobacco excise taxes.

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			Aim of TI	Arguments used	Mechanisms employed	Success of TI
Campbell and Balbach, (2008) (contd)			tax increases. Initial focus was on federal increases but in 1991, efforts turned to state-based tax proposals		credible liberal allies, particularly genuine public interest groups (groups traditionally perceived to be at odds with the TI). NB The CTA appears to have been dissolved in 1993. - Also focused on garnering media coverage of the issue (this included sponsorship of TV ads, plus a media tour by CTA Executive Director). - By working via the CTA (which did not divulge the industry's role in its formation), the TI was able to obscure its own role in these efforts.	- "The Tobacco Institute was pleased with the impact of the [TV] advertising [sponsored by the CTA], as measured by tracking polls commissioned to measure their effectiveness" which found they increased people's opposition to tobacco excise taxes. - Tobacco excise taxes were increased in 1990 and 1993 at USA federal level, but the increase was much less than originally predicted (8 cents, rather than 16 cents) and was introduced in two phases (authors accept that it is not possible to say whether or how CTA activities affected this outcome).
Kelton and Givel, (2008)	Analyses TI documents, newspaper reports, journal articles, scholarly reports, court cases, government data, court testimony, and federal and state statutes and regulations, plus relevant information from websites	1,2,4-7,9,10	To maintain/expand sales despite tax increases and to use the issue of smuggling as part of campaign to reduce taxes	TI blamed rampant smuggling on excessive taxation	- TI "promoted smuggling schemes" not only to increase profits but also to "provide an argument for tobacco taxation reduction." Effectively, the TI "secretly pushed for increased tobacco smuggling so that it could argue against higher taxes as a motivation to smuggle." - "Because of the federal excise and export tax breaks that apply on U.S. Native American land, for more than 10 years the tobacco industry utilized this land as smuggling routes to avoid newly	- Smuggling hindered Canadian tobacco tax increases from furthering a consistent reduction in consumption rates in 1990s. - The Canadian government responded to the influx of smuggled tobacco that culminated after the tax increases by, in 1994, returning taxes to their original level. "The intention of the tax reduction was to alleviate the growing illegal activity, but the illegal activity was more than just a result of high taxation. The Canadian government was

Study	Methods	CA criteria met*	Key findings			
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Kelton and Givel, (2008) (contd)					imposed Canadian taxes on tobacco products. By 1993, this tobacco smuggling accounted for 30 to 40 percent of the total Canadian tobacco market.”	ill-prepared and unable to reduce or eliminate tobacco smuggling.” - “The tax rollback has prevented the Canadian government from earning public finances estimated in the billions of dollars from tobacco taxes that would have alleviated the societal cost of Canadian smokers. Lower cigarette prices have also injured the public health by increasing smoking prevalence to levels that would not have existed if the tobacco tax increases had met their expected goals.”
Campbell and Balbach, (2009)	Analysis of tobacco industry documents and media reports (located through searches on Lexis—Nexus)	2,3,5-7,9,10	- To change the debate from the effects of cigarettes to the people paying cigarette taxes. - To discourage liberal and labour groups from taking anti-tobacco positions, including on tobacco excise increases	- That cigarette taxes are regressive and that regressive tax increases are unfair. - That this is true even when taxes are earmarked for healthcare spending. - That there is little evidence that increasing taxes on alcohol and cigarettes reduces consumption	- Tobacco taxation was framed as part of a broader category of consumer excise taxes, also including petrol and alcohol. -Tobacco Institute’s strategy included recruiting "organized labor, minorities, and other liberal groups" to provide early warnings of legislative tax initiatives, help tobacco industry lobbyists gain access to legislators who were not industry allies, demonstrate constituent support for pro-tobacco votes, and testify on the industry’s behalf. The Institute was successful in forging relationships with—and providing significant financial support to two prominent progressive organizations.	- CTJ initially responded to TI approach by saying tobacco excise was not a priority issue for the organisation, but agreed to work with the TI when it received funding, from 1984 onwards. Relationship deepened in 1986, as more funding was provided. CTJ took anti tobacco tax positions and lobbied on this issue, including by testifying before the Senate Finance Committee against an increase in the federal tax on cigarettes. - TI appears to have been pleased with activities on tax undertaken by both CA and CTJ, including on earmarking issue (which included Clinton’s healthcare proposals).

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Campbell and Balbach, (2009) (contd)					Citizens for Tax Justice (CT) and Citizen Action, to oppose cigarette excise tax increases as part of its policy efforts." - As other articles outline, the LMC was used to obscure connections between the Tobacco Institute and the labour groups it worked with, such as CTJ and CA. - TI supported CTJ to hold a conference in 1987, which focused on promoting the arguments that had been used at federal level to state level. - CTJ lobbied Senate Finance Committee. - CTJ position pieces covered in media. - As tobacco tax concerns moved increasingly to state level, the TI (through LMC) recruited Citizen Action in a similar way to CTJ and for similar reasons (CA was better organised at state level though, being more of a grassroots organisation). - TI also recruited other progressive tax groups. - CA and CTJ were also used to help the TI lobby against proposals that tobacco tax increases would be earmarked for health care spending	- The Tobacco Institute was dissolved in 1998 as part of the Master Settlement but "interest in cigarette excise taxes remains high" and "controversy continues over the economic hardship they may cause for low-income smokers" and on "the fairness of raising revenue from one population subgroup (smokers) for programs with broader social benefits."

Study	Methods	CA criteria met*	Key findings			
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Lum *et al*., (2009)	Analyzed proposed ballot measures in US states (used various documentary sources) and TI documents. Used public and private polls (obtained from proponents of the ballot measures, pollster websites or the tobacco industry documents) to identify early levels of support for the tax proposals and how this support compared with the final election outcomes	1-3,5-10	To avoid tobacco excise tax increases and, in particular, to avoid earmarked taxes	- Argued proposed tax increases did not dedicate enough to tobacco control and that hospitals and health maintenance organizations would profit (i.e. ‘‘only a small amount of the tax increase will go to education about the hazards of smoking.’’). - Argued tax increases are unfair - Built on popular themes of ‘‘anti-tax/ HMO scheme’’ and ‘‘what they aren’t telling you’’ as effective arguments against ballot measures	- TI developed a voter segmentation model to determine which tobacco tax increases it could defeat in USA states. - After doing market research on the issue, sought to present tobacco taxes as part of broader tax rise issues. - The Tobacco Institute […] organized its Tobacco Industry Ballot Issues Committee, which provided ‘‘oversight of all prevention, preparation, and execution of tactics relating to ballot issues, as well as the place to discuss new strategies and technologies related to battles in this arena’’. - TI was advised to: lobby legislatures to ‘‘reform initiative and referendum laws to make qualification of ballot issues more difficult’’, ‘‘encourage third party ballot issues which threaten […] opposition and impede their progress’’, mount ‘‘legal challenges which complicate opposition progress’’ and prevent ‘the opposition from using inappropriate funding sources for their political activities’. - TI also conducted public relations campaigns, conducted benchmark research and built partnerships with other organizations that might be needed in a campaign. - In the 2000s, the industry became much more selective in which	- “The industry effectively influenced early voters.” - Tobacco tax ballot measures commonly allocated substantial funds to medical services, despite lack of public support for this. Tobacco companies “are becoming more successful in making this use of funds an issue.” - Between 1988 and 1998 the TI mounted extensive opposition campaigns to all nine tobacco tax ballot measures that were proposed, but only defeated four (44%) of them. From 1998 to 2008 it only challenged five out of 13 of the tobacco tax measures and defeated four (so 80% of those it challenged). Thus it is becoming more successful in campaigns it conducts but probably at least partially because it has become more selective. - Claims TI “learned to combine the argument that the tax would primarily benefit hospitals and HMOs with lack of funding for benefits for smokers. When either of the two arguments was used alone, the tobacco industry lost three out of four elections, but when they were combined, they won three out of four elections.” - Claims TI spending alone does not explain outcomes of state proposals to increase tobacco taxes.

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Lum *et al.*, (2009) (contd)					campaigns it opposed (although, after deciding not to fight the tax proposals in Washington, it did also realize that not opposing such increases was likely to encourage states to take action so began also taking this into consideration.) - Drew on its "essentially unlimited financial resources"	
Raebeck *et al.*, (2009)	Analysis of tobacco industry documents and academic articles	1-3,5-7,9,10	- The goals of the LMC included lobbying elected officials, discouraging liberal and labour groups from taking anti-tobacco positions, and building support for industry positions among organized labour. Notes tobacco taxes and smoke-free legislation were seen to be most effective at reducing smoking rates (and implies, therefore, that these were perceived by the Tobacco Institute to be the biggest threats)	- Argued excise taxes are regressive	- TI provided significant funding to African and American and Latino labour organizations and also sponsored special projects within these organizations, including studies, brochures, and conference events. - Helped support these organizations' priorities, even where they did not directly relate to tobacco. - Framed discussions of tobacco taxes as part of debates about broader, 'consumer' excise taxes. - Framed issues so that they would be more appealing to labour and minority groups which the TI was trying to work with, e.g. presented policies (tobacco taxation increases and smokefree legislation) as particularly detrimental to organized labour and, specifically, to people of colour. - To facilitate working with these kinds of labour	- The TI did appear to be successful in influencing the position on tobacco excise of some key African American and Latino labour organizations (notes at least one key group appeared to shift its position on tobacco control issues between 1984 and 1988). This is despite the fact that other research the authors cite indicates these groups' core population constituencies did support tobacco tax increases. - According to a 1990 Institute briefing, the LMC's use of allies, such as the African and American and Latino Labor Organizations it was supporting, ''demonstrate[d] to legislators––particularly the liberal Democrats [sic] who are most likely to support increases to fund social programs–– that consumer excise taxes

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Raebeck *et al.*, (2009) (contd)					groups, the Tobacco Institute established the Tobacco Industry Labor Management Committee (LMC) in 1984 (see above). - The Tobacco Institute then used the coalitions it had formed with these organizations "to appeal to politicians who were traditionally more responsive to such arguments, specifically Democrats, liberals, and politicians of color." - The Institute, through the LMC, supported the release of studies, letters, and op-eds opposing excise taxes. These were often credited to the labor organizations that the TI was supporting via the LMC, rather than to the TI, even though they were "usually written by the Institute or its consultants". - The Tobacco Institute paid a PR firm, Ogilvy, Adams & Rinehart, to help write a publication that was officially by one of the labour organizations it was supporting, called, ''Fair Taxes: Still a Dream for African-Americans", and then promoted it ''the black and labor media''. - TI paid for studies that highlighted regressive nature of consumer taxes (framing tobacco taxes as part of this) and its impact on these groups (e.g. industry sponsored	are: Unfair Regressive Inconsistent with tax reform.'' - In 1993, when Clinton's healthcare plan included a US$1 per pack cigarette tax, the Tobacco Institute mobilized these groups to lobby the Congressional Black and Hispanic Caucuses, respectively. - Claims the TI's "reframing of ideas was particularly successful because the points were valid – i.e. excise taxes are regressive…" - Authors conclude: "Whether the involvement of [these organizations] had a significant impact on tobacco policy decisions is unclear, but both organizations had political influence among policymakers, organized labor, and people of color."

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Raebeck *et al.*, (2009) (contd)					study claimed "An African-American family, with both parents working, two children and an income of $25 000, will pay an almost six times larger share of its income on federal consumer excise taxes than a family making $250 000 a year").	
Studies concerned with tobacco industry efforts to influence tobacco excise structures (indicates that studies also touch briefly on lobbying around tobacco excise rates)**						
O'Sullivan and Chapman, (2000)	Analysis of tobacco industry documents	2-5,8	TTCs were "frustrated in their export attempts to China by tax barriers" and wanted to promote a flat excise tax structure "to reduce price differentials between imported and locally produced cigarettes." - TTCs sought to persuade Chinese government that, in order to optimise their revenue derived from the cigarette industry, they should institute a "simple system, a flat excise tax based on per thousand cigarettes.''	In 1985, Clive Turner (managing director of the Asian Tobacco Council) "sought to demonstrate to Asian governments that taxation across the Asian region was "over the top, and needlessly punitive" and that excessive taxation would "further reduce the taxable base" for governments leading to "a revenue reduction" - TTCs tried to gain USA support for its arguments (and in so doing were careful to frame the exports as being for existing smokers, rather than potentially increasing smoking rates)	On tobacco tax issues (which is not the main focus of this study), the authors claim the TI: - Lobbied American trade associations on the issue of exports. - Lobbied Chinese, US and UK officials and politicians - Tried to involve the Chinese monopoly in TI organisations - Philip Morris proposed some joint ventures.	Not assessed in this article (though presumably unsuccessful, given Chinese state monopolies still dominate).
Szilágyi and Chapman, (2003)**	Analysis of tobacco industry documents and media coverage of the tax harmonisation issues. This was supplemented by interviews with a finance ministry official and an investigative journalist	1-3,5-7,9,10	- To keep tax increases low (BAT and Philip Morris); - To secure a beneficial tax structure (Philip Morris lobbied for specific structure, though other companies lobbied for other structures, e.g. BAT lobbied for *ad valorem*);	- Tax increases will increase black market - While companies increased their prices to ensure their profits, publicly they decried the taxes imposed to them	- Efforts to draw public attention to high tobacco taxes; - Use of economic impact studies to support arguments (e.g. a study was produced by KPMG to support arguments against introducing EU tobacco tax excise levels	- Philip Morris failed to prevent a tax increase, even though it achieved significant political support on the issue. Officials who were sympathetic to Philip Morris' position blamed this failure on the *"divided position of the industry as well as heavy lobbying by*

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Szilágyi and Chapman, (2003)** (contd)			- To prevent the introduction of tax stickers; - To get rid of import duties		at time of Hungary's accession to EU, and PM commissioned a study from the Institute for Economic Research (Italy), on 'the consequences of rapid alignment to the EU's minimum tax on cigarettes in five accession countries', including Hungary). Such reports were largely sent to relevant officials, although sometimes also reported in media; - Created a coalition against the proposed tax stickers (which TTCs would have had to pay for); - Attempted to 'divert legislators' attention' away from proposed tax increases by offering the creation of a special fund to support tobacco growing in Hungary (to be levied via specific tax increases on cigarettes)	*BAT".* - In line with TI hopes, the tax burden on cigarettes in Hungary decreased in real terms between 1990 and 1996. - Even so, retail prices of cigarettes increased dynamically as a result of pricing policies instated by the industry itself. - The Hungarian budget has still one of the lowest contributions from tobacco taxes among countries of the former communist bloc. - TTCs were successful in "developing a sphere of supporters within relevant ministries (with special regard to the agricultural and finance portfolios and MPs sympathetic to TTCs views) and third parties (hospitality industry, tobacco growers, advertising industry) ready to react without delay in the case of government attempts to raising tobacco taxes." - More recently, in 1990s, TI sources admit that sales volumes have been "severely affected" by significant tax increases. - Authors imply TI helped shift government position on derogation period to meet EU tax harmonisation requirements, which required tax increases.

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Gilmore and McKee, (2004b)	Analysis of tobacco industry documents and supplementary data from tobacco industry journals, newspapers, routine data, and other published reports	1-3,5-7,9,10	In the context of persuading government to privatise state monopolies (preferably through closed deals), TTCs sought to secure excise structures that were favourable to their products	- BAT argued the excise regimes it favoured would increase fiscal and excise revenues received by targeted governments (even when BAT was itself involved in tax evasion via smuggling and has in other circumstances a track record of lobbying for tax reductions, which have the potential to reduce revenues)	- BAT employed various arguments to suggest that it was a better TTC to deal with than its competitors. This included presenting itself as a helpful and supportive corporation which could help advise government on things like excise regimes. - BAT attempted to establish good political connections/contacts to promote these arguments, sometimes working via consultants.	Not assessed in this article (at least not in relation to tax issues)
Gilmore *et al.*, (2005)	Analysis of tobacco industry documents and supplementary data, such as newspapers	1-10	BAT sought to acquire a monopoly position (through an exclusive deal) and then bolster its position by influencing excise rules so that they would "uniquely favour its products" (which would encourage smokers to switch from filterless to more expensive filter brands, despite low incomes). - It hoped not to increase its market share to over 80% within 4 years, by "closing the market to external competition" and undertaking marketing campaign. - As part of efforts to close the market to external competition, BAT wanted to use a system of Banderols. It also wanted to secure tax exemptions for BAT products	No relevant information on this issue is provided by this study (focuses instead on arguments used in relation to privatisation)	Not specified in relation to BAT's tax-related proposals (probably because privatisation did not proceed)	At the time of writing, the Moldovan state tobacco companies had still not been privatised, so BAT had not succeeded

Study	Methods	CA criteria met*	Key findings			
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Delnevo C *et al*., (2007)	Statistical modeling, using ACNielsen data, of what is likely to happen to prices of moist snuff and tax revenues following implementation of changes promoted by US Smokeless Tobacco in New Jersey	1,2,6,9,10	To change the taxation of moist snuff from an *ad valorem* to a weight-based system	- US Smokeless Tobacco argued the new tax system would raise 'an additional $2 million in revenue' and would discourage 'youth from buying it,' by raising the price of the cheapest available snuff	No information on this issue in this study	Changes were implemented, even though authors claim both arguments are flawed; the authors calculate the revised tax system is actually likely to encourage youth purchasing
Gilmore *et al*., (2007)**	Analysis of tobacco industry documents, other documentary data and some interviews	1-7,9,10	Having secured a privatization deal in Uzbekistan, BAT sought to: - introduce protective import taxes; - equalize excise on imports and domestic production; - ensure the proper control and collection of taxes, particularly on competitors' import (e.g. through the introduction of a tax stamp system, from which BAT would hopefully be exempted) - achieve a reduction in the excise tax on cigarettes (even though rates were already low); - achieve the implementation of an excise system to benefit BAT's brands and disadvantage those of its competitors (particularly Philip Morris). This involved a mixed excise system, which would ensure high-end brands (such as Marlboro) were hit through maintaining an *ad valorem* tax on inputs,	- Argued against the imposition of high taxation rates on the basis that high rates would encourage smuggling (even though BAT was involved in smuggling). - Argued its excise system proposals would minimize smuggling and optimize government revenue (even though BAT internal docs indicate the driving force was to achieve the best possible market position for BAT and that the company was aware its recommendations perhaps weren't always the best deal for the government)	- Lobbying of government officials responsible for taxation policy. - BAT offered to help officials in charge of tobacco taxation, who were unsure of the issues involved and who were inexperienced. Effectively, BAT created "a symbiotic relationship" between BAT and the Ministry of Finance. - BAT staff produced papers on smuggling, which fed into the above negotiations. - BAT bought up local TI to achieve market dominance and political influence	- BAT achieved a reduction of approximately 50% in the excise tax on cigarettes. - BAT achieved an excise system it believed would benefit its brands and disadvantage those of its competitors (particularly Philip Morris), this included the introduction of tax stamps in 1996, a licensing requirement for import and export, as well as wholesale and retail distribution. - "The price of cigarettes in Uzbekistan is now the lowest of all countries in the World Health Organization's Europe region, including those with which it is economically comparable". Overall: "BAT thoroughly redesigned Uzbekistan's tobacco taxation system to advance corporate objectives" (achieved all its objectives, bar one – which it still hoped to achieve at the end of the study)

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Study	Methods	CA criteria met*	Key findings			
			Aim of TI	Arguments used	Mechanisms employed	Success of TI
Gilmore *et al.*, (2007)** (contd)			and which also involved having a specific element for imports to try to reduce cheaper imports (ideally, BAT hoped this rate would not apply to them). - an *ad valorem* domestic system of 40% on filtered and 25% on plain cigarettes. This was of benefit to BAT, which was focusing on the local filterless brand Astra, and planned to later introduce other cheap local brands. - a requirement for a license to import and export cigarettes, as well as to provide wholesale and retail distribution			
Nakkash, (2007)**	Analysis of tobacco industry documents, plus secondary documentary sources and 20 semi-structured interviews with key informants	1-6,8-10	- TTCs lobbied to influence tobacco taxation policy in Lebanon. - PM sought to achieve a simplified excise system, with a unified flat charge per case, effectively changing the system from *ad valorem* to *specific* excise (circa early-mid 1980s). - PM and BAT were both concerned about possible government intentions to raise tax rates as a control measure, and Philip Morris lobbied on "the dangers of excessive taxation and how a rise in tax levels could run counter to their prime objective."	- BAT claimed its plan would "afford some protection to local manufacture; […] swell the government's tax revenue [and]… […] improve balance of payments through import substitution/local value added." - A BAT study warned that "significant and too frequent tax increases will encourage a resurgence of contraband on the one hand and discourage any outflow of goods from the market on the other." Tax reform, it was claimed, would "curb smuggling" - BAT argued against the specific system Philip Morris supported	(This review only notes mechanisms listed in relation to TI tax lobbying – more general mechanisms of TI influence/lobbying are also discussed in this thesis): - Lobbying of key officials, e.g. BAT set out to "[p] repare lobby plan for Faoud Seniora Minister of Finance (known to BATCo consultant)." - Says BAT plan for excise reform had support from IMF and implies BAT helped secure this support	- BAT appears to have been successful in influencing tax structure: "In May 1995, Macleod reported an unconfirmed report that the Lebanese Regie has finally come down on the side of an *ad valorem* structure and has submitted a recommendation to the Ministry of Finance" - But taxes were increased: "In April 1999, tobacco taxes substantially increased from 54% to 90% plus an additional 48% as local consumption tax (total 138%)." - However, the April 1999 tax increase was later revoked, following claims

Study	Methods	CA criteria met*	Key findings			
			Aim of TI	**Arguments used**	**Mechanisms employed**	**Success of TI**
Nakkash, (2007)** (contd)			- BAT wanted to avoid the specific structure being promoted by Philip Morris and instead secure the introduction of a tax structure which would render a similar return on both premium and low priced imports, as it believed this would be beneficial to its products over the longer term. - BAT also wanted to lobby against any restrictions on "imports through increases in import duties"	by implying it could exacerbate smuggling and reduce the government's revenue. - TI argued reducing taxes could help reduce smuggling		that the rise resulted in further smuggling and losses to the Treasury

* The following critical appraisal (CA) criteria were used to appraise all of the included studies (the numbers listed for each study in the CA column in Table 3.3, above, indicate the criteria for which that study met positively):

1. How clear is/are the research question(s) and/or aim(s)?
2. Was the methodology appropriate for addressing the stated aims of the study?
3. Where applicable, was the recruitment/search strategy appropriate and/or was an adequate sample obtained to support the claims being made (i.e. was the data collection adequate and appropriate)?
4. Were the methods of data analysis appropriate to the subject matter?
5. Is the description of the findings provided in enough detail and depth to allow interpretation of the meanings and context of what is being studied? [Are data presented to support interpretations, etc?]
6. Are the conclusions justified by the results?
7. If applicable, are the theoretical developments justified by the results?
8. Have the limitations of the study and their impact on the findings been considered?
9. Do researchers discuss whether or how the findings can be transferred to other contexts or consider other ways in which the research may be used?
10. If the answer to 9 is 'yes', do you agree these suggestions are appropriate, based on the research?

** indicates that studies also touch briefly on lobbying around tobacco excise rates

Table 3.4. Summary of the foci of North American studies to highlight potential overlap

North American policy development / tobacco industry tactic (categorised according to main focus of article)	References focusing on this development	Total
TI alliances with labour and minority groups in USA to counter tax increases (mostly earmarked)	(Yerger and Malone, 2002; Levenstein *et al.*, 2005; Balbach and Campbell, 2009; Balbach *et al.*, 2006; Campbell and Balbach, 2009; Raebeck *et al.*, 2009)	6
TI establishment and use of front groups to counter tax increases (mostly earmarked)	(Givel, 2007; Campbell and Balbach, 2008)	2
Various – US federal- and state-level lobbying to counter tax increases (some of which covered various specific policy developments in this table – many were earmarked)	(Givel and Glantz, 2001; Morley *et al.*, 2002; Alamar and Glantz, 2004; Givel, 2006; Lum *et al.*, 2009)	5
Proposition 99 in California (earmarked)	(Begay *et al.*, 1993; Traynor and Glantz, 1996; Balbach *et al.*, 2000)	3
Proposition 200 in Arizona (earmarked)	(Bialous and Glantz, 1999)	1
Measure 44 in Oregon (earmarked)	(Goldman and Glantz, 1999)	1
Question 1 in Massachusetts (earmarked)	(Koh, 1996; Heiser and Begay, 1997)	2
Failed initiative in Montana (earmarked)	(Moon *et al.*, 1993)	1
Tax increases in Canada in early 1990s	(Breton *et al.*, 2006; Kelton and Givel, 2008)	2
TI lobbying of excise structure for moist tobacco	(Delnevo *et al.*, 2007)	1
Total		***24***

Table 3.5. Geographic breakdown of studies

Geographic focus	No. of studies overall	No. of studies examining industry influence on excise rates	No. of studies examining industry influence on excise structures
USA	22	21	1
Canada	2	2	0
EU countries*	2*	2*	1 (Hungary)
Former Soviet Union	3	1	3
China	1	0	1
Lebanon	1	1	1
Total	***31***	***27***	***7***

*One covered Hungary which was not at that time an EU Member State; the other covered the United Kingdom and Sweden

Tobacco industry efforts to keep tobacco taxes low and prevent earmarking

Tobacco industry arguments to keep tobacco taxes low

The arguments employed by the industry to prevent tobacco excise increases or achieve reductions in current rates were relatively consistent and (in order of prominence with which they featured in the studies in this review) involved:

<u>Emphasizing the regressive nature of tobacco taxation</u>

The argument employed by the industry most often in the studies included in this review involved pointing out that tobacco excises are regressive and consequently claiming that higher taxes are unfair on poorer and more marginal groups in society (Koh, 1996; Traynor and Glantz, 1996; Heiser and Begay, 1997; Yerger and Malone, 2002; Levenstein *et al.*, 2005; Balbach *et al.*, 2006; Campbell and Balbach, 2008, 2009; Balbach and Campbell, 2009; Raebeck *et al.*, 2009). In some cases, the industry went as far as arguing that tobacco tax increases would contribute to class warfare, pitting upper-middle-class liberals (mostly white) against lower-middle-class working people (mostly minority) (Koh, 1996). By employing this argument, the tobacco industry was able to forge partnerships with non-traditional allies, such as labour groups (unions, etc.) and organizations representing minority ethnic groups in their campaigns against tobacco tax increases (see below). Although tobacco taxes represent a higher percentage of the income of poorer consumers (Chaloupka *et al.*, 2001; Cnossen, 2006) and because poorer groups tend to consume more tobacco products, the tax burden on these groups is higher (Chaloupka *et al.*, 2001; Cnossen, 2006), this argument ignores research which finds that tobacco tax increases tend to be progressive (Chaloupka *et al.*, 2001; Gruber & Koszegi, 2008). This is explained further in Chapter 7. When promoting this argument, one study (published as two articles) even reported that the industry had involved itself in a campaign calling for tax increases on large corporations rather than on consumer products such as tobacco (Balbach *et al.*, 2006; Balbach and Campbell, 2009). This is despite the fact that large tobacco companies have themselves been involved in efforts to avoid paying high rates of corporate tax (Knorr, 1985; Batuke, 1992; Burgess, 1993; O'Callaghan, 1998) and are members of organizations, such as the US Chamber of Commerce (Murray, 1989; Molinelli, 1999), that are actively pushing for lower corporate taxes (US Chamber of Commerce, 2011).

<u>Linking higher taxes to illicit trade and organized crime</u>

The second most-popular argument employed by the tobacco industry in this review involved claiming that tax increases lead to higher rates of illicit trade (Koh, 1996; Traynor and Glantz, 1996; Heiser and Begay, 1997; Joossens and Raw, 2003; Szilágyi and Chapman, 2003; Alamar and Glantz, 2004; Breton *et al.*, 2006; Gilmore *et al.*, 2007; Nakkash, 2007; Kelton and Givel, 2008). Such arguments were use in spite of extensive evidence that the industry has itself been involved in global smuggling operations (see Chapter 8) and specifically in promoting smuggling following tax increases, as explored further below (Kelton and Givel, 2008). Although the studies refer generically to the "industry", it should not of course be assumed that every tobacco company, major or minor, took part in the smuggling, or other activities that are the subject matter of these studies and the others referred to in this chapter.

In one study (Traynor and Glantz, 1996), the authors found that the industry used arguments about smuggling to claim that tobacco tax increases would therefore lead to broader crime-related problems, such as more money being spent on guns and drugs, with police attention being diverted away from other crimes to tackle tobacco smuggling. Working through a front group it had helped establish, Californians Against Unfair Tax Increases (CAUTI), the industry was able to secure endorsements for these arguments from the Californian Sheriffs' Association and the California Peace Officers' Association, which lent credibility to such claims (Traynor and Glantz, 1996). However, various factors eventually undermined this element of the industry's campaign, including an official report that concluded the effect of the increase on smuggling was likely to be negligible, and which criticized an advertising campaign that CAUTI had funded which highlighted this argument (the report led to police groups that had supported the industry position dropping their support) (Traynor and Glantz, 1996).

<u>Claiming tobacco taxes are unfair to smokers</u>

The industry also argued, quite simply, that high tobacco taxes were unfair to smokers (Koh, 1996; Breton *et al.*, 2006; Lum *et al.*, 2009) and, by claiming that smoking was a matter of individual (adult) choice, insisted it was unreasonable to burden smokers with excessive taxes (Givel, 2006, 2007). Such arguments ignore the fact that nicotine is addictive (Advisory Group of the Royal College of Physicians, 2000) and, therefore, that smoking is not a 'choice'. Indeed, research has repeatedly demonstrated that most smokers do not want to smoke (Robinson and Bugler, 2008; Gallup, 2010).

<u>Denying links between price and consumption</u>

One study in the USA found that the industry was denying the existence of credible evidence that increasing taxes on cigarettes reduces consumption (Campbell and Balbach, 2009). Another, in Canada, found that following tax decreases there was an increase in smoking rates among young people, but the industry argued that these were unrelated to the change in price (Breton *et al.*, 2006). Such arguments were made despite the overwhelming evidence on this issue (see Chapters 4 to 7) and the fact, as detailed earlier in this chapter, that the tobacco company internal documents show how the industry was fully aware of the relationship between price and consumption and was using such evidence to plan the nature and timing of price-related marketing campaigns (Chaloupka *et al.*, 2002).

Tobacco industry arguments to prevent earmarking

Where proposals to increase tobacco taxes included plans to earmark the taxes to pay for health programmes (particularly tobacco control initiatives and health care programmes), the industry also consistently argued that (again, arguments are listed in order of prominence in the studies included in this review):

The extra funds would be diverted/ misused

Many of the studies found the tobacco industry, and various groups it lobbied through, claimed that earmarked funds would be used in ways which the public did not support or which differed from those described in the original proposal (Moon *et al.*, 1993; Koh, 1996; Traynor and Glantz, 1996; Heiser and Begay, 1997; Bialous and Glantz, 1999; Goldman and Glantz, 1999; Lum *et al.*, 2009). In the context of the USA, where health care is largely private, the industry used proposals to use some of the earmarked funds for health care of poorer groups to emphasize this issue, framing these developments as a diversion of the funds to doctors, hospitals and health care companies rather than to the uninsured public (Bialous and Glantz, 1999; Traynor and Glantz, 1996). Such efforts were helped by the fact that health care/insurance organizations often did want to divert the funds towards healthcare costs and also worked (sometimes in collaboration with the tobacco industry) to try to achieve this (Begay *et al.*, 1993; Traynor & Glantz, 1996; Balbach *et al.*, 2000).

Arguing that policies requiring smokers to subsidise policies benefiting others are unfair

One study found the industry framed the use of earmarked funds from tobacco taxes to pay for healthcare-related costs as equating to a tax on smokers to pay for services for others, which it argued was unfair to smokers (Goldman and Glantz, 1999).

Claiming that earmarking would result in spending cuts for specific programmes

The same study found evidence of the industry arguing that earmarking would lead to cuts in spending on programmes that were currently funded by tobacco tax, even though this was not true (Goldman and Glantz, 1999).

Tobacco industry tactics to keep tobacco taxes low and prevent earmarking

The tactics/mechanisms employed by the tobacco industry campaigns to counter excise increases mirror industry activities on a range of other issues (see, for example, Feldman and Bayer, 2004; World Health Organization, 2009). These included (in order with which they feature in the studies included in this review):

Use of front groups

To obscure its own economic interests in promoting many of the arguments outlined above and thereby increase their credibility, the studies reveal that the industry frequently established "front groups"; see Figure 3.4 (Moon *et al.*, 1993; Koh, 1996; Traynor and Glantz, 1996; Heiser and Begay, 1997; Bialous and Glantz, 1999; Goldman and Glantz, 1999; Balbach *et al.*, 2000; Givel and Glantz, 2001; Levenstein *et al.*, 2005; Balbach *et al.*, 2006; Givel, 2006, 2007; Campbell and Balbach, 2008; Raebeck *et al.*, 2009).

Such groups were used both to promote arguments directly (Moon *et al.*, 1993; Koh, 1996; Traynor and Glantz, 1996; Heiser and Begay, 1997; Bialous and Glantz, 1999; Goldman and Glantz, 1999; Balbach *et al.*, 2000; Givel and Glantz, 2001; Levenstein *et al.*, 2005; Givel, 2006, 2007; Raebeck *et al.*, 2009) and to help recruit credible allies (Traynor and Glantz, 1996; Levenstein *et al.*, 2005; Balbach *et al.*, 2006; Campbell and Balbach, 2008; Balbach and Campbell, 2009), a tactic discussed in more detail in the following section.

Working with credible allies

In addition to creating front groups, the industry was able to ally itself with a wide range of pre-existing and credible public interest groups not normally associated with tobacco, thereby increasing the perceived credibility of key arguments (Begay *et*

Figure 3.4. Front groups identified in the studies

- Tobacco Institute's Labor Management Committee (made up of union groups associated with the tobacco industry) (Levenstein *et al.*, 2005; Balbach *et al.*, 2006; Balbach and Campbell, 2009; Campbell and Balbach, 2009; Raebeck *et al.*, 2009),
- Californians for Smoker's Rights (Balbach *et al.*, 2000),
- Enough is Enough (Bialous and Glantz, 1999),
- No More Taxes (Bialous and Glantz, 1999),
- Consumer Tax Alliance (Campbell and Balbach, 2008),
- National Smokers' Alliance (Givel and Glantz, 2001; Givel, 2006, 2007),
- The Fairness Matters to Oregonians Committee (Goldman and Glantz, 1999),
- The Committee Against Unfair Taxes (Koh, 1996; Heiser and Begay, 1997),
- Citizens Against More Tax and Bureaucracy (Moon *et al.*, 1993),
- Californians Against Unfair Tax Increases (Traynor and Glantz, 1996).

al., 1993; Moon *et al*., 1993; Traynor and Glantz, 1996; Balbach *et al*., 2000; Givel and Glantz, 2001; Yerger and Malone, 2002; Levenstein *et al*., 2005; Balbach *et al*., 2006; Breton *et al*., 2006; Givel, 2006; Campbell and Balbach, 2008, 2009; Lum *et al*., 2009; Raebeck *et al*., 2009). By emphasizing the regressive nature of tobacco taxes, the industry was able to entice various labour and minority ethnic groups (which it commonly approached via the Tobacco Institute's Labour Management Committee and an industry-created front group known as the Consumer Tax Alliance; see below) to argue against tobacco tax increases (Yerger and Malone, 2002; Levenstein *et al*., 2005; Balbach *et al*., 2006; Campbell and Balbach, 2008, 2009; Balbach and Campbell, 2009; Raebeck *et al*., 2009).

Groups that were successfully recruited to argue against tobacco tax increases included the Coalition of Labour Union Women (CLUW) (Balbach *et al*., 2006; Balbach and Campbell, 2009), Citizens for Tax Justice (Campbell and Balbach, 2009), Citizen Action (Campbell and Balbach, 2009), Women Involved in Farm Economics (Givel and Glantz, 2001), the National Taxpayers Conference (Givel and Glantz, 2001), the Congressional Black Caucus (Yerger and Malone, 2002) and the National Black Police Association (Yerger and Malone, 2002). The industry also used claims that tobacco tax increases would lead to increases in smuggling to ensure the support of business groups such as retailers' associations (Moon *et al*., 1993; Breton *et al*., 2006) and police groups (Traynor and Glantz, 1996; Breton *et al*., 2006). Finally, in seeking to divert earmarked funds away from tobacco control programmes (see below), the industry was able to ally itself with private healthcare organizations and groups representing medics and healthcare organizations in the USA (Begay *et al*., 1993; Balbach *et al*., 2000).

Traditional lobbying

Ten of the studies also reported evidence of the tobacco industry using more traditional lobbying techniques by targeting key decision-makers, both directly and indirectly (e.g. via consultants, campaign groups, business organizations, etc) (Begay *et al*., 1993; Traynor and Glantz, 1996; Bialous and Glantz, 1999; Balbach *et al*., 2000; Morley *et al*., 2002; Joossens and Raw, 2003; Levenstein *et al*., 2005; Balbach *et al*., 2006; Givel, 2006, 2007).

Media campaigns

Nine of the studies found evidence of the tobacco industry using mass media and other publicity campaigns to raise public awareness of policy proposals and create/increase public support for the industry positions (Koh, 1996; Traynor and Glantz, 1996; Heiser and Begay, 1997; Goldman and Glantz, 1999; Breton *et al*., 2006; Givel, 2007; Campbell and Balbach, 2008; Campbell and Balbach, 2009; Raebeck *et al*., 2009). One study reported that the most effective media campaign undertaken by industry groups involved an advert featuring an alleged undercover police officer discussing the crime implications of the proposed tobacco tax increases (more time would be spent on smuggled cigarettes, hence less time on other issues, and the increased criminal money from smuggling, etc. would be spent on drugs and guns) (Traynor and Glantz, 1996). However, it was eventually revealed that the "undercover policeman" had nothing more than a desk job in the police and was also a part-time actor (Traynor and Glantz, 1996).

Mounting legal and other official challenges

Seven studies reported industry efforts to mount legal or other official challenges to proposed and existing excise legislation (Koh, 1996; Traynor and Glantz, 1996; Heiser and Begay, 1997; Bialous and Glantz, 1999; Goldman and Glantz, 1999; Givel, 2007; Lum *et al*., 2009). For example, where earmarked tax increases were being pursued via a public ballot system (a method which gained popularity among public health communities in eligible American states from the late 1980s onwards, in light of an apparent reluctance by state legislators to pass such legislation), one study reported that the industry legally challenged the draft proposal on the basis that it violated the state constitution, filed subsequent legal challenges at later stages and also tried to use a signatures expert to disqualify signatures supporting the ballot proposal (Heiser and Begay, 1997). As a result of this latter tactic, several studies reported that the supporters of later policy proposals insured themselves against this by collecting substantially more signatures than the law required (Traynor and Glantz, 1996).

Commissioning supportive/ informative research

Six of the studies reported evidence of the industry commissioning studies to support and inform industry positions on tobacco excise debates (Moon *et al*., 1993; Yerger and Malone, 2002; Balbach *et al*., 2006; Breton *et al*., 2006; Lum *et al*., 2009; Raebeck *et al*., 2009). This included market-research to assess: (i) whether it was worth challenging a given proposal, and (ii) how best to challenge particular proposals. For example, one study found the industry was undertaking telephone research to assess the possible impact of various campaign themes (Moon *et al.*, 1993). A review of state-level efforts to achieve earmarked tobacco excise increases via public ballots in the USA found the industry had increasingly begun to undertake a significant amount of research before deciding whether to invest significantly in efforts to defeat the proposed legislation (Lum *et al.*, 2009). In addition, the industry paid for studies that supported some of the arguments outlined in the above section, such as a series of studies by labour groups and political caucuses, including CLUW, which highlighted the regressive nature of tobacco taxes (Yerger and Malone, 2002; Balbach *et al.*, 2006; Raebeck *et al.*, 2009). The Tobacco Institute also produced some economic studies to support its claims about taxes (Yerger and Malone, 2002).

Employing consultants and public relations staff/firms

Several studies demonstrate that, to gain advice on and assistance with lobbying, the tobacco industry has used a range of consultancy and public relations firms and other lobbyists (Begay *et al.*, 1993; Koh, 1996; Traynor and Glantz, 1996; Bialous and Glantz, 1999; Givel, 2006, 2007; Raebeck *et al.*, 2009).

Working to divert earmarked funds

Some of the studies found that where earmarked tobacco excise increases were being pursued, the tobacco industry had worked to divert funds away from tobacco control measures to other causes such as healthcare subsidies for uninsured groups (Begay *et al.*, 1993; Koh, 1996; Traynor and Glantz, 1996; Heiser and Begay, 1997; Bialous and Glantz, 1999; Goldman and Glantz, 1999; Balbach *et al.*, 2000). This approach not only helped the industry to limit state tobacco control activities that had potential to further reduce consumption, but also provided evidence to support the industry argument that the funds are likely to be used in ways other than those stated and/or which the public did not support (see above).

Paying or providing gifts to policy-makers

Several of the studies found evidence of the industry paying or giving gifts to officials and political parties or campaigns to help attract political support for the industry's positions on taxation (Begay *et al.*, 1993; Balbach *et al.*, 2000; Yerger and Malone, 2002; Givel, 2006). Key officials most likely to be able to influence decisions about tobacco taxation were targeted (Begay *et al.*, 1993; Balbach *et al.*, 2000), and funds were often provided via third parties, such as advertising agencies, so it was not obvious that they originated from the industry (Balbach *et al.*, 2000).

Confusing debates about tobacco tax increases with broader tax debates

Four studies reported industry efforts to frame debates about tobacco excise increases within broader debates about general tax increases to confuse the issue and to help garner opposition to proposals for tobacco tax increases (Moon *et al.*, 1993; Balbach *et al.*, 2006; Lum *et al.*, 2009; Raebeck *et al.*, 2009). This tactic was apparently supported by the industry's own market research (Lum *et al.*, 2009). In one of the few studies focusing on a policy proposal for a tax increase which the industry managed to defeat, the industry linked the proposed tobacco tax increase with proposals for property tax increases in rural areas that were happening simultaneously (Moon *et al.*, 1993).

Proposing alternative legislation

Four studies found evidence of industry efforts to promote alternative (weaker or irrelevant) proposals/public ballots to distract attention and energy from the original proposal (Koh, 1996; Traynor and Glantz, 1996; Heiser and Begay, 1997; Goldman and Glantz, 1999). One study (Goldman and Glantz, 1999) found that while signatures were being collected to qualify the proposal for a ballot the tobacco industry began contributing money to a different ballot measure campaign in order "to disrupt the signature-gathering process", for the Oregon-based proposal (known as Measure 44), and "to divert the energy and financial resources of the health insurers". Likewise, a study of a similar proposal in California reported that an industry-funded group circulated its own petition at the same time as signatures were being gathered in support of the earmarked tax proposal as a way of reducing the pool of available paid signature-gatherers (by paying them more) and confusing voters about the official proposal (Traynor and Glantz, 1996). Two other studies of similar state-level policy proposals found the industry put forward compromise proposals that involved smaller tax increases and fewer funds being allocated to tobacco control programmes (Koh, 1996; Heiser and Begay, 1997).

Using friendly "experts"

Three studies found evidence of the industry using friendly experts to present industry positions and bolster the credibility of industry arguments (Traynor and Glantz, 1996; Goldman and Glantz, 1999; Alamar and Glantz, 2004). Examples included Wall Street analysts who had been directly briefed by the tobacco industry before presenting their opinions to officials but who did not disclose this (Alamar and Glantz, 2004), a high-profile dentist (Goldman and Glantz, 1999) and an alleged undercover police officer (who was later found to be a desk officer and part-time actor, as described above) (Traynor and Glantz, 1996).

Trying to undermine tobacco control experts

One study reported that the tobacco industry had wrongly targeted and tried to undermine the credibility of a key tobacco control academic (Givel, 2007). This involved alleging (but not proving) that University of California–San Francisco Professor of Medicine Stanton Glantz had misused grant funds for illegal political purposes and lobbying.

Stimulating smuggling in the event of tax increases

One of the two studies of tobacco excise increases in Canada in the early 1990s, which were later revoked, claims that the industry itself helped promote smuggling (via Native American reservations, which are not subject to the same taxation laws) during the period in which the tax increases were in place (Kelton and Givel, 2008). The authors claim the industry did this both because it enabled them to maintain or increase profit margins despite the tax-related price increases and because it provided support for the industry's claim that the tax increases led to a rise in illicit trade (Kelton and Givel, 2008). This approach appears to have been relatively successful, with the Canadian government responding "to the influx of smuggled tobacco that culminated after the tax increases by, in 1994, returning taxes to their original level" (Kelton and Givel, 2008). The study goes on to note that although the intention of the tax reduction was to alleviate the growing illicit trade in tobacco products, it did not succeed because 'the illegal activity was more than just a result of high taxation' (Kelton and Givel, 2008).

The success of tobacco industry efforts to keep tobacco taxes low and prevent earmarking

In the USA, the industry has had some success in preventing proposed earmarked excise increases (Moon *et al.*, 1993; Lum *et al.*, 2009), although many such proposals did pass (Begay *et al.*, 1993; Koh, 1996; Traynor and Glantz, 1996; Heiser and Begay, 1997; Bialous and Glantz, 1999; Goldman and Glantz, 1999; Balbach *et al.*, 2000; Lum *et al.*, 2009). Key contextual factors that appear to have assisted passage and implementation of earmarked tobacco tax increases include: (i) coherent and adequately funded campaigns by coalitions favouring the tobacco tax increase (in many of the studies included here, these campaigns were partially funded by voluntary health groups, such as the American Cancer Society, and healthcare organizations); and (ii) budgetary deficits, which worked to increase legislative support for proposals.

Overall, the studies included in this review suggest that the industry has been more successful in diverting earmarked funds away from tobacco control activities, usually at the implementation stage, than it has in completely preventing excise increases (Begay *et al.*, 1993; Koh, 1996; Traynor and Glantz, 1996; Heiser and Begay, 1997; Balbach *et al.*, 2000; Lum *et al.*, 2009). The industry's success in doing this in turn provides support for one of the industry's most frequently used arguments used to counter future proposals for earmarked tax increases, namely that revenue from earmarked taxes will be diverted or misused. Indeed, part of the reason this argument has been so effective is that there is a great deal of evidence to support this claim; in several of the US states that introduced earmarked tax increases, the revenue was used for purposes other than those described in the original proposal. In some cases, the industry was found to have played a key role in helping to ensure funds were diverted, which helped the industry from the point of view of limiting spending on tobacco control activities and providing evidence to shore up this argument in future debates. However, the industry alone cannot be blamed for the success of this argument; all of the studies that highlighted this issue found that a range of other actors, notably healthcare providers, worked to divert funds away from tobacco control programmes. As Bialous and Glantz (1999) point out, this highlights the importance of focusing on the longer-term implementation of tobacco control policies as well as on their development and official acceptance into law.

However, when assessing the success of the tobacco industry in preventing the numerous state-level proposals for earmarked tax increases that emerged in the USA from the late 1980s onwards, it should be noted that there appears to have been a research and publication bias towards proposals that succeeded. Hence, this review includes seven studies of successful proposals (three studies of Proposition 99 in California, two of Question 1 in Massachusetts, and one each of Proposition 200 in Arizona and Measure 44 in Oregon) and only one of a similar initiative in Montana which was unsuccessful. This is a ratio of seven studies of four successful proposals compared to only one study of one unsuccessful proposal. Yet, Lum and colleagues (2009) report that between 1988 and 2008 the industry attempted to defeat 14 out of 22 state-level earmarked tax proposals and was successful in 8 cases, giving a 57% success rate (8 out of 14 attempts) where it attempted to challenge and a 36% rate at blocking state-level proposals for tobacco tax increases overall (8 out of 22 proposals).

In terms of assessing which arguments and tactics were most successful in defeating these state-level tax increases, Lum and colleagues (2009) claim that the amount of resources invested in lobbying by the industry was a poor indicator of success. Instead, the authors argue that industry success was associated with the extent to which it was guided by market research (the authors report that after 1998, the industry made increasing use of voter segmentation models and market research to decide whether state-level excise proposals were worth challenging; once the industry took this approach, its success rate increased). The same study suggests that the industry fared better when it combined arguments concerning the diversion of funds to health care providers with arguments relating to the unfairness of the proposals on smokers, pointing out that "when either of the two arguments was used alone, the tobacco industry lost three out of four elections, but when they were combined, they won three out of four elections" (Lum *et al.*, 2009).

In contrast to the studies concerning USA state-level efforts to increase and earmark tobacco taxes, most of the studies on industry efforts to prevent national/federal level tax increases, or to secure tax decreases at this level, found the industry was successful. Studies report the industry was successful in defeating both the McCain Bill (Alamar and Glantz, 2004) and the Clinton administration's healthcare proposals in the USA (Campbell and Balbach, 2009), although the tobacco industry was clearly not the only interested party involved in the defeat of these bills. The industry was also found to have helped reduce the levels of federal tobacco tax increases implemented in 1990 and 1993 (Campbell and Balbach, 2008). Studies also report the industry was successful in achieving tax decreases in Canada (Joossens & Raw, 2003; Breton *et al.*, 2006; Kelton and Givel, 2008), Sweden (Joossens and Raw, 2003), Lebanon (Nakkash, 2007) and some former Soviet Union countries (Gilmore *et al.*, 2007). In all of these successful lobbying efforts, the studies report that a key argument employed by the industry involved claiming that tax increases would fuel or were already fuelling illicit trade. This argument was also identified by one of the USA state-level studies as being particularly effective (Traynor and Glantz, 1996).

However, the illicit trade argument was also used in the only example of a study reporting that the industry did not succeed in preventing/limiting tax increases at the national level. This study involved industry lobbying in Hungary in the 1990s (Szilágyi and Chapman, 2003); in this example, Philip Morris' efforts to prevent an excise increase appear to have failed because of the "divided position of the industry" (Szilágyi and Chapman, 2003). This is an interesting factor that the other studies in this section of the review reveal almost nothing about, because very few comment on the extent to which different tobacco companies worked together to influence policy. This company differentiation, however, features somewhat more in the studies exploring industry efforts to influence tobacco excise structures (see following section).

The remaining studies concerning tobacco industry efforts to prevent/undermine tobacco excise increases all focus on assessing how the industry worked to persuade credible interest groups to support the industry position on tobacco taxes (Yerger and Malone, 2002; Levenstein *et al.*, 2005; Balbach *et al.*, 2006; Campbell and Balbach, 2008, 2009; Balbach and Campbell, 2009; Raebeck *et al.*, 2009). These studies, which all focus on the USA, report that the industry was generally successful in recruiting credible, existing public interest groups with an interest in the issue between the 1980s and early 2000s. In most cases, these groups already had at least some commitment to lobbying against regressive taxation, although most were not actively lobbying on tobacco tax issues before being encouraged to do so by tobacco industry groups. Recruiting the support of such organizations was achieved by taking three main approaches: (1) emphasizing arguments concerning the regressive nature of tobacco taxes, to demonstrate why this was an issue of interest to labour and civil rights organizations; (2) approaching the groups indirectly via a union organization that, despite having been established and funded by the Tobacco Institute, was not obviously a tobacco industry organization; and (3) offering to support targeted groups in a range of ways, including on issues that the industry had no interest in, to develop the relationship. All of the studies suggest the industry's success in recruiting these kinds of groups in the USA is likely to have aided efforts to prevent tax increases because it provided far greater credibility to arguments concerning the unfair and regressive nature of tobacco excise taxes. This allowed the industry to claim that one of its key arguments was widely supported, and it also facilitated the lobbying of officials and politicians who would not normally be expected to side with the industry (e.g. liberal Democrats).

Studies concerned with tobacco industry efforts to influence tobacco excise structures

From the limited available evidence concerning tobacco industry efforts to influence tobacco excise structures, we know that different companies favour different structures in different contexts. From the studies included in this review, it appears Philip Morris (which produces the high-end Marlboro cigarettes) tends to favour specific taxes (Szilágyi and Chapman, 2003; Nakkash, 2007), whereas British American Tobacco (which, historically at least, had a far more diverse brand portfolio including mid-price and cheaper, local brands) tends to support mixed excise structures, incorporating an *ad valorem* element (Szilágyi and Chapman, 2003; Nakkash, 2007; Gilmore *et al.*, 2007). One reason BAT may prefer a mixed structure is because of the competitive advantage it confers over Philip Morris (Gilmore *et al.*, 2007; Nakkash, 2007).

Other attempts to influence excise structures in ways which would give one company an advantage over others included promoting the use of tax stamps (Gilmore *et al.*, 2005; Gilmore *et al.*, 2007) and lobbying for high import duties (Gilmore *et al.*, 2007) to protect a dominant market position. In contrast, when BAT and Philip Morris had not yet achieved a significant market share in a country, they both lobbied for lower import duties/fewer restrictions (O'Sullivan and Chapman, 2000; Szilágyi and Chapman, 2003; Nakkash, 2007).

As far as it is possible to discern any patterns from this limited data, arguments that different tobacco companies use to promote their preferred structures seem to focus on claims that their particular approach will increase government revenue (Gilmore and McKee, 2004b; Delnevo *et al.*, 2007; Gilmore *et al.*, 2007; Nakkash, 2007) and reduce illicit trade (Gilmore and McKee, 2004b; Gilmore *et al.*, 2007; Nakkash, 2007). The lobbying on this issue that was revealed by these studies tended to be behind-the-scenes, mainly involving direct lobbying of relevant officials, although this was sometimes directed via third parties such as consultants (Gilmore and McKee, 2004b; Gilmore *et al.*, 2007). Two studies suggest particular companies may have also actively sought support for their preferred excise structures from international financial organizations such as the IMF (Nakkash, 2007) and American trade organizations (O'Sullivan and Chapman, 2000). In former Soviet Union countries, BAT appears to have been able to create a symbiotic relationship between itself and finance ministries, in which finance ministers perceived the company as a source of expert advice on excise issues (Gilmore and McKee, 2004b; Gilmore *et al.*, 2007). This is likely to have been made far easier by the fact that officials in former Soviet Union countries were, at that time, unused to regulating and dealing with free-market corporations and had little if any experience of dealing with tobacco excise, which had previously been dealt with centrally (Gilmore and McKee 2004b.; Gilmore *et al.*, 2007). In this context, officials are therefore likely to have been far more open to tobacco company arguments than might otherwise have been the case.

It is unclear to what extent the approaches taken to lobbying on this issue were informed by the fact that most of the countries involved were at that time undergoing a process of political and economic transition and/ or were undemocratic (O'Sullivan and Chapman, 2000; Szilágyi and Chapman, 2003; Gilmore and McKee, 2004b; Gilmore *et al.*, 2007; Nakkash, 2007). More research is required to better understand what different parts of the tobacco industry aim to achieve in relation to tobacco excise structures and how they lobby on this issue beyond the countries that have been studied.

Discussion and conclusions

This systematic review suggests that the different parts of the tobacco industry tend uniformly to lobby against significant tobacco excise increases and, in particular, against tobacco excise increases that are to be earmarked for tobacco control activities. In challenging such proposals, the arguments employed most often and most successfully by the industry involve claims that tax increases are socially regressive, and that they increase illicit tobacco trade and therefore contribute to broader crime problems. Yet these and the other most frequently used arguments (e.g. that tobacco taxes are unfair on smokers and that tax rises do not lead to reductions in consumption) all have flaws, as outlined above and explained further in other chapters. The most effective argument used against earmarked tax increases has been to claim that the revenue from earmarked taxes will be diverted or misused, and because this has occurred, in part as a result of tobacco industry efforts, such arguments carry weight.

Favoured industry tactics to influence policy decisions about tobacco excise increases include traditional lobbying of relevant officials (direct and indirect), allying with credible political groups that have (or can be persuaded to have) a shared interest in tobacco taxes (particularly on the basis of the perceived regressive nature of tobacco tax increases), and establishing industry "front groups" to lobby against tobacco tax increases.

From the limited available evidence concerning tobacco industry efforts to influence tobacco excise structures (seven papers in seven different countries/regions), we observe that different companies favour different tax structures, with Philip Morris tending to prefer 100% specific structures and BAT tending to prefer mixed structures (predominantly specific but also including a substantial *ad valorem* element). As far as it is possible to discern any patterns from this limited data, tobacco companies appear to promote their preferred structure by claiming that it will increase government revenue and reduce illicit trade.

As highlighted earlier, there is a significant geographical bias in the studies that met the inclusion criteria for this review, with far more evidence being available in relation to North America than anywhere else. Given that North America is one of the world's most economically developed and wealthiest regions, and that tobacco excise rates are lower there than in other high-income countries (World Health Organization, 2010), it should not be assumed that the industry has (or will) necessarily take the same approaches elsewhere. It is clear, therefore, that further research on tax-related lobbying is needed in other geographical areas and in particular to better understand what different parts of the tobacco industry aim to achieve in relation to tobacco excise structures.

One argument that anecdotal evidence reports the industry employing to counter tax increases (Chaloupka *et al.*, 2001; Kyriss *et al.* 2008) but which was not highlighted in the included studies is that higher tax rates will lead to a decline in consumption and thereby contribute to job losses in the tobacco sector, reducing the industry's contribution to the economy. It is possible that this argument was used by the industry in some of the policy developments covered by this review but did not feature in the studies. Alternatively, it may not have been employed either because: (i) it undermined another argument which was used, that tax increases would not reduce consumption; or (ii) the industry deemed it less persuasive in the context of growing evidence that in all but the most tobacco dependent economies, the tobacco industry does not make a net positive economic contribution (Jha and Chaloupka, 1999; Gruber & Koszegi, 2008) (for further discussion see Chapter 9).

Most of the tactics the industry used in its efforts both to counter (planned and actual) tobacco tax increases and to try to influence tax structures mirror those reported by studies of tobacco industry efforts to influence policy more generally. For example, the industry's use of front groups (Apollonio and Bero, 2007; Smith *et al.*, 2010) and third-party allies (Ong and Glantz, 2001; Neuman *et al.*, 2002; Smith *et al.*, 2010) have both been widely reported, as have more traditional lobbying approaches focusing on targeting officials (Barnoya and Glantz, 2002), mass media campaigns (Axeland *et al.*, 1994), legal challenges (Neuman *et al.*, 2002), the commissioning and use of supportive research (Barnes and Bero, 1996; Grüning *et al.*, 2006), the use of professional consultants and public relations services (Ong and Glantz, 2001, Smith *et al.*, 2010), paying or providing gifts to policy-makers (Saloojee and Dagli, 2000), proposing alternative (weaker) legislation (Neuman *et al.*, 2002), and using friendly "experts" (Grüning *et al.*, 2006).

There was also no evidence of tobacco industry support for incremental tax increases (other than in relation to support for alternative, weaker proposals than those on offer). However, as studies of tobacco company pricing strategies suggest that tobacco companies may use tax increases as opportunities to increase their own profit margins (Van Walbeek, 2000), it should not be assumed that the industry will always lobby against tax increases, only that it is likely to do so where such increases are significant and/or earmarked.

Policies to limit industry price manipulation

Article 6 of the WHO Framework Convention on Tobacco Control (FCTC) calls on Parties to adopt and maintain tax and price policies that will contribute to the health objectives. To achieve this, this chapter illustrates that governments need to understand and address industry pricing and price-related marketing strategies. The example of the USA indicates that collecting data (ideally monthly to track industry responses to policy interventions) on industry marketing expenditure by category (thus including price-based promotions) would be a useful first step and one that would be in line with

Article 5.3 of the FCTC (see Figure 3.5). Furthermore, governments also require detailed brand or price-category specific data on tobacco pricing to determine effective policies, and such data should be made available to researchers to identify the empirical research deficit identified in this chapter.

Beyond data collection and research, the chapter illustrates the need to develop and implement effective strategies to prevent price-related marketing and industry pricing schemes from undermining tax and other tobacco control efforts. Potential actions fall into two broad categories: (1) bans or restrictions on price-related promotions and (2) regulation of tobacco prices including the setting of minimum retail prices on tobacco products. This section reviews the (very limited) available literature exploring each of these policy approaches. Then in light of the evidence presented above on industry efforts to influence and undermine taxation policies, it turns to explore interventions to reduce industry influence on policy in the form of Article 5.3 of the WHO Framework Convention on Tobacco Control.

Figure 3.5. Extract from the Guidelines for implementation of Article 5.3, WHO-FCTC

> "Parties should require the tobacco industry and those working to further its interests to periodically submit information on tobacco production, manufacture, market share, market expenditure and any other activity, including lobbying, philanthropy, political contributions and all other activities not prohibited or not yet prohibited under Article 13 of the convention" (Recommendation 5.2). "Parties should require rules for the disclosure or registration of the tobacco industry activities, affiliated organizations and individual acting on their behalf including lobbyists" (Recommendation 5.3).

Restrict or ban price-related promotional activities

Comprehensive bans on price-related and price-reducing promotions and retailer incentive schemes would, if enforced, inevitably help prevent these forms industry promotion. The evidence presented in this chapter would suggest, in line with broader evidence that the industry simply shifts its marketing expenditure from one area to another when faced with marketing restrictions (Saffer, 2000), that such schemes would need to cover every type of price-related promotion—price-reducing promotions (e.g. voucher schemes), price-based promotions (e.g. price-marked packaging) and retailer incentive schemes.

In this respect it is worth noting that while bans on all in-store promotions, including placing cigarettes below the counter, would limit the opportunity for price-based promotions to be communicated to the consumer (and thus likely limit the effectiveness of retailer incentive schemes), as long as packaging remains unregulated, prices could be communicated to consumers in this way as recently documented (Moodie & Hastings, 2009). In other words, preventing all price-based marketing would require bans on point-of-sale marketing and standardised packaging in line with Article 13 of the WHO FCTC guidelines.

Although, as outlined in section (b), a large number of countries have now implemented some form of control on price-related marketing we only found one (US-based) study that specifically evaluated the impact of restrictions on price-based marketing, and this was limited enough in its focus and design to preclude inclusion (Feighery *et al.*, 2009). It is important to note, however, that there is good evidence for the effectiveness of comprehensive marketing restrictions on reducing consumption (Blecher, 2008).

Price regulation and minimum pricing

The broader economic literature details two reasons for using minimum prices: to facilitate collusion (price fixing) between firms by preventing price wars and to help maintain profit margins thus providing sufficient funds for marketing. In line with this, most minimum pricing rules on tobacco have been implemented to protect businesses rather than health. Yet minimum prices may also be used for public health purposes—to prevent low-cost selling from existing firms and to prevent new firms coming into the market with lower-priced offers—and several countries have now implemented such rules for this purpose. Yet, as we explore below using a recent example from the EU, such rules may find themselves in contravention of trade treaty rules (including the EU Treaty) on non-discrimination (see also Chapter 2).

Minimum pricing rules on tobacco now exist in a variety of jurisdictions. These include half of US states (where they originated between the 1940s and 1960s and were meant to protect businesses and not public health) (Michael, 2000), a small number of EU Member States[1] (where the rationale again was largely to protect retailers), and Malaysia where they were implemented in January 2010 (for

[1] However, following a recent ECJ ruling, these minimum pricing rules are now or have already been ended

public health purposes, to reduce cigarette purchases by children and low-income smokers) along with prohibition of words that mean discount or cheap sale. The US minimum pricing rules are limited, however, as most allow cigarette company promotional incentives offered to retailers, such as buy-downs and Retail Leaders Programs, to be added into the formula that sets the minimum price.

To evaluate the effect of minimum pricing on tobacco control, two questions must be answered: (i) do minimum price laws raise cigarette prices and prevent cut-price offers and (ii) are they effective in the presence of promotional incentives? The first question looks at the effectiveness of minimum pricing in general, but we found no studies addressing this topic. The second examines effectiveness when minimum price laws allow promotional incentives to be deducted from formulas for establishing the minimum cigarette price (as is the case in most US states). The only study on this topic (Feighery *et al.*, 2005) suggests that when such incentives are included, minimum pricing is not effective; net cigarette prices did not differ between stores in eight states with minimum price laws and seven states without, a finding likely explained by the fact that nearly all the minimum price laws in the study allowed promotional incentives. Separate comparisons with New York, the one state which did not allow these incentives, showed that cigarette prices were significantly higher in New York than in the 24 other states, although the number of New York stores participating in the study was small, and the study did not control for differences in cost of living across states.

In the USA advocates of minimum prices argue that minimum prices are based on percentage mark ups on wholesale prices (in the EU, most minimum prices are a percentage (e.g. 95%) of the weighted average price) and, therefore minimum prices will rise as the manufacturer's price rise over time (thereby, keeping up with inflation). In contrast, excise taxes, when wholly specific (e.g. cigarette excises in the USA) lose their value as inflation occurs. However, this is not a problem when specific taxes are inflation-adjusted on a regular basis or when *ad valorem* taxes are imposed in addition (as is required in the EU). Opponents of minimum pricing argue that excise taxes generate government revenues while prices raised through minimum price laws benefit the wholesaler and/or the retailer. That is, minimum prices benefit tobacco sellers rather than governments and publicly-funded programmes. This is an issue that deserves more attention, as minimum pricing policies may leave the industry with more money to invest in marketing research and innovative ways to attract more customers.

In the EU Member States that implemented minimum prices on cigarettes (Austria, France, Italy, Belgium and Ireland), their implementation had been advocated by the Ministries of Finance (because of their high *ad valorem* excise duties which create greater price ranges) as well as by the manufacturers of premium brands (e.g. PMI). Moreover, the retail sector supported the measures as their margin is, in most Member States, a fixed percentage of the maximum retail price determined by the manufacturer or importer. Only in Ireland were minimum prices an initiative of the Ministry of Health to prevent the industry offering price-discounts (F. Van Driessche, personal communication).

Where an EU Member State chooses to introduce minimum prices, it must comply with its obligations under the EU Treaties, more particularly with the rules on the free movement of goods (Articles 34 and 36 of the Treaty on the Functioning of the European Union), the rules on competition (Articles 101 TFEU in conjunction with Article 4, paragraph 3 of the Treaty of the European Union) and relevant case-law of the Courts of the European Union. However, national rules fixing retail prices may be justified on grounds of, *inter alia*, protection of human health, provided that they do not constitute means of arbitrary discrimination or a disguised restriction on trade between Member States (Article 36 TFEU) and that they are proportionate to the aim pursued. Proportionality requires a measure to be necessary to achieve the objective, and that the objective cannot be achieved by any less trade-restrictive means, for example, whether the same public health aim could not be equally ensured by increasing excise duties. The EU directive that covers the structure of tobacco taxation (95/59/EC) also stipulates that manufacturers or importers of tobacco "shall be free to determine the maximum retail selling price" for their products.

It is perhaps unsurprising therefore that the European Court of Justice found that the setting of a minimum retail selling price for tobacco in Austria, France and Ireland was illegal under the EU Treaties[2] as it limited the freedom of producers and importers to determine their maximum retail selling prices, distorted competition and simply benefited cigarette

[2] Judgment of the Court (Third Chamber), 4 March, 2010, in cases C-197/08 Commission v France, C-198/08 Commission v Austria and C- 221/08 Commission v Ireland.

manufacturers by safeguarding their profit margins. However, the Court stated that the Member States could prohibit the sale of manufactured tobacco products at a price below the sum of the cost price and all taxes (i.e. they could prevent producers or importers from selling them at a loss by absorbing, even temporarily, the impact of taxes on the retail selling price of manufactured tobacco products). Belgium has removed its minimum pricing rule and a further case is pending against Italy.

The above-mentioned cases were based on the application of Article 9 of EU Directive 95/59/EC which relates to the price determined by the manufacturer or the importer. In other judgments (on minimum prices for alcohol), the court has ruled that national rules fixing retail prices could constitute measures having an equivalent effect to quantitative restrictions on imports (Article 34). This would be the case if imported products were placed at a disadvantage in relation to domestic products, for example, because competitive advantage conferred by lower cost prices were eliminated. However this implies that minimum prices are not per definition against the Treaty.

A key concern the European Commission had with minimum pricing was that it distorted competition and benefitted tobacco manufacturers by further increasing their profits. Yet other forms of price-regulation are allowed under the EU treaty and widely used, for example, in the utilities sector. A proposal for price regulation in the tobacco sector (Gilmore *et al.*, 2010) has recently been made that would be compatible with EU treaty rules and would, in theory at least, address many of the key problems outlined in this chapter. An alternative might be a windfall tax on profits with a provision to prevent this being passed onto consumers. A surcharge on tobacco industry profits was implemented in Canada in 1994 to recoup losses from industry involvement in smuggling. Although this surcharge was passed onto customers, its implementation illustrates that such interventions are feasible. The problems with industry pricing outlined in this chapter suggest that such proposals should be given serious consideration.

Preventing industry lobbying

In light of overwhelming evidence of the tobacco industry's efforts to undermine public policy, the parties to the WHO Framework Convention on Tobacco Control agreed upon Article 5.3, which requires that "in setting and implementing their public health policies with respect to tobacco control, Parties shall act to protect those policies from commercial and other vested interests of the tobacco industry in accordance with national law." If properly implemented, Article 5.3 has the potential to reduce industry influence on policy and thus to prevent the inappropriate influence on excise policy documented above. However, implementation and enforcement will be difficult and require considerable political will. The industry has already been using complex arguments to justify its inclusion in the policy process (Smith *et al.*, 2009) and it is particularly likely to do so in relation to taxation policy on the basis that can be considered primarily an economic rather than health policy. It is therefore also essential that policymakers and the public are made aware of the flawed nature of the arguments the tobacco industry uses against excise policies (as outlined in this chapter). Finally, ensuring that earmarked taxes, once passed, are properly implemented (i.e. that money is not diverted from the proposed policy areas) will eliminate one argument from the industry's armament.

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Appendix

Literature Search strategy and results (searches undertaken between October 2009 and March 2010)

Electronic databases
Academic Search Premier, ECLAS (European Commission Library Catalogue), ESRC Society Today, Intute, Web of Knowledge, Ovid (Embase, Econlit, Social Policy & Practice), Index to Theses, IBSS, Business Source Premier, European Sources Online, JSTOR, National Library for Health, Periodicals Archive Online

Websites
GLOBALink, http://www.escholarship.org/uc/ctcre_tcpmus,
http://escholarship.org/uc/ctcre_tcpmi

Search Strategies
Academic Search Premier
Searched for: '(tobacco OR cigar* OR snus OR «Philip Morris» OR JTI OR «R.J. Reynolds» OR Gallaher) AND (taxation OR tax OR excise OR price OR pricing) AND (polic* OR intervention OR lobb* OR influence)' in 'Title, abstract or keywords'.

Results: 407 references

ECLAS (European Commission Library Catalogue)
Searched for: '(tobacco OR cigar* OR snus OR «Philip Morris» OR JTI OR «R.J. Reynolds» OR Gallaher) AND (taxation OR tax OR excise OR price OR pricing) AND (polic* OR intervention OR lobb* OR influence)' in 'All Fields'

Results: 36 references

ESRC Society Today
Searched for: '(tobacco OR cigar* OR snus OR «Philip Morris» OR JTI OR «R.J. Reynolds» OR Gallaher) AND (taxation OR tax OR excise OR price OR pricing) AND (polic* OR intervention OR lobb* OR influence)' in 'ESRC Awards & Outputs'

Results: 16 references

Intute
Searched for: '(tobacco OR cigar* OR snus OR «Philip Morris» OR JTI OR «R.J. Reynolds» OR Gallaher) AND (taxation OR tax OR excise OR price OR pricing) AND (polic* OR intervention OR lobb* OR influence)' in 'All Fields'

Results: 3 references

Web of Knowledge
Searched on Medline and BIOSIS for: '(tobacco OR cigar* OR snus OR «Philip Morris» OR JTI OR «R.J. Reynolds» OR Gallaher) AND (taxation OR tax OR excise OR price OR pricing) AND (polic* OR intervention OR lobb* OR influence)' in 'Title' or 'Topic'

Results: 480 references

Searched in all other Web of Knowledge databases for: '(tobacco OR cigar* OR snus OR «Philip Morris» OR JTI OR «R.J. Reynolds» OR Gallaher) AND (taxation OR tax OR excise OR price OR pricing) AND (polic* OR intervention OR lobb* OR influence)' in 'Title' or 'Topic'

Results: 563 references

Ovid (Embase, Econlit, Social Policy & Practice)
Searched for: '(tobacco OR cigar* OR snus OR «Philip Morris» OR JTI OR «R.J. Reynolds» OR Gallaher) in 'Abstract' AND '(taxation OR tax OR excise OR price OR pricing)' in Abstract AND '(polic* OR intervention OR lobb* OR influence)' in Abstract

Searched for: '(tobacco OR cigar* OR snus OR «Philip Morris» OR JTI OR «R.J. Reynolds» OR Gallaher)' in Title AND '(taxation OR tax OR excise OR price OR pricing)' in Title AND '(polic* OR intervention OR lobb* OR influence)' in Title

Results: 420

Index to Theses
Searched for: '(tobacco OR cigar* OR snus OR «Philip Morris» OR JTI OR «R.J. Reynolds» OR Gallaher) AND (taxation OR tax OR excise OR price OR pricing) AND (polic* OR intervention OR lobb* OR influence)' in 'All Fields'

Results: 21

IBSS
Searched for: '(tobacco OR cigar* OR snus OR «Philip Morris» OR JTI OR «R.J. Reynolds» OR Gallaher) AND (taxation OR tax OR excise OR price OR pricing) AND (polic* OR intervention OR lobb* OR influence)' in 'All Fields'

Results: 172

Business Source Premier
Searched for: '(tobacco OR cigar* OR snus OR «Philip Morris» OR JTI OR «R.J. Reynolds» OR Gallaher) AND (taxation OR tax OR excise OR price OR pricing) AND (polic* OR intervention OR lobb* OR influence)' in Title, Abstract & Keywords

Results: 398

European Sources Online
Searched for 'tobacco tax' and 'tobacco excise' in 'keywords' and in 'title'

Results: 9

JSTOR
(tobacco OR cigar* OR snus OR «Philip Morris» OR JTI OR «R.J. Reynolds» OR Gallaher) AND (taxation OR tax OR excise OR price OR pricing) AND (polic* OR intervention OR lobb* OR influence) in Abstract & Title

Results: 89

National Library for Health
Searched for: '(tobacco OR cigar* OR snus OR «Philip Morris» OR JTI OR «R.J. Reynolds» OR Gallaher) AND (taxation OR tax OR excise OR price OR pricing) AND (polic* OR intervention OR lobb* OR influence)' in Evidence Based Reviews, Specialist Collections and Books and Journals

Results: 15

Periodicals Archive Online
Searched for: '(tobacco OR cigar* OR snus OR «Philip Morris» OR JTI OR «R.J. Reynolds» OR Gallaher) AND (taxation OR tax OR excise OR price OR pricing) AND (polic* OR intervention OR lobb* OR influence)' in Article, Title & Keyword(s)

Results: 9

Chapter 4
Tax, price and aggregate demand for tobacco products

Introduction

Ever since the detrimental health impact of tobacco smoking was scientifically established in the 1950s and 1960s, the medical and public health community has called for interventions aimed at reducing smoking. This call was particularly strong in the United States, the United Kingdom, Canada, Australia and New Zealand, and these countries have implemented strong and effective tobacco control strategies. In the 1960s and 1970s, tobacco control strategy was driven primarily by the dissemination of information. In the 1980s and especially the 1990s the strategy became far more comprehensive, incorporating restrictions on public smoking, restrictions on advertising, legal challenges to the industry, and focused tax increases. Most other developed countries have subsequently implemented similar strategies, with the result that per-capita tobacco consumption in the developed world has been decreasing since the early 1980s (Gajalakshmi *et al.*, 2000). Tobacco use in low- and middle-income countries has lagged tobacco use in high-income countries, although there has been a strong increase in tobacco use in the past half century. As a result, low- and middle-income countries have lagged developed countries in tobacco control, but since the early 1990s several developing countries, among them Bangladesh, Brazil, India, Poland, South Africa and Thailand, have implemented effective tobacco control strategies (De Beyer and Waverley Brigden, 2003).

Of the tobacco control interventions that are available, some (e.g. health warnings, restrictions on tar and nicotine content) have limited economic content, and as such, economists have little to say about these interventions. Other interventions (e.g. restrictions on smoking in hospitality establishments, advertising bans and restrictions of sales to minors) have definite economic consequences (for example, the alleged loss of revenue suffered by the hospitality industry after the imposition of clean indoor air legislation), but in the popular debate, the focus is usually on the non-economic aspects, such as freedom of choice and freedom of expression. The focus of this Handbook is not on these tobacco control interventions, thus they are not discussed further.

The primary theme of this book is that increases in the price of cigarettes are particularly effective in reducing the demand for cigarettes. This chapter provides a theoretical framework used in other chapters and reviews the literature that considers demand studies that are estimated with aggregate data. Aggregate data is constructed by, in principle, adding the relevant data of individuals for the relevant variables (such as consumption, income and advertising expenditure). Typically aggregate data are produced by government agencies. A common theme in all these studies is that cigarette prices are a crucial determinant of the demand for cigarettes. The price elasticity of demand is typically the metric of interest. The more price-elastic the demand, the more effective is a cigarette price increase in reducing cigarette consumption. The relevant policy variable is the excise tax; by increasing the excise tax, the government can raise the retail price of cigarettes. The policy implications of knowing the price elasticity of demand are: (1) it allows one to predict the likely decrease in consumption if the price of cigarettes were to increase by a certain percentage, and (2) it allows one to estimate the fiscal impact of a change in the excise tax on cigarettes.

The empirical literature on the demand for cigarettes is sizeable, and has several different focus points. In particular, in the past two decades there has been an explosion in the number of studies that are based on individual- or household-level data. These studies are discussed in Chapters 5 and 6. The current chapter is limited to a review of studies based on aggregate data only. This literature grew rapidly before the 1990s, but has largely been eclipsed by studies based on micro-level data since then. In this chapter studies are categorized by geographical area: (1) the United States, (2) other developed countries and (3) developing countries. The rationale for this categorization is that studies from each of these geographic regions have tended to focus on different themes in the tobacco control literature.

The structure of the chapter is as follows. The theoretical framework underlying the demand for tobacco is considered in the first section. The following section provides a short overview of the econometric strategies that have been used to estimate the demand for tobacco using aggregate data. Next the relevant empirical literature is reviewed, focusing especially on price and income elasticities of demand. The chapter then concludes with a consideration of the issue of affordability and how this influences the demand for cigarettes.

Theoretical frameworks for the demand for tobacco

The negative relationship between the price of a product and the quantity demanded is a fundamental concept in economics. This relationship, the law of demand, applies not only for goods and services, but also to factors of production, in both micro and macro contexts. For example, within a microeconomic context, an increase in the price of a product decreases the quantity demanded of that product, if all other factors are held constant. Similarly, within a macroeconomic context, an appreciation of the currency (effectively making imported products more expensive) decreases aggregate imports.

The law of demand is derived from a constrained utility maximizing framework. Given consumers' preferences, which are presented by the utility function, the imposition of a budget constraint allows one to derive the demand function for a product, where the quantity demanded is a negative function of the price of that product. Empirically the interesting aspect is typically not whether the negative relationship between price and quantity demanded exists, but rather how responsive the quantity demanded is to changes in the price. This responsiveness is captured in the price elasticity of demand. The price elasticity of demand, which is a number without units, indicates by what percentage the quantity demanded changes in response to a 1% change in the price.

The relationship between cigarette price and consumption has opened up a lively methodological debate. One major source of contention is the theoretical modelling of addictive products, since the assumptions underlying the models employed have fundamentally different implications for the optimal tax level (Guhl and Hughes, 2006). Modelling tobacco consumption based on economic models of choice has undergone continuous evolution in response to expanding knowledge and insights into addictive behaviour. Initially the demand for tobacco was modelled with a contemporaneous specification. This means that current demand is specified as a function of current prices and current values of all other explanatory variables. Addictive behaviour was initially modelled through backward-looking "myopic" demand models, meaning that previous consumption (or the previous period's prices) influences current consumption. As an improvement on backward-looking demand models, forward-looking rational addiction models arose in the late 1980s. These were subsequently revised, at least on a theoretical level, by models of addictive behaviour that assumed that smokers were subject to time-inconsistent behaviour. This section describes this progression.

Underlying conventional demand models is the assumption that consumers are fully rational and sovereign in their decision-making. As such, they are the best judges of their own behaviour and on what goods and services to spend their money. Within this conventional framework tobacco is considered a good like any other good. A chosen behaviour is *a priori* assumed optimal because a person has rationally chosen it and the government has no reason, in the absence of market failures, to interfere with this revealed preference.

However, if a product is addictive, the assumption of consumer sovereignty applies no more. The addictiveness of the product "forces" a consumer to buy a product that she might not have bought had she not been addicted to it. Some early theorists have postulated that, given the addictive nature of nicotine, it was not conducive to standard economic analysis (Chaloupka, 1991). It also implies that the demand for tobacco products does not respond to changes in the price, and is thus perfectly price-inelastic (U.S. Department of Health and Human Services, 2000). If this view were true, it would imply that increases in the excise tax would be impotent as a measure to reduce tobacco consumption. However, as will be clear from this and other chapters in this book, this view does not have any empirical support.

Before the 1990s, empirical studies that investigated the determinants of demand for tobacco were, in terms of their theoretical specification, not much different from studies that investigated the demand for other consumer products. Broadly speaking, tobacco consumption was specified as a function of the price of the tobacco product in question, an income variable, the prices of substitutes and complements, an advertising variable, and often some dummy variables aimed at capturing the impact of anti-tobacco measures. In some cases a lagged dependent variable was included in the regression equation to capture "habit persistence." Other than improving the statistical fit of the regression equation, it also allowed one to differentiate between short-run and long-run price elasticities of demand, as will be pointed out in the next section.

Empirical tobacco demand analyses in the past two decades have largely been underpinned by the rational addiction framework formally introduced by Gary Becker and Kevin Murphy in 1988. The model of rational addiction has become the standard approach to modelling the consumption of addictive goods. It has been applied to coffee (Olekalns and Bardsley, 1996), alcohol (Waters and Sloan, 1995; Grossman *et al*., 1998) and tobacco (Chaloupka, 1991; Becker *et al*., 1994). The essence of the rational addiction model is that people with stable preferences may rationally decide to engage in an addictive behaviour since this maximizes their lifetime utility (Becker and Murphy, 1988).

Becker and Murphy distinguish between myopic and rational addiction. A myopically addicted person's current consumption is determined by his/her past consumption. However, such a person does not consider the future in determining current consumption. As such, the future is discounted at an infinitely high rate.

A rationally addicted person's current consumption, on the other hand, is determined not only by past consumption (which in turn is determined by past prices), but also by future prices. For instance, if consumers of addictive goods predict that the price of the product will increase in future, that knowledge will cause his/her consumption in the current period to decrease.

Importantly, the full price of the product includes not only the monetary price of the product, but also the negative health effects and the legal sanctions associated with consumption. For example, the *full* price of drugs includes the fines, prison sentences and increased mortality associated with drug use, over and above the purchase price of the drugs. Similarly, for alcohol, the full price includes the increased risk of accidents, domestic violence and increased morbidity and mortality, while for tobacco, the full price includes social disapproval, increased morbidity and premature death, over and above the prices paid for these products. As an illustration, Becker and Murphy (1988) argue that the US Surgeon General's report published in January 1964 (U.S. Department of Health Education and Welfare, 1964) greatly increased the full price of tobacco smoking. Between 1964 and 1975 per-capita cigarette consumption in the US decreased by 34%. Becker and Murphy argue that this large decrease in consumption is consistent with rational (i.e. forward-looking) behaviour, and inconsistent with myopic behaviour. If smokers were myopic they would not respond to information about future consequences of their activities.

The rational addiction framework provides a theoretical model to describe three important concepts in the addiction literature, namely tolerance, reinforcement and withdrawal (Chaloupka, 1991). Tolerance implies that a given quantity of current consumption yields less additional satisfaction as the cumulative past consumption of the product increases. This implies that, to obtain the same amount of additional satisfaction, consumers would have to consume increasingly larger quantities of the product. Reinforcement means that current consumption of the product increases future consumption, and that past consumption increases current consumption. Stated differently, the more one consumes, the more one wants to consume. Withdrawal means that the smoker's total utility/satisfaction falls if cigarette consumption is reduced.

Furthermore, Becker and Murphy (1988) show that the rational addiction model can explain the observation that heavily addicted smokers often quit their consumption abruptly, i.e. "cold turkey." The explanation lies in the fact that if the addiction is strong, reinforcement in consumption is larger than had the addiction been weak. As the level of reinforcement increases, so does the degree of (adjacent) complementarity between current and future consumption. A person who wishes to reduce consumption slowly would be incurring a loss of utility over a long time period. On the other hand, by quitting abruptly, the consumer incurs a large immediate loss of utility, but this utility loss is smaller than the utility losses that would have been incurred had the quitting period been extended over a period of time.

Becker and Murphy (1988) point out some important interactions between time preference and addiction. First, people who discount the future more heavily are more likely to become addicted. Second, addicts with higher discount rates will be relatively more responsive to changes in the price than those with lower discount rates. They tend to be more affected by short-term shocks, e.g. current cigarette price increases, than by long-term implications of smoking, e.g. detrimental health consequences in middle and old age. These two theoretical results explain why young and poor people are more likely to initiate smoking than older and richer people and typically have higher price elasticities of demand, as indicated in Chapters 6 and 7. Third, the long-run price elasticity of demand will be greater, in absolute terms, than the short-run price elasticity. Fourthly, the impact of an expected change in the price of the addictive good will be greater than the impact of an unanticipated price change.

The Becker-Murphy model has been empirically tested in a variety of contexts, using both aggregate data and cross-sectional data, and generally the studies find support for the hypothesis of rational addiction. These studies are discussed in later in this chapter and in Chapter 5. While studies differ in the econometric detail, the contribution of the Becker-Murphy approach lies in the fact that forward-looking behaviour is explicitly modelled into the demand equations.

However, the rational addiction framework has been severely criticized from some quarters. For many addiction researchers the concept of *rational* addiction is oxymoronic. Why would a person pursue an activity that he/she becomes addicted to? Becker and Murphy answer this question as follows. First, the model applies to a large range of human activities and endeavours. People become addicted to different things, some of which are not necessarily bad. For instance, Becker and Murphy point out that people can be addicted to "good" things like work, music, television, religion, other people, etc. Second, the model assumes that people recognize the addictive nature of the products they choose to consume, but they may still make them because the gains of consuming the product exceed the cost of future addiction. The model does not suggest that if an addict is rational, he/she is "happy." In fact, in real life addicts are often unhappy and depressed. Sometimes the addiction results from anxiety-raising and depressing events like death or divorce, which lowers their utility. Becker and Murphy (1988) argue that their model recognizes that people become addicted precisely because they are unhappy. However, they would be even unhappier if they were prevented from consuming the addictive goods.

The most criticized aspect of the rational addiction model is the assumption of perfect foresight (Chaloupka and Warner, 1999). The model assumes that people rationally decide that they will maximize their discounted lifetime utility by consuming an addictive product. According to Akerlof (Chaloupka *et al.*, 2000a), the rational addiction model does not allow the possibility that people regret that they ever started smoking, given that they are assumed to be fully aware of the consequences of their consumption of a potentially addictive good when making these decisions. This is unrealistic, because surveys have shown that most smokers indicate that they want to quit and regret that they started smoking (Gruber and Köszegi, 2001). Similarly, numerous studies find that individuals do not have sufficient knowledge on which to base their consumption decisions (Guhl and Hughes, 2006). Chaloupka and Warner (1999), for example, observe that adolescents often underestimate the addictive nature of smoking.

Auld and Grootendorst (2002) attack the rational addiction model on a different level. While the rational addiction model has been successfully applied to several obviously addictive products (Grossman *et al.*, 1998; Auld and Grootendorst, 2002), presumably the strength of the theory should lie in the fact that it would find that people are not addicted to things that clearly are not addictive. Auld and Grootendorst (2002) found that the standard methodology is generally biased in the direction of rational addiction. Using aggregate time series data, they found that milk, eggs and oranges were rationally addictive, and, specifically, that milk was more addictive than cigarettes. This result implied that the estimable rational addiction model tends to yield spurious evidence in favour of the rational addiction hypothesis when aggregate data are used.

The rational addiction framework assumes that consumers discount the future at an exponentially declining discount factor $d(t) = \delta t$, where $0 < \delta < 1$. The discount factor δ is often expressed as $1/(1+r)$, where r is a discount rate. Exponential discounting implies that consumers are time-consistent, i.e. have stable preferences. Any discounting is premised on the idea that people are impatient; they place a higher value on a unit of consumption today and demand compensation to defer consumption until tomorrow. In 2001 Gruber and Kozsegi added to both the theoretical and empirical debate by arguing that consumer preferences may not be stable over time. Preferences are time-inconsistent if a person, when asked on different occasions, displays different relative preferences. Camerer and Loewenstein (2002) explain hyperbolic discount preferences, one mathematical form of time-inconsistent discounting, as follows:

> "Hyperbolic time discounting implies that people will make relatively far-sighted decisions when planning in advance—when all costs and benefits will occur in the future—but will make relatively short-sighted decisions when some costs or benefits are immediate. The systematic changes in decisions produced by hyperbolic time discounting create a time-inconsistency in intertemporal choice not present in the exponential model. An agent who discounts utilities exponentially would, if faced with the same choice and the same information, make the same decision prospectively as he would when the time for a decision actually arrives. In contrast, somebody with time-inconsistent hyperbolic discounting will wish prospectively that in the future he will take far-sighted actions; but when the future arrives he will behave against his earlier wishes, pursuing immediate gratification rather than long-run well-being."

If a person discounts the future at a hyperbolic rather than an exponential rate, time-inconsistent preferences are a likely outcome. Results from laboratory experiments and psychological research suggest that consumers are time-inconsistent and exhibit self-control problems (Gruber and Köszegi, 2002). Self-control problems are introduced into economic models through the idea of a competing internal self, where an individual's preferences change at different times with a view to improving the current self's welfare, sometimes at the expense of the future self's (O'Donoghue and Rabin, 2003). Most people exhibit present-biased preferences; they have a tendency to pursue immediate gratification in a way that they themselves may disapprove of in the long run. For instance, a smoker might indicate that he wishes to quit, but only in a year's time. In this scenario the future self makes the decision. However, if one were to ask him in a year's time whether he has quit smoking, the typical answer would be "no." Despite the commitment of a year earlier, the current self dominates the decision. The large time delay between exposure and disease makes smokers particularly prone to this phenomenon, since the health consequences of their current actions are only realized at a future date (Jha *et al.*, 2000). This type of time-inconsistency, which describes smoking as an outcome of "multiple selves", strongly accords with common sense and conventional wisdom (O'Donoghue and Rabin, 2003). Many smokers want to quit smoking, but the immediate gratification from nicotine dominates the desire to quit. In this framework, cigarette consumption is more appropriately modelled based on the assumption that consumers are time-inconsistent. The existence of an "internality," arising from the psychological phenomenon of hyperbolic discounting and unstable preferences, supports an argument for a cigarette tax, not only on externality grounds, but on the grounds that smoking creates "internal" costs that markets fail to correct.

If consumers exhibit present-biased preferences (i.e. the time-inconsistent model), the assumptions of rational and time-consistent behaviour (i.e. the rational addiction model) may be seriously flawed. More importantly, the optimal tax rate prescribed by each model will differ significantly. Under the rational addiction hypothesis, tobacco consumption decisions are governed by the same rational decision-making process as any other good (Gruber and Mullainathan, 2002). Under this paradigm the optimal role for government is to correct for the "external costs" of smoking. Addiction *per se* does not constitute market failure, and the costs smokers impose on themselves are irrelevant for taxation unless they are rooted in misperceptions about the harmfulness of smoking (Guhl and Hughes, 2006). In comparison, the policy conclusion from the time-inconsistency approach is that "internality costs" should be accounted for in the same way as externality costs when setting government policy. Taxation may thus be theoretically justified even where no externalities are present (Gruber and Köszegi, 2001). As a result, time-inconsistency models generally prescribe an optimal tax level which is higher than that of the rational addiction model, since the internal costs often dwarf the external costs (Gruber and Köszegi, 2002).

The empirical strategy

Over the past decades there have been vast improvements in the techniques that are available for time series econometricians. Time series data are data that are published at regular intervals and that refer to well-defined time periods, e.g. years, quarters or months. Most of the studies discussed in this chapter consider the time series data for a particular country, and thus derive appropriate coefficients for that country. However, in a limited number of cases researchers have used a pooled set of time-series data. A pooled (or in some cases a panel) data set consists of the time series data of several countries (or regions).

Pooling data results in many more observations and more often yields statistically meaningful results. Early econometric studies that investigated the demand for tobacco and other commodities would be regarded as quite out-of-date by many applied time series econometricians today. However, since these studies were important then, and since many recent studies have not employed the most up-to-date techniques, it is worthwhile to discuss the methodology of such studies.

The typical starting point for estimating the price and income elasticities of demand is to specify a demand equation. According to standard demand theory, the quantity demanded of a product is a function of the price of the product, an income variable, the prices of substitutes and/or complements, advertising, and possibly some product specific factors. Within the context of tobacco demand studies, price and income are the most important and most commonly used variables. Earlier studies[1] often included an advertising variable in the regression equation (either advertising expenditure, some measure of the stock of advertising or some rudimentary count of the levels of advertising). Relatively few studies included the price of complementary and substitute goods in the regression equation. A notable exception is the seminal study by Chapman and Richardson (1990), who included the price of substitutes in their demand equations (leaf tobacco prices in the demand for cigarettes and cigarette prices in the demand for leaf tobacco). Similarly, Hsieh *et al*. (1999) included imported cigarette prices in the demand for local cigarettes and local cigarette prices in the demand for imported cigarettes.

The mathematical form of the regression equation is important. Many studies use a log-log specification, primarily because this results in a constant and easily derived elasticity estimate. The price elasticity is simply the coefficient on the (logged) price variable, and similarly the income elasticity can be read off as the coefficient on the (logged) income variable. It is important to note that this specification *assumes* a constant elasticity, over time or at different points on the demand curve. Of course such a specification would not allow one to determine whether there are changes in the price elasticity over time, whether the elasticity differs for various price levels, or whether the elasticity differs for different magnitudes of price changes.

Another standard mathematical form is a linear specification. The coefficients cannot be interpreted as elasticities, but with minor effort elasticity estimates can be calculated. Usually the elasticity is calculated at the mean quantity and price (or income, if one wishes to estimate the income elasticity).[2] The added advantage of the linear specification is that is allows one to estimate the elasticity at any point in time (Bardsley and Olekalns, 1999; Van Walbeek, 2002).

In some studies the addictiveness of tobacco was modelled by including a lagged dependent variable in the regression equation. This is a standard econometric technique, based on the concept of "habit persistence" (Gujarati, 2003). If the product is addictive, it is intuitively obvious that past consumption determines current consumption. An econometric specification that includes a lagged dependent variable has the property that one can differentiate between short-run and long-run price elasticity. If ε_P is the short-run price elasticity and α is the coefficient on the lagged dependent variable ($0 < \alpha < 1$), then the long-run price elasticity is equal to $\varepsilon_P/(1-\alpha)$. The long-run elasticity is always greater (in absolute terms) than the short-run elasticity, suggesting that a current change in the price will have a greater impact on consumption in the long run than in the short run.

To test the rational addiction hypothesis, the focus is on future price or future consumption, explaining current consumption. Becker *et al*. (1994) tested their theoretical model using US state-level time series data. The forward-looking nature of the model made them include next-period consumption (i.e. C_t+_1) into the demand equation. If α_1 is the coefficient on C_t-_1 and α_2 is the coefficient on C_t+_1, then rational addiction would imply that α_2 is statistically significant. If only α_1 is significant, this would suggest that smokers are myopically addicted. Also, within this framework, the short-run elasticity is derived from the coefficient on P_t, while the long-run elasticity is equal to $\varepsilon_P/(1-\alpha_1-\alpha_2)$. If smokers are rationally addicted, one would find that the long-run price elasticity is greater than if smokers are myopically addicted.

In the econometric literature the potential problem of identification (i.e. distinguishing between supply and demand) has been an important issue. The price-quantity combination at any moment in time is an equilibrium point,

[1] Hamilton (1972), McGuinness and Cowling (1975), Fujii (1980), Witt and Pass (1981), Bishop and Yoo (1985), Leeflang and Reuijl (1985), Radfar (1985), Abernethy and Teel (1986), Baltagi and Levin (1986), Chetwynd *et al.* (1988), Kao and Tremblay (1988), Duffy (1991), Seldon and Boyd (1991), Tegene (1991), Wilcox and Vacker (1992), Valdés (1993), Duffy (1995), Tremblay and Tremblay (1995), and Cameron (1997).

[2] See Warner (1977), Warner (1981), Leeflang and Reuijl (1985), Warner (1989), Flewelling *et al.* (1992), Becker *et al.* (1994), Wilcox *et al.* (1994), Tremblay and Tremblay (1995), Van Walbeek (1996), Bardsley and Olekalns (1999) and Bask and Melkersson (2004) for examples of elasticities at the mean.

i.e. the intersection of the supply and the demand curve. Any change in the equilibrium position from one period to another is the result of a change in the demand or the supply curve, or both. To identify the demand curve a systems approach is recommended. If the system meets certain criteria, one can specify both the supply and the demand curves. Very few studies follow this approach, with notable exceptions being Bishop and Yoo (1985) and Tremblay and Tremblay (1995). Bishop and Yoo (1985) point out that a single equation demand model can provide consistent estimates if the supply curve is either perfectly elastic or perfectly inelastic. An assumption of a perfectly inelastic supply curve, given the storability of tobacco, is unrealistic. On the assumption that the supply curve is perfectly elastic, changes in the price will trace out a demand curve. Most studies assume that the demand curve is stable in price-quantity space and that movements in the curve are a result of changes in the other demand determinants. In the absence of data on costs and other supply determinants, and given that tobacco companies often have significant market power (which results in them not having identifiable supply curves), it is little wonder that so few studies attempt to estimate supply equations.

The dependent variable is almost always the quantity of cigarettes consumed, although some variations have been used. The quantity consumed is typically calculated in one of two ways. The first method is to obtain, or derive, the quantity consumed from the fiscal authorities. By dividing the total excise tax revenue by the average excise tax amount per cigarette, one can calculate the quantity of cigarettes consumed. This considers the consumption of legal cigarettes only; counterfeit and smuggled cigarettes are not considered. If the proportion of smuggled cigarettes remains constant over time, then the price elasticity estimates and other coefficients will not be affected. However, if the proportion of smuggled cigarettes increases in response to an increase in price, the legal sales of cigarettes will understate true cigarette consumption. To the extent that this may occur, the price elasticity estimate (in absolute terms) will be biased upwards. The second approach calculates cigarette consumption as cigarette production, plus imports, less exports. The method of data collection could also lead to biases. Local production may be underreported (because of illicit manufacturing, for example) or imports may be underreported (through large-scale or small-scale smuggling). If such underreporting were to increase in sympathy with increases in the real price of cigarettes, the absolute value of the price elasticity estimates would be biased upwards. Essentially, consumption cannot be directly observed, and what is termed as consumption is proxied by a measure that represents tax paid production or shipments. Furthermore, timing issues may affect the composition of the series since retailers or consumers might increase purchases in response to an anticipated price increase, thereby artificially increasing consumption now and reducing consumption in some future period. This becomes more of an issue in higher-frequency data.

Cigarette prices and income enter the models as independent variables and are presented in real terms by dividing the nominal variable (or index) by an appropriate deflator (usually the consumer price index). The conversion of nominal price and nominal income to real price and real income is critical, since the prices of almost all goods (both substitutes and complements) rise over time. The absolute change in nominal cigarette prices is not important; what is important is by how much cigarette prices change relative to the changes in the prices of all other goods. Models using only nominal values are also likely to provide spurious results, since all both price and income are likely to trend upward over time. Real income can be presented in aggregate or per-capita terms. Some studies regress aggregate consumption on aggregate income and the real price while other studies regress per capita consumption on per-capita income and a price variable (examples). Most studies use the adult population (aged 15 or 16 and older) as the appropriate population measure with which they obtain per-capita values, although this is not a strict rule.

Other variables that have been included in demand equations revolve around policy interventions (e.g. advertising restrictions, counter advertising, smoke free policies, age restrictions, etc). The most common way to account for policy interventions is by means of dummy variables. For example, the counter-advertising that was legislated through the Fairness Doctrine in the USA in the late 1960s and early 1970s is typically captured by a variable that had a value of one in the period 1968 to 1970, and zeroes in all other years (Hamilton, 1972; Kao & Tremblay, 1988).

The most tested interventions are advertising bans and restrictions. Initially the approach was to investigate the relationship between cigarette consumption and advertising expenditure (or other measures of advertising including stocks and counts), controlling for other demand determinants (Hamilton, 1972; Fujii, 1980; Bishop

& Yoo, 1985; Abernethy & Teel, 1986; Holak & Reddy, 1986; Kao & Tremblay, 1988; Wilcox & Vacker, 1992). The argument was that if a positive relationship between these two variables was found, a reduction in advertising expenditure would result in a reduction in tobacco consumption. This would be the empirical foundation for a ban on tobacco advertising. No consistently strong relationships were found. However, this finding was subsequently rationalised on the grounds that, since tobacco products were among the most advertised products in the world, and advertising expenditure is probably subject to decreasing returns, moderate changes in the advertising expenditure are unlikely to be picked up in substantial changes in cigarette consumption (Saffer and Chaloupka, 2000). Subsequent studies have tested the impact of advertising *bans*, rather than advertising *expenditure*, on consumption and have found that bans have typically resulted in significant declines in consumption (see the last section of this chapter for a more comprehensive discussion of this literature).

Since the early 1990s there have been significant advances in time series econometrics. This has been primarily in reaction to the long-known but largely suppressed fact that regression on non-stationary variables can easily result in statistically significant but economically meaningless relationships. Most economic variables are non-stationary, meaning that they tend to be subject to long-run upward or downward trends. To prevent such spurious relationships, cointegration techniques were developed. The technical details of cointegration are available in any standard econometric textbook (for example, Hamilton, 1994, Pindyck and Rubinfeld 1998, Enders, 2004). The first studies that used cointegration techniques used the Engle-Granger two-step procedure. Subsequently the Johansen procedure was developed, which is theoretically less restrictive than the Engle-Granger approach. In similar vein, econometric techniques that placed fewer restrictions on the data, like vector autoregression, were developed.

The uptake of the more advanced econometric techniques has been relatively slow in tobacco demand studies based on aggregate data. The primary reason seems to be a lack of data. Time series data are typically of annual, quarterly or monthly frequency, and even when the series are relatively long, the data demands of the new techniques are often such that the modern techniques are not applied. In developing countries this problem is more acute than in developed countries. In many instances the data are available only at an annual frequency, and consists of no more than 20 or 30 observations. The quality and accuracy of data in developing countries are likely to be inferior to that in developed countries. In cases where the data are limited or of dubious quality, state-of-the-art techniques will not always be possible. However, data limitations should not provide a licence for researchers to ignore modern developments in econometrics. At the very minimum, one should test for the time series properties of the data, and possibly perform the regression in first differences. The review of the literature suggests that many studies in the past two decades do not employ these econometric developments.

The proportion of tobacco demand studies that use aggregate data has been declining relative to studies that use microeconomic or household cross sectional data. Studies that use household data are discussed and reviewed in Chapters 5 and 6. Studies based on aggregate data have some significant drawbacks. The first is the relative paucity of data. Data sets in excess of 50 time series observations are scarce (Prest, 1949; Tegene, 1991, being important exceptions). In contrast, the number of observations in household surveys is limited only by the budget of the survey. Second, the questions one can answer with aggregate data are limited. One can estimate price and income elasticities, but one cannot, for example, estimate the impact of price or income changes on the consumption of different groups (by gender, race, income, education, etc.), or determine changes in smoking prevalence or smoking intensity. Household data sets are much richer than aggregate data sets, and are better suited to answering such questions. Third, data limitations may result in biased parameter estimates. A high degree of multicollinearity between the independent variables, a very common problem in time series data, results in large standard errors on the estimated coefficients. Regressions may also suffer from omitted variable bias. Some variables might be omitted because the data do not exist or because the inclusion of the data worsens the multicollinearity problem to the extent that the researchers decide to exclude variables that they regard as important. Similarly, autocorrelation in the residuals, a very common problem in time series data, results in inefficient coefficients. Having said this, studies based on household data are subject to similar and other estimation and data problems.

A more recent development has been the estimation of cross-country (or, in the USA, cross-state) panel models, which are essentially cross sectional models based on the aggregated data of a country (or state). The first study in this genre was by Baltagi and Levin (1986), who exploited the fact that different US states had different excise tax regimes, and they could thus estimate price elasticity of demand, making appropriate adjustments for small-scale smuggling from low-tax to high-tax states. Models that are based on country data provide global estimates of price and income elasticities; in most cases these models control for price and income effects when testing the effectiveness of advertising bans and restrictions on a global level. Earlier models were elementary and did not use fixed effects to control for cross-country differences nor the addictive nature of cigarettes (Laugesen and Meads 1991; Stewart 1993). More recent additions to the literature have made significant improvements in methodology and estimation techniques. Saffer and Chaloupka (2000) applied country-specific fixed effects. Nelson (2003) tested the endogeneity of advertising bans, and Blecher (2008) extended the sample of countries to include a large number of developing countries.

Empirical literature

A survey of tobacco demand studies reveals that the focus of attention has changed several times in the past 60 years. In fact, several "waves" of empirical studies into the demand for tobacco can be identified.

In what could be termed the first wave, a small number of studies investigated the demand for tobacco in the 1940s to 1960s (Stone, 1945; Prest, 1949; Koutsoyiannis, 1963). These studies were part of a growing literature that aimed to investigate the demand for household goods. Price and income elasticities were estimated, but the public health implications of these estimates were not discussed, presumably because the health impact of smoking was not well publicized at that time.

The focus of tobacco-related empirical research changed significantly in the early 1970s. During the 1970s–1990s, which could be called a second wave, researchers began to draw policy conclusions from their results. The focus in this period shifted away from the estimation of price and income elasticities to the impact of advertising and health awareness on the demand for tobacco products. In estimating the impact of advertising and health awareness on cigarette demand, price and income were included as control variables in the regression equation, but these were often not the focus of the investigation. During this period the lines between "pro-industry" research and "pro-tobacco control" research were drawn, and the debate between these two camps was vigorous and often acrimonious.

The first two waves focused exclusively on developed countries, and the empirical results were based on time series data. The third wave had its origins in 1990, when price elasticity estimates were published for Papua New Guinea, the first developing country studied (Chapman and Richardson, 1990). During the 1990s the focus gradually shifted towards developing countries. This shift in research focus was in reaction to the large increase in smoking in the developing world, and the likely impact that this would have on mortality patterns in the 21st century (Jha and Chaloupka, 1999). The focus in most of the developing country studies was on the price elasticity of demand.

United States of America

In terms of methodological complexity, the USA-based studies are generally the most advanced, and have addressed issues that have not been addressed by researchers in other countries. Researchers in the US have several significant advantages over their colleagues in other countries. First, tobacco control is high on the authorities' agendas[3] and attracts large financial resources from government and private institutions. Consider the following examples. In 2000 the 11th World Conference on Tobacco or Health, held in Chicago, received a US$10 million sponsorship from two US health societies and a private foundation. This is more than ten times any previous World Conference.[4] In 2002 the Fogarty International Centre made US$18 million available for tobacco control research around the world. One of the requirements was that the research teams in other countries be linked to established research bodies in the US. Subsequently much larger amounts have been made available by US aid agencies, primarily for tobacco-related research in low-and middle-income countries. These studies are often anchored by US researchers. More than 40 working papers have been published by the prestigious National Bureau for Economic Research (NBER) on matters relating to the economics of tobacco control. There is a pool of researchers who specialize in

[3] This is generally true for most states and particularly true for states like California and New York State. However, the tobacco-growing states like Kentucky and the Carolinas do not have a strong tobacco control focus.
[4] The World Conference on Tobacco or Health is held every three years and is the premier meeting of tobacco control experts, researchers and lobbyists.

the economics of tobacco control research, unmatched in any other country. As an illustration, of the 39 authors that contributed to Tobacco Control in Developing Countries (Jha and Chaloupka, 2000), arguably the most comprehensive book on the economics of tobacco control to date, 19 were from academic and/or governmental institutions in the USA, while another eight were from the World Bank, World Health Organization or the International Monetary Fund. Of the remaining 12 authors, ten were from developed countries (especially the United Kingdom and Australia), and two were from developing countries.

Second, the existence of more than 50 states and territories, each with separate legislative, excise tax and retail pricing systems, often creates a research design environment that allows researchers to test phenomena that would have been virtually impossible to test otherwise. For example, changes in state-specific excise taxes were used to obtain quasi-experimental price elasticities of demand (Baltagi and Goel, 1987). Also, studies that employ individual-level data to determine price elasticities of demand for specific demographic groups can take advantage of the fact that there is a large degree of variation in individual states' tobacco excise tax regimes and other tobacco control interventions.[5]

Third, there are some very large survey data sets that specifically investigate smoking behaviour, especially among the young. Because these surveys are often repeated year after year, changes in smoking behaviour over time can be monitored. For example, several waves of the Monitoring the Future Surveys have been used to estimate the price elasticity of demand for cigarettes among secondary school pupils, and various demographic groups within this sample (e.g. Chaloupka and Grossman, 1996; Chaloupka and Pacula, 1998). These studies are discussed in detail in Chapters 5 and 6.

As indicated in the discussion of econometric strategies, the demand for cigarettes is typically specified as a function of price, income and some tobacco control interventions. For most US studies, the prime focus of the study is on the impact of cigarette prices on quantity consumed. However, some studies focused primarily on the effect of a non-price determinant of the demand for cigarettes (such as advertising, health publicity or other tobacco control interventions), and in such cases the price would enter the regression equation as a control variable. Table 4.1 is a comprehensive chronological summary of studies of cigarette demand in the US using aggregate data studies. The studies differed in many respects, including: (1) the frequency of data,[6] (2) the use of econometric or non-econometric estimation techniques,[7] (3) the use of single equation versus multiple equation regression techniques, and (4) the use of national or state-specific data.[8]

While the techniques for estimating the demand equations are similar enough to not list all the US studies in this chapter, some seminal articles, as well as those that are in some way unique, are briefly discussed here.

Warner (1977) estimated the impact of various health scares and other high-profile anti-smoking publicity campaigns on the demand for cigarettes. In his study he did not estimate the price elasticity of demand, but included the impact of price into the regression model by *assuming* that the demand curve was linear in price-quantity space and that the price elasticity of demand was the mean price and quantity for the period (1947–70) being studied. Imposing a price elasticity onto the regression equation, rather than allowing the data to estimate the price elasticity, was rationalised on the grounds that including price in the regression equation would result in unacceptable levels of multicollinearity. Based on this analysis, Warner concluded that the various anti-smoking campaigns resulted in a significant decrease in smoking. In fact, he suggests that per capita consumption of cigarettes would have been 20–30% higher in 1975 had it not been for the success of the anti-smoking campaign. What is interesting about this study is that changes in the excise tax on cigarettes were not presented as a particularly effective tobacco control instrument. The focus was on anti-tobacco publicity, and excise-induced changes in the retail price appear to have entered the analysis as somewhat of an afterthought.

[5] For example, see Chaloupka and Wechsler (1997), Chaloupka and Pacula (1998), Tauras and Chaloupka (1999), and Tauras *et al.*, (2001). These studies are dealt with separately in Chapters 5 and 6.

[6] Most studies made use of annual data. Flewelling *et al.* (1992), Wilcox and Vacker (1992), Duffy (1995) and Hu *et al.* (1995a) use quarterly data, while Keeler *et al.* (1993), Hu *et al.* (1994 and 1995b) and Gruber and Köszegi (2001) use monthly data.

[7] Studies that have estimated price elasticities without using econometric techniques include Baltagi and Goel (1987) and Peterson *et al.* (1992). In these studies the researchers assessed the magnitude of changes in cigarette consumption following state-specific cigarette tax increases.

[8] Of all US states, California (closely followed by New York) has the most stringent tobacco control legislation. Published studies that have investigated the impact of tobacco control interventions on the demand for cigarettes in California include Flewelling *et al.* (1992), and Hu et al. (1994 and 1995b). Most US studies that investigate the demand for cigarettes focus on the country as a whole. Some studies take cognizance of differences in taxes between states and try to account for the small- and large-scale smuggling between low-tax and high-tax states (Baltagi and Levin, 1986, Baltagi and Goel, 1987 and Thursby and Thursby, 2000).

Table 4.1. Studies employing aggregate data in the United States

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Hamilton (1972)	United States	-0.51	0.73	Advertising expenditures (positive although insignificant), health scares (negative and generally significant)	Myopic addiction log linear and linear OLS	Annual time series data from 1926 to 1970	
Warner (1977)	United States	-0.5	Not included	Time trend, health, dummies for health scares, Surgeon General's report and Fairness Doctrine	Myopic addiction	Annual time series data from 1947 to 1970	
Fujii (1980)	United States	**Short-run** *Log linear* -0.63 *Linear* -0.48 **Long-run** *Log linear* -0.92 *Linear* -0.71	**Short-run** *Log linear* 0.33 *Linear* 0.27 **Long-run** *Log linear* 0.50 *Linear* 0.33	Advertising expenditure (positive although not generally significant), time period dummies (negative but generally insignificant)	Log linear and linear myopic addiction OLS	Annual time series data from 1929 to 1973	
Warner (1981)	United States	-0.37	Positive and significant	Many dummies for various health scares and interventions, state law population measure	Static myopic addiction model OLS	Annual time series data from 1947 to 1978	
Bishop and Yoo (1985)	United States	Preferred value = -0.45; other specifications yield elasticities between -0.41 and -0.64	Preferred value = 0.92; other specifications yield elasticities from 0.86 to 1.10	Advertising expenditure, health scare dummy variable	Static system approach (equations for both supply and demand equations) using 2SLS and 3SLS	Annual time series data from 1954 to 1980	
Abernethy and Teel (1986)	United States	Negative and significant (unable to calculate elasticity since model is linear)	Not included in model	Print advertising (generally positive and significant), broadcast advertising (generally positive although insignificant), package warnings (negative although generally insignificant), broadcast counter advertising (negative	Linear OLS and log dependent variable OLS, myopic addiction	Annual time series data from 1949 to 1981	

Table 4.1. Studies employing aggregate data in the United States

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Abernethy and Teel (1986) (contd)				and significant), print advertising warning (negative although insignificant), broadcast advertising ban (insignificant)			
Baltagi and Levin (1986)	46 US States	**Short-run** -0.22 to -0.23	Insignificant	Price in neighbouring states (positive), advertising (positive although insignificant), Fairness Doctrine dummy (negative although generally insignificant)	Log linear myopic addiction OLS within, Hausman-Talyor, Zellner-Geisel Search Procedure	Pooled annual data from 1963 to 1980	Uses the price of cigarettes in neighbouring states to control for smuggling; finds that there may be spill over effects to neighbouring states where smuggling may be significant
Holak and Reddy (1986)	United States	**Wide variation and significance** *Before advertising ban* 0.07 to 0.50 (yes, positive) *After advertising ban* 0.70 (yes, positive) to -0.84	Income not controlled for	None	Log linear myopic addiction model (Maximum likelihood)	Annual time series 1950 to 1979	Industry and brand-level regressions
Baltagi and Goel (1987)	United States	-0.17 to -0.56 Downward trend in elasticities over time and an upward biased in states where small-scale smuggling exists	Not controlled for	Small-scale smuggling	Non-econometric quasi experimental computational approach	Annual time series data from 1956 to 1983	Attempts to understand how elasticities change over time and how small-scale smuggling impacts on elasticities
Kao and Tremblay (1988)	United States	**Static** -0.50 to -0.66 **Dynamic** *Short-run* -0.50 to -1.02 *Long-run* -0.44 to -1.77	**Static** 0.77 to 1.30 **Myopic** *Short-run* 0.74 to 1.48 *Long-run* 0.59 to 3.03	Advertising expenditure (positive), dummies for the 1964 health scare (negative), 1968 Fairness Doctrine (insignificant), 1971 broadcast ban (insignificant)	Log linear myopic addiction with an IV technique	Annual time series data from 1953 to 1980	Improving Bishop and Yoo
Seldon and Doroodian (1989)	United States	**Short-run** -0.4	**Short-run** 0.27	Health scare (negative), media policy (negative although	Non-linear myopic addiction 3SLS simultaneous demand system	Annual time series data from 1952 to 1984	

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Seldon and Doroodian (1989) (contd)				insignificant), advertising increase competition			
Warner (1989)	United States	-0.2	Significant and positive	Dummies for interventions	Linear myopic addiction OLS	Annual time series data from 1947 to 1987	
Seldon and Boyd (1991)	United States	**Short-run** -0.22 to -0.26. Long-run not significantly different from short-run	**Short-run** 0.14 to 0.25. Long-run not significantly different from short-run	Advertising (positive), policy dummies in 1964, 1968, 1971, 1979 (Negative)	Myopic addiction Maximum Likelihood	Annual time series data from 1953 to 1984	Uses a Cooley-Prescott model, interested in the instability of demand due to continuous government intervention
Tegene (1991)	United States	-0.29	0.53	Advertising	Log linear myopic addiction model with Kalman filter	Annual time series data from 1929 to 1986	Elasticities are found to decline over time
Flewelling *et al.* (1992)	California, United States	-0.25 to -0.35	Income not included	Seasonal and trend dummies and dummies to control for consumption spikes related to previous tax increases	Linear static OLS (including ridge regression)	Quarterly time series data from 1980 to 1990	
Peterson *et al.* (1992)	United States	Not a demand model. Tax increases were associated with a decline in consumption. Larger the increase, the larger the decline	Not in model	None	Analytical model	Annual time series data from 1955 to 1988	
Wilcox and Vacker (1992)	United States	Positive and insignificant	Positive and insignificant (nominal income)	Advertising, seasonality population, inflation, warnings and policies. Only price and income in final model	Linear stepwise regression	Quarterly time series data from 1961 to 1990	Nominal prices rather than real prices are used
Keeler *et al.* (1993)	California, United States	**Short-run** -0.3 to -0.5 **Long-run** -0.5 to -0.6	Insignificant	Regulation (negative), Arizona and Oregon tax increase dummies (positive)	Non-linear myopic, rational and constrained rational addiction models	Monthly time series data from 1980 to 1990	
Becker *et al.* (1994)	50+1 US States	**Short-run** -0.36 to -0.48 **Long-run** -0.73 to -0.85 (unable to estimate myopic addiction elasticities since the	Generally positive and significant (unable to estimate elasticities since the models were linear and the income elasticities were not	Index of incentive to smuggle, index of incentive for short distance export smuggling, index of incentive for short distance export	Linear myopic and rational addiction models, 2SLS and OLS with group and year fixed effects	Pooled annual data from 1955 to 1985	

Table 4.1. Studies employing aggregate data in the United States

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Becker *et al.* (1994) (contd)		models were linear)	specifically reported)	smuggling; all three generally negative and significant			
Hu *et al.* (1994)	California, United States	No elasticity estimated, examining the direct impact of a tax change instead	Not included in model	Time trend	Analytical time series model	Monthly time series data from January 1984 to December 1991	
Sung *et al.* (1994)	11 Western US states	**Short-run** -0.40 **Long-run** -0.48	Positive	Many demographic variables, regulation (negative), small-scale smuggling (positive)	Rational addiction panel linear	Pooled annual data from 1967 to 1990	
Thursby and Thursby (1994)	39 US states	-0.26	0.11	Canada-bordering states (negative although insignificant), Indian reservations (positive), military (negative although not significant), tax differentials (negative although not significant), membership of anti-smuggling organisations (positive), felony (negative), discount rate paid to wholesalers (negative), time dummies (negative)	Log linear static and myopic addiction models	Pooled annual data from 1972 to 1990	Model attempts to estimate the extent of smuggling
Hu *et al.* (1995a)	California, United States	No elasticity estimated, examing the direct impact of a tax change instead	Not included in model	Quarterly dummies, tax, media	Analytical time series model	Quarterly time series data from 1980 to 1993	
Tremblay and Tremblay (1995)	United States	-0.41 to -0.43	Positive and significant	Advertising expenditure, dummies for Surgeon General's report, Fairness Doctrine, time trend	Linear static 2SLS W2SLS	Annual time series data from 1955 to 1990	Includes supply side in the equation

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Keeler *et al.* (1996)	United States	Not a demand study. Shows that price competition can reduce impact of regulation. A 1 cent state tax increase increases prices by 1.11 cents	N/a	N/a	Analytical model	Pooled annual data from 1960 to 1990	
Baltagi *et al.* (2000)	46 US States	**Traditional models (OLS, GLS, etc)** *Short-run* -0.09 to -0.30 *Long-run* -1.79 to -2.98 **Instrumental models** *Short-run* -0.21 to -0.50 *Long-run* -0.68 to -1.37	**Traditional models (OLS, GLS, etc)** *Short-run* -0.03 to 0.10 *Long-run* -1.00 to 0.60 **Instrumental models** *Short-run* -0.02 to 0.19 *Long-run* -0.11 to 0.51	State-specific demographic variables including religion, education and race. Price in neighbouring states (substitutes)	Various dynamic panel estimators including OLS and GLS (with various effects), and 2SLS, EC2SLS and FD2SLS for dynamic.	Pooled annual data from 1963 to 1992	Tests whether homogenous estimators preferred to heterogeneous estimators
Gruber and Köszegi (2001)	United States	*Short-run* [-0.43 to -0.48]	Not reported	Unknown	Linear rational addiction model with group and year fixed effects	Annual time series data from 1973 to 1996	Values in [ ] calculated by the Working Group
Huang *et al.* (2004)	42 states and Washington DC, USA	*Short-run* -0.21 *Long-run* [-1.88] **Instrumental** *Short-run* -0.41 *Long-run* [-2.69]	*Short-run* 0.04 *Long-run* [3.73] **Instrumental** *Short-run* 0.06 *Long-run* [0.38]	Price in neighbouring states, time trends, proportion of population 65 and above	Log linear myopic addiction, OLS and 2SLS	Pooled annual data from 1961 to 2002	Long-run results calculated from the short-run results and the lagged dependent variable by the Working Group
Goel (2009)	United States	**Static** -0.86 to -0.92 **Dynamic** *Short-run* -0.04 to -0.11 *Long-run* [-2 to -3.7]	**Static** 0.05 to 0.08 **Dynamic** *Short-run* -0.01 to -0.03 *Long-run* [-0.3 to -1.5]	Advertising, master settlement agreement	Log linear dynamic OLS with fixed effects	Pooled annual data from 1975 to 2004	Long-run results calculated from the short-run results and the lagged dependent variable by the Working Group

Values in [ ] calculated by the Working Group using data reported in corresponding studies.
EC2SLS, 2-stage least squares procedure that assumes a one-way error-component model; FD2SLS, first-difference 2-stage least square estimator; GLS, generalized least squares estimates/estimator; OLS, ordinary least squares estimates/estimator; W2SLS, weighted least squares estimates/estimator; 2SLS, 2-stage least squares estimates/estimator; 3SLS, 3-stage least squares estimates/estimator

Fujii's (1980) study uses ridge regression to alleviate the problems associated with multicollinearity between the independent variables. While the focus of his analysis was still largely on the impact of the health scare introduced by the Surgeon General in 1964 and airing of anti-smoking commercials at the end of the 1960s, he found the effects of these interventions modest. However, he concluded that "taxation, however, could have more substantial effects. Estimates of the price elasticity of demand (about −0.45) indicate that a 10% increase in the price of cigarettes will lower consumption by 4.5%. This effect became more pronounced in the long run" (Fujii, 1980).

Baltagi and Levin (1986) estimated the demand for cigarettes in the USA, based on annual data for the period 1963–1980 for 46 states. What is interesting about this study is that it accounts for possible small-scale smuggling between states and cross-border shopping. Given differences in cigarette excise taxes and hence prices between states, one can expect a difference between sales and consumption in states (high-price states have greater consumption than sales, and vice versa in low-price states). If one does not account for the small-scale smuggling effect and cross-border sales, the price elasticity estimates would be biased away from zero. To account for small-scale smuggling and cross-border sales between high- or low-price states, they included the cigarette price in the lowest-price neighbouring state.

They found a neighbouring state price elasticity of 0.08, suggesting that if the price in the neighbouring state is 10% lower than the home state, the cigarette sales in the home state would be expected to decrease by 0.8%. The price elasticity accounting for the small-scale smuggling effect and cross border sales is estimated at about −0.2.

An innovation introduced by Seldon and Boyd (1991) was to test and adjust for instability in the demand function. Using annual data for the period 1953–1984 and using a technique developed by Cooley and Prescott (1976), they found that the demand for cigarettes was in fact quite unstable over this period. The instability of the demand function is attributed to government interventions (e.g. the 1964 Surgeon General's report, the 1965 Cigarette Labelling and Advertising Act and the anti-smoking commercials that started after 1968). By including appropriate dummy variables for these interventions and estimating the demand equations with a Maximum Likelihood technique derived from the Cooley-Prescott method, they found that the demand system stabilized, and that the inclusion of the dummy variables reduces the price elasticity estimate in absolute terms from −0.26 to −0.22.

The rational addiction framework of Becker and Murphy spawned a substantial literature that aimed to incorporate the principles of forward-looking behaviour into the empirical results. The rational addiction framework has been applied to both aggregate and individual-level data. Studies based on individual-level data, initiated by Chaloupka (1991), are covered in Chapter 6. The first studies to test the rational addiction hypothesis with aggregate data were by Keeler *et al*. (1993) and Becker *et al*. (1994).

Keeler *et al*. (1993) considered monthly data for California for the period 1980–1990. In specifying a demand equation, they regressed current consumption on, among others, future consumption. Given that the monthly data were too unstable to yield meaningful results, they were forced to use an unweighted moving average of the previous 12 months' consumption as a proxy for current consumption and an unweighted moving average of the next 12 months' consumption as a proxy for next period consumption. They found that the coefficient on future consumption is positive and significant, and thus supportive of the rational addiction hypothesis. However, they found that the price elasticities produced by the myopic and rational addiction frameworks, and by a framework which does not account for addictive behaviour, were remarkably consistent in the range of −0.47 to −0.58.

Becker *et al*. (1994) used a large aggregate data set of more than 1500 observations (50 states over 31 years) to investigate empirically whether cigarette smokers are "rational" in the way that rational addiction is defined. Overall, the results rejected the myopic model of addiction, and provided evidence that consumers do consider future prices in their current consumption decisions (Becker *et al*., 1994).

Despite the many differences in research methodology, there are several generalizations that follow from these studies. First, all empirical studies included the cigarette price as a determinant of cigarette consumption, and evidence for a strong negative relationship between these two variables is overwhelming. The price elasticity estimates generally varied between −0.15 and −0.90, but seem to be concentrated in the −0.20 to −0.60 range. This implies that the demand for cigarettes is relatively price-inelastic, but certainly not perfectly price-inelastic. From a tobacco control perspective this result provides the rationale for using excise tax increases as a tool to reduce cigarette consumption. An increase in the excise tax increases the retail price of cigarettes, which in turn decreases cigarette consumption. Furthermore, since cigarettes are inelastic, the increase in price will be greater than the decrease in consumption. Therefore, total tax revenue is likely to rise when taxes rise since the tax increase more than compensates for the declining consumption.

Second, studies that investigated "health scares" and anti-smoking publicity which resulted from the Fairness Doctrine generally found that they reduced the demand for cigarettes (Hamilton, 1972; Baltagi and Levin, 1986; Kao and Tremblay, 1988). According to this Doctrine, companies advertising "controversial goods" (which, after the publication of the 1964 Surgeon General's report, included cigarettes) had to pay for advertisements that presented the alternative view. This resulted in substantial anti-tobacco advertising between 1967 and 1970. However, the relative magnitude of the publicity effect is unclear. Hamilton (1972), Warner (1977, 1981 and 1989), Kao and Tremblay (1988), found evidence of a sizeable long-term effect, while Fujii (1980) and Bishop and Yoo (1985) concluded that the impact was small and transitory. In more recent studies, anti-smoking publicity as a determinant of consumption seems to have received little attention in the empirical literature.

Third, there is no consensus on the impact of advertising expenditure on the demand for cigarettes. Several studies (Hamilton, 1972; Wilcox and Vacker, 1992; Duffy, 1995), found no significant relationship between advertising expenditure and cigarette consumption. Other studies found a positive relationship, but even when such a relationship was found, its impact on cigarette consumption was small (Fujii, 1980; Bishop and Yoo, 1985; Abernethy and Teel, 1986;[9] Holak and Reddy, 1986; Kao and Tremblay, 1988; Seldon and Doroodian, 1989; Seldon and Boyd, 1991).[10]

Saffer (2000) has proposed that advertising *per se* is an inappropriate measure and that, since many countries have experimented with advertising restrictions and bans, we can actually test the impact of policies (we review this literature in the last section of this chapter). He argues that the high level of aggregation of advertising expenditure data used in time series studies leaves little variation to correlate with consumption data. Generally, since the marginal product of advertising is very low (and possibly even zero) it is not likely that we would find any relationship between advertising expenditure and consumption. Chapman (1989) also criticized the use of these techniques, and in particular noted the inability of aggregate studies to examine all methods of promotion (including non-advertising and price-based promotion) used by the tobacco industry. Econometric analysis only examines the effects of advertising on aggregate data, while advertising also has an influence on smoking related cognition and beliefs.

Fourthly, most studies incorporate an income variable in the demand equation as a control variable. There is no consensus on the value of the income elasticity of demand for cigarettes, other than that it lies between zero and one (Andrews and Franke, 1991). This suggests that cigarettes are a normal good, which is intuitively reasonable (income elasticity estimates are explicitly reviewed in this chapter). However, the policy impact of this result is not that one should advocate for lower income as a tobacco control measure, but that growth in income should be taken into account when considering tax policy. A separate literature that considers affordability (price and income simultaneously) has recently developed and is considered later in this chapter.

Baltagi and Goel (1987) and Tegene (1991) used estimation techniques that allowed the price elasticity to change over time and found that the demand for cigarettes in the USA became less elastic over time. Andrews and Franke (1991), using a meta-analysis of published studies came to a similar conclusion. Figure 4.1 shows a scatter plot of the estimated price elasticity of demand, against the midpoint of the period for which the study was performed. The studies included in this scatter plot have been taken primarily from Andrews and Franke (1991) and US Department of Health and Human Services (2000), supplemented by more recent research.[11] In Figure 4.1 the number of years of data used in each study is represented by the size of each dot. The smallest dots represent the smallest number of years of data, while the studies that use the largest number of years of data have the largest dots. The smallest number of years of data is 10 years while the largest is 58 years.

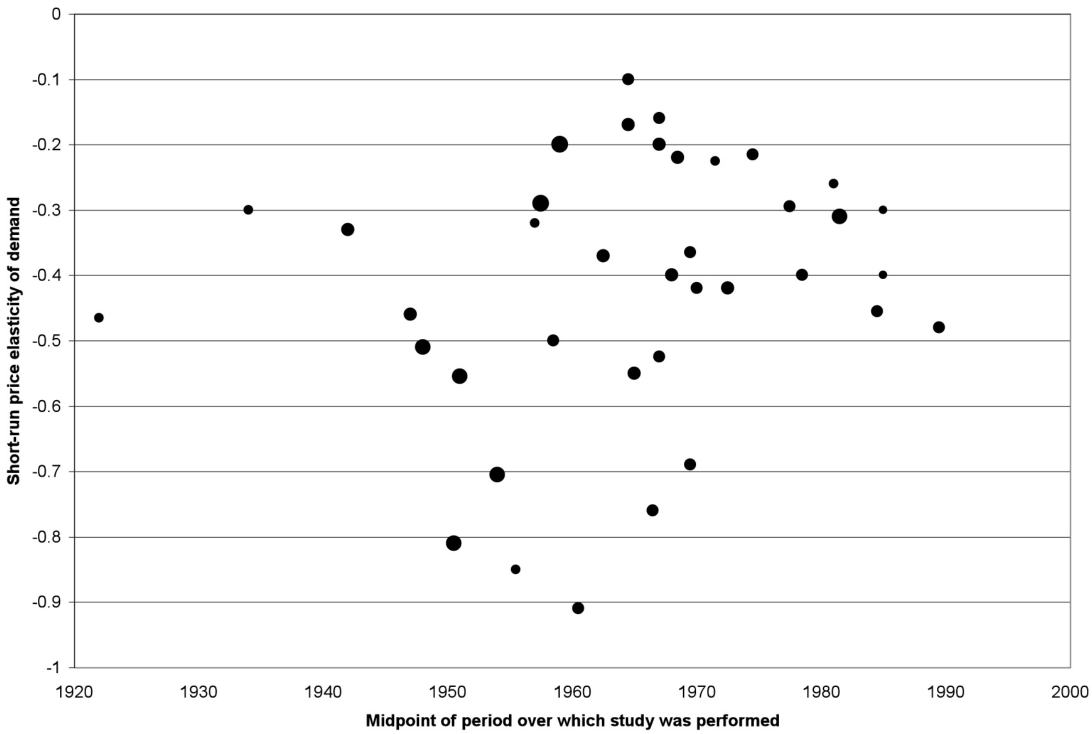
Figure 4.1 shows that the majority of estimates of price elasticity lie between −0.1 and −1.0, with most clustered between −0.2 and −0.6.

[9] Abernethy and Teel (1986) found a significant positive relationship for print advertising but not broadcast advertising.

[10] See Andrews and Franke (1991) for a more complete list.

[11] For studies listed in US Department of Health and Human Services (2000), the price elasticity estimates as published in USDHHS were used in Figure 4.1. For studies listed in Andrews and Franke (1991), an average price elasticity is calculated if more than one price elasticity estimate was published in any particular study. Long-run price elasticities are not shown.

Figure 4.1. Price elasticity estimates for the USA, based on time series studies

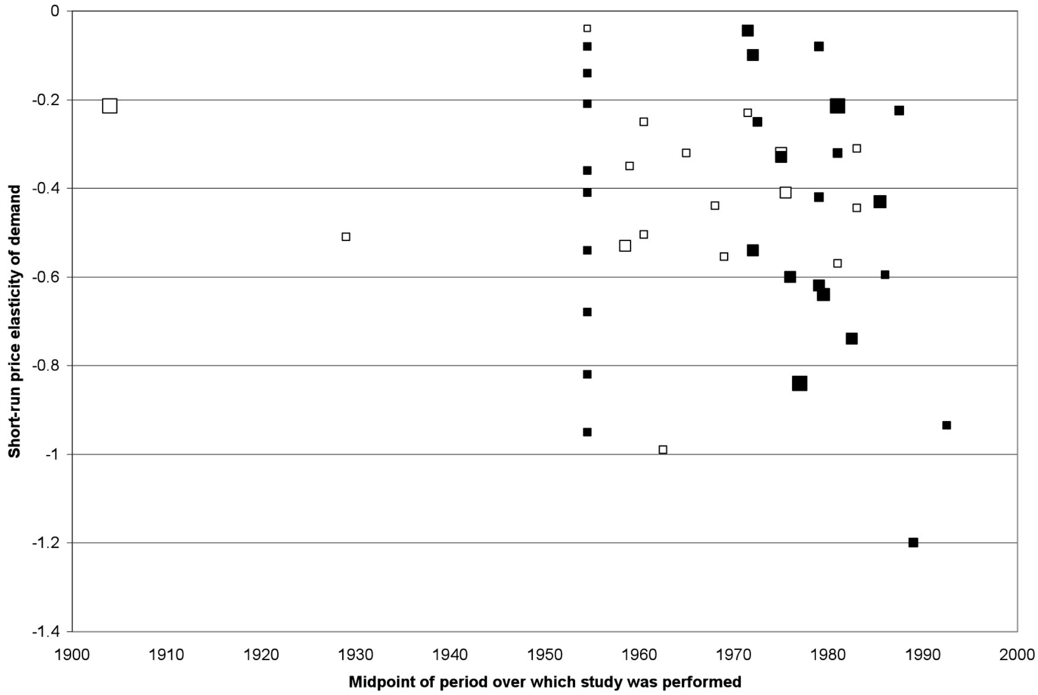


Sources: The studies referred to in the figure can be found in Table 4.1. The table only includes short-run elasticities. The years refer to the middle year under investigation in those studies, hence the most recent study (Goel, 2009) includes data from 1975 to 2004 and is thus listed in 1989/90.

The small number of studies which fall outside of this cluster have no systematic methodological, data or estimation technique differences from those within the cluster. On the basis of these studies there is no strong evidence that the demand for cigarettes has become less elastic over time. More recent studies suggest that the range of estimated price elasticities has narrowed somewhat since the 1970s, with reduced variability, between −0.20 and −0.50. Of course this raises the question of why this may be the case. Several reasons can be put forward. First, estimation techniques (and possibly data quality) may have improved over time. For example, including variables in the demand equation that are positively related to price will tend to reduce the coefficient on price (and thus reduce the absolute value of the price elasticity). However, while this is a theoretical possibility, the list of control variables in demand equations based on aggregate data has not changed much over time, and thus more complete and more comprehensive specification of the demand equation is not a likely reason for the perceived reduction in the price elasticity over time. However, more recent studies have given explicit recognition of illicit cigarettes (i.e. smuggled, etc.) and their impact on the price elasticity estimates (Baltagi and Levin, 1986, Baltagi and Goel, 1987, Becker *et al.*, 1994, Sung *et al.*, 1994, Thursby and Thursby, 2000, Baltagi *et al.*, 2000, Huang *et al.*, 2004). If the illicit trade in cigarettes is not controlled for, this results in price elasticity estimates that are biased away from zero. Accounting for illicit cigarettes reduces the bias and hence the absolute value of the price elasticity estimates.

Second, as the general level of income has increased over the past 50 years, cigarettes have generally become more affordable (despite the fact that their real price has increased over this time period). Thus the proportion of income required to purchase a packet of cigarettes has decreased over this long time period. However, this is not true for the past two decades, which have seen very rapid increases in the price of cigarettes. Economic theory indicates that the price elasticity (in absolute terms) decreases as the product takes up a smaller proportion of a

Figure 4.2. Price elasticity estimates for the United Kingdom and other high-income countries, based on time series studies. White squares are United Kingdom studies and solid black squares are from other high-income countries.



Sources: Figure calculated by the Working Group.
The studies referred to in the figure can be found in Table 4.2. The table only includes short-run elasticities. Estimates for several countries come from a single study by Koutsoyiannis (1963) and result in a grouping on the midpoint 1954/1955. The years refer to the middle year under investigation; hence the most recent study (Pierani and Tiezzi, 2009) includes data from 1960 to 2002 and is thus listed in 1981.

person's or household's total income and becomes more affordable.

Other high-income countries

Table 4.2 is a comprehensive chronological summary of 39 published cigarette demand studies in developed countries other than the US. The list is dominated by studies based on the United Kingdom (16), followed by that of New Zealand (four). As it turns out, these two countries, together with Australia, Canada and the USA, have been at the forefront of tobacco control policy.

Figure 4.2 depicts all of the elasticity estimates from Table 4.2. The large number of estimates from the United Kingdom are depicted by the white squares and studies from other high-income countries by the solid black squares. Again, the larger squares represent longer time periods under consideration, the smallest being 9 years and the largest being 68 years. The price elasticity estimates range between zero (i.e. not significant) and −1.2, with most studies clustered between −0.2 and −0.6. With two exceptions, all estimates in the United Kingdom lie between −0.2 and −0.6. There is greater variation in other high-income countries, although this might be expected since the countries vary significantly with respect to many factors (i.e. price, income and tobacco control measures). Even though the methodologies, types of data and estimation techniques differ widely between studies, the results do not differ widely, especially in the United Kingdom. Whereas there is very limited evidence that the absolute value of the price elasticity of demand may be decreasing in the USA, there is no such evidence for other developed countries. It is part of the conventional wisdom that the average price elasticity of demand for tobacco is around −0.4 in developed countries (Jha and Chaloupka, 1999; Chaloupka *et al.*, 2000b; U.S. Department of Health and Human Service, 2000).

Several of the studies in this group of countries are notable. Stone (1945), Prest (1949) and Koutsoyiannis (1963) were the first to estimate demand in any country. Townsend (1987) was unique in that it estimated different elasticities for different social classes in the United Kingdom.

Table 4.2. Studies employing aggregate data in other high-income countries

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Stone (1945)	United Kingdom and United States	**UK** between –0.49 and –0.53 **UK** 0.24	**UK** 0.07 (not significant) **US** 0.33	Time trend (positive), UK dummy for coupon trading (1928–33) (positive)	Static log linear OLS	Annual time series data from 1920 to 1938	First known study to attempt to estimate elasticities
Prest (1949)	United Kingdom	Between –0.12 and –0.31, depending on specification	0.17	Time trend (positive), post-World War I dummy variable (positive)	Static levels and first differences log linear model	Annual time series data from 1870 to 1938 with 1915 to 1919 excluded	
Koutsoyiannis (1963)	14 high-income countries (single country equations)	**US** -0.94 **UK** -0.04 (insig.) **France** -0.54 **Italy** -0.82 **The Netherlands** -0.08 (insig.) **Belgium** -0.68 **Sweden** -0.41 **Norway** Not shown (insig.) **Finland** -0.41 **Austria** -0.95 **Greece** Not shown (insig.) **Ireland** -0.15 (insig.) **Canada** -0.21 (insig.) **Australia** -0.36	**US** 0.34 (insig.) **UK** 0.07 (insig.) **France** 0.83 **Italy** 0.48 (insig.) **The Netherlands** 0.10 (insig.) **Belgium** Not shown **Sweden** 0.26 (insig.) **Norway** 0.18 **Finland** 0.13 (insig.) **Austria** 0.11 **Greece** 0.07 (insig.) **Ireland** 0.56 (insig.) **Canada** 0.09 (insig.) **Australia** 0.43 (insig.)	Population size (positive), prices of all other goods and services (negative for Greece, not included for other countries), Time trend (generally positive)	Static log linear OLS	Annual time series data from 1950 to 1959	Single equation for each country
Sumner (1971)	United Kingdom	**For annual data** between –0.13 and –0.57, depending on specification **For quarterly data** between –0.60 and –0.83, depending on specification	Positive	Health publicity dummy and trend variables (negative)		Annual and quarterly time series data from 1951 to 1967	Investigated the impact of the 1962 Royal College of Physicians report on cigarette consumption

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Atkinson and Skegg (1973)	United Kingdom	**All adults** between –0.1 and –0.4 depending on specification *Males* statistically insignificant *Females* -0.35	Positive	Health publicity dummy and trend variables (generally negative)		Annual time series data from 1951 to 1970	
Russell (1973)	United Kingdom	-0.50 to –0.66	Not explicitly included, a price-income ratio is included (affordablility elasticity) -0.44 to -0.58	Royal College of Physicians Reports (1962 and 1971) (negative)	Rather than using regression analysis, the results are based on correlations and graphical representations of the data	Annual time series data from 1946 to 1971	Males only
Peto (1974)	United Kingdom	*For males* -0.37 to –0.64 Females not investigated	0.14 to 0.49 (generally insignificant)	Health publicity dummy and trend variables (generally negative)	Seemingly a log linear OLS	Annual time series data from 1951 to 1970	Used to try to address the conflicting results regarding price elasticity between Atkinson and Skegg (1973) and Russell (1973)
McGuinness and Cowling (1975)	United Kingdom	**Short run** -0.99 **Long run** -1.05	**Short run** 0.31 **Long run** 0.33	«Stock» od advertising expenditure (positive)	Log linear model addition (Koyck)	Quarterly time series data from 1957 (Q2) to 1968 (Q4)	
Metra Consulting Group Ltd (1979)	United Kingdom	**Short-term** -0.34 to –0.54 **Long-term** -0.42 to –0.54	Unknown	Unknown	Unknown	Quarterly time series data from 1958 to 1978	The study was based on and aimed to refute McGuinness and Cowling's (1975) finding of a positive relationship between advertising and cigarette consumption. Using data supplied by the tobacco industry, the study found no significant relationship between advertising and cigarette consumption. Quoted in High (1999)

Table 4.2. Studies employing aggregate data in other high-income countries

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Witt and Pass (1981)	United Kingdom	-0.3	Income (positive)	Advertising expenditure (positive), "Health scare" dummy variables (negative)		Annual time series data from 1955 to 1975	Investigated whether the reports by the Royal College of Physicians (1962 and 1971) and the US Surgeon General (1964) had an impact on cigarette consumption
Leeflang and Reuijl (1985)	West Germany	Excluded from analysis because "coefficient of variation is extremely low"	[0.50 to 0.60] (insignificant)	Household consumption (proxy for income) (positive), Sales quantities of substitutes to cigarettes (generally negative), Advertising expenditure (positive)	Linear OLS myopic addiction	Annual, quarterly and monthly time series data from 1961 to 1975	The Working Group calculated the elasticities in [ ] at the mean
Radfar (1985)	United Kingdom	-0.23	0.12	"Stock" of advertising expenditure (positive), health publicity (interaction dummy variables with advertising variables)	Myopic addiction log linear OLS	Quarterly time series data from 1965 (Q3) to 1980 (Q4)	Replicates McGuinness and Cowling's (1975) study
Johnson (1986)	Australia	-0.10 at the means of the sample data	Positive	Advertising expenditure (insignificant), ban on electronic media advertising dummy variables (insignificant)		Annual data from 1961/62 to 1982/83	
Worgotter and Kunze (1986)	Austria	-0.54	Positive	Total private consumption (proxy for income) (positive), "Stop smoking" dummy variable for 1974 (negative)		Annual time series data from 1955 to 1983	
Stavrinos (1987)	Greece	**Linear** *Short-run* -0.01 *Long-run* -0.57 **Log linear** *Short-run* -0.08 *Long-run* -0.15	**Linear** *Short-run* 0.12 *Long-run* 0.70 **Log linear** *Short-run* 0.18 *Long-run* 0.33	Health promotion programme dummy variable (negative)	Myopic addiction linear and log linear OLS	Annual time series data from 1961 to 1982	Uses nominal data

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Townsend (1987)	United Kingdom	Between +0.15 (male professionals) and –1.26 (for unskilled male workers), all insignificant	Between 2.6 (male professionals) and 0.2 (for unskilled male workers), all insignificant	Trend (generally negative, but insignificant), Health publicity dummy variables (varying, but generally negative)	Static log linear OLS	Annual time series data from 1961 to 1977	Investigates differential elasticities amongst demographic groups (five social classes); more educated and well-off people have lower price elasticity of demand, but respond faster to health information than less-educated and poorer people
Chetwynd *et al.* (1988)	New Zealand	Between –0.13 and –0.73 (but insignificant)	Between –0.26 and 0.64 (but insignificant), only significant estimates are between 0.50 and 0.64	Advertising expenditure (positive), consumption in previous period (positive)	Myopic addiction, log linear OLS	Quarterly and annual time series data from 1973 to 1985	
Harrison *et al.* (1989)	New Zealand	**Short-run** -0.08 **Long-run** [-0.14] (but both elasticity estimates are statistically insignificant)	**Short-run** 0.50 **Long-run** [0.78] The Working Group calculated the long-run estimates in [ ] from the short-run estimate and the lagged dependent variable	Lagged consumption, Seasonal dummy variables	Log linear OLS		An extension of Chetwynd *et al.* (1988) and addresses Jackson and Ekelund's (1989) criticism that the original paper suffers from a number of econometric modelling drawbacks. Using some standard econometric tests, Harrison *et al.* show that "the original model and conclusions appear to be very robust"
Harrison and Chetwynd (1990)	New Zealand	-0.32	Positive	Advertising expenditure (positive), Anti-smoking advertising (negative)		Quarterly time series data from 1973 (Q1) to 1989 (Q2)	
Duffy (1991)	United Kingdom	-0.32	0.89	Advertising expenditure (not significant)	Demand system model	Quarterly time series data from 1963 (Q1) to 1987 (Q3)	Demand system includes alcoholic drinks and cigarettes

Table 4.2. Studies employing aggregate data in other high-income countries

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Andrews and Franke (1991)	Meta analysis of studies performed in the United Kingdom, United States, and six other countries	**Weighted mean elasticity for all 198 regression equations** -0.36 **Weighted mean elasticity for all 41 studies** -0.47	**Weighted mean elasticity for all 190 regression equations** 0.36 **Weighted mean elasticity for all 36 studies** 0.40	Other relationships: Advertising expenditure (positive)	Meta-analysis		Meta-analysis of 48 studies
Valdés (1993)	Spain	**Short-run** -0.60 **Long-run** -0.69	**Short-run** 0.17 **Long-run** 0.20	Advertising expenditure (positive), dummy variables for legislative interventions (generally negative)	Myopic log linear OLS	Annual time series data from 1964 to 1988	
Simester and Brodie (1994)	Meta-analysis of studies performed in United Kingdom, United States, New Zealand and West Germany	**Average price elasticity** -0.54 **Median price elasticity** -0.48	Positive	Advertising (positive)	Meta-analysis		Meta-analysis of 29 published studies
Townsend *et al.* (1994)	United Kingdom	**For males (overall)** -0.47 **For females (overall)** -0.61 Elasticity was inversely related to social class. Young adult males are not price-responsive, but young adult females are	Generally no significant income effect, generally positive amongst men with the exception of older men (50+)	Health publicity (negative)	Static log linear OLS, single equation for each group	Annual time series data from 1972 to 1990	Assesses elasticitties for different demographic groups
Duffy (1995)	United Kingdom	-0.35 to -0.47	0.96 to 1.01	Advertising (insignificant)	Almost Ideal Demand System (AIDS), static and dynamic	Quarterly time series data from 1963 (Q1) to 1992 (Q1)	System includes beer, spirits, wine and all other commodities
Cameron (1997)	Greece	Negative and insignificant price elasticity	Income (positive and significant in myopic addiction model, positive and insignificant in rational addiction model)	Television advertising dummy (positive but insignificant), Anti smoking campaign dummy (generally negative and significant)	Linear and log linear myopic and rational addiction OLS	Annual time series data from 1970	No end date reported

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Hondroyiannis and Papapetrou (1997)	Greece	**Short-run** -0.33 **Long-run** -0.60	**Short-run** 0.35 **Long-run** 0.54		Dynamic Error Correction Model	Annual time series data from 1960 to 1990	
Lanoie and Leclair (1998)	Canada	**Legal consumption** *Short-run* [-0.34] *Long-run* [-0.61] **Total consumption** *Short-run* [-0.11] *Long-run* [-0.28]	**Legal consumption** *Short-run* [0.24] *Long-run* [0.44] **Total consumption** *Short-run* [0.14] *Long-run* [0.36]	Regulation and time trend	Myopic linear GLS with fixed effects	Pooled annual data from 1980 to 1995	Looks at smuggling and its impact on elasticities. Values in [ ] calculated by the Working Group
Bardsley and Olekalns (1999)	Australia	**Short-run** Between [-0.2 and –0.3] for period 1963 to early 1980s, but increases rapidly to [–1.2] between 1982 and 1996 **Long-run** Between [-0.5 and –0.6] for period 1963 to early 1980s, but increases rapidly to [–3.0] between 1982 and 1996	**Short-run** Between [0.2 and 0.4] for period 1963 to early 1980s, but increases rapidly to [0.7] between 1982 and 1996 **Long-run** Between [0.4 and 0.8] for period 1963 to early 1980s, but increases rapidly to [1.5] between 1982 and 1996	Age structure of population (older population ==> more cigarette consumption), Advertising (positive, but small), Health warnings (negative, but small), Ban on smoking in public places (negative, but small)	Linear rational addiction model, GMM	Annual time series data from 1962/63 to1995/96	Investigates how elasticity estimates have changed over time. Elasticity values in [ ] computed at the mean by the Working Group
Mindell and Whynes (2000)	Netherlands	-0.45 to -1.03	1.2	Unemployment and health promotion expenditure	Log linear static OLS	Annual time series data from 1970 to 1995	Looks specifically at substitution between manufactured and hand-rolled
Reinhardt and Giles (2001)	Canada	**Short-run** -0.62 **Long-run** -0.23	**Short-run** 0.19 **Long-run** no estimated	Includes dummy variables for structural breaks	Log linear OLS Myopic model	Quarterly times series data from 1968:1 to 1990:2	
Yorozu and Zhou (2002)	Japan	-0.64 to -1.23	-0.20 to 0.38	Anti smoking budget, time trend	Static linear OLS and WLS	Data from two time periods: 1990 and 1995	Study looks at regional cross sections at two points in time
Gallus *et al.* (2003)	Italy	-0.43	0.10		Static log linear model	Annual time series data from 1970 to 2001	
Gruber, Sen and Stabile (2003)	Canada	-0.72 but -0.47 excluding smuggling, provinces and years	Positive	Unemployment	Two way fixed effects linear model	Annual time series data from 1981 to 1991	

Table 4.2. Studies employing aggregate data in other high-income countries

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Bask and Melkersson (2004)	Sweden	**Long-run** *Separate models* -0.81 (-3.63 when two lags and leads included) *Joint models (alcohol and cigarettes together)* -0.65 to -1.03	Not included in model	Price of alcohol (negative)	Rational addiction linear OLS, SUR and GMM. First differences.	Annual time series data from 1955 to 1999	
Escario and Molina (2004)	Spain	**Virginia tobacco** -0.80 **Black tobacco** -0.48 **Cigars** -0.93	**Expenditure elasticities** *Virginia tobacco* 0.37 *Black tobacco* 0.67 *Cigars* 0.70		Almost Ideal Demand System	Annual time series data 1964 to 1995	Elasticities have fallen over time in absolute terms
Duffy (2006)	United Kingdom	**Static** -0.41 to -0.48 Myopic Short-run -0.16 to -0.46 Long-run -0.45 to -0.49 Rational Short-run -0.01 to -0.13 Long-run -0.26 to -0.41	Static 0.28 to 0.31 Myopic Short-run 0.08 to 0.28 Long-run 0.20 to 0.29 Rational Short-run 0.05 to 0.06 Long-run 0.11 to 0.16	Advertising expenditure	Static, myopic and rational models, linear, elasticity at the mean. Demand system.	Quarterly time series data from 1962, 2nd quarter to 2002, 3rd quarter	
Pierani and Tiezzi (2009)	Italy	**Short-run** [-0.09 to -.0.34] **Long-run** [-0.31 to -1.07]	**Short-run** [-0.09 to -.034] **Long-run** [0.19 to 1.56]	Price of complement (i.e. alcohol or tobacco) in single equation model	Rational addiction first difference GMM (independent and systems equations)	Annual time series data between 1960 and 2002	Studies the relationship between alcohol and cigarette consumption. Elasticity values in [ ] computed at the mean by the Working Group

For quarterly data, corresponding quarter specified in parenthesis.
In this table, short-run & long-run estimates can also be designated as SR and LR respectively.
Values in [ ] calculated by the Working Group using data reported in corresponding studies.
(insig.) refers to non statistically significant estimates
GLS, generalized least squares estimates/estimator; GMM, generalized methods of moments estimator; OLS, ordinary least squares estimates/estimator; SUR, seemingly unrelated system of equations; WLS, weighted least squares estimates/estimator

This is unusual in aggregate data studies and usually only found in cross-sectional studies. Unsurprisingly, the results showed that unskilled male workers were more responsive to price changes than were male professionals. Townsend *et al.* (1994), in another United Kingdom study again estimated elasticities for different socioeconomic and age groups using aggregate data. They found that females are more sensitive to price changes than were males, and that elasticities are inversely related to social class. Young adult males were not found to be price-responsive but young adult females were (see Chapters 5 and 6, which consider cross-sectional studies with similar themes). Chetwynd *et al.* (1988) began a series of important studies in New Zealand. The study was concerned with examining the relationship between print advertising and consumption but estimated price elasticities ranging between −0.13 and −0.73 as a control in the model. Harrison *et al.* (1989) was an extension to address the methodological concerns raised, and improved the paper by using a myopic addiction model estimating a smaller price elasticity of −0.08. Harrison and Chetwynd (1990) made further improvements using quarterly data instead of annual data, and estimated a price elasticity of −0.32.

Duffy (1991) estimated cigarette demand using aggregate data by employing a demand system in the United Kingdom. The Almost Ideal Demand System (AIDS) yielded estimates of own price and cross price elasticities for cigarettes as well as alcoholic drinks (beer, wine and spirits). Duffy found that cigarettes and alcoholic drinks exhibited no significantly complementary behaviour. Duffy (1995) conducted another AIDS model including cigarettes, beer, wine, spirits and all other commodities. This time Duffy used a dynamic specification of demand although he did not report the cross price elasticities. Escario and Molina (2004) employed a dynamic AIDS in Spain.

However, they did not include alcohol, rather including three different types of tobacco products, Virginia tobacco, black tobacco and cigars. They found that the price elasticities, in absolute terms, fell over time between 1964 and 1995. Price elasticities for all tobacco products considered were negative, and Virginia tobacco and cigars were more price sensitive than black tobacco. Virginia and black tobacco were found to be substitutes in consumption, as were black tobacco and cigars, although Virginia tobacco and cigars were complements in consumption.

Although using a far simpler methodology, Mindell and Whynes (2000) also estimated product substitution although between manufactured cigarettes and hand-rolled cigarettes in the Netherlands. Although cross-price elasticities were negative, this was explained by the collinearity between the prices for manufactured and hand rolled cigarettes. However, they found that when the price of hand-rolled cigarettes increased by a greater proportion than the price of manufactured cigarettes, the decline in manufactured cigarette consumption was accompanied by a decline in hand-rolled cigarette consumption.

Hondroyiannis and Papapetrou (1997) is one of several Greek studies. It is one of the more thorough time series studies in that it estimates a dynamic specification of demand and employs an Error Correction Model to deal with the time series issues in the data. The use of advanced time series techniques is relatively rare in this literature, and this was the first studies to do so in this context. It found a short-run price elasticity of −0.33 and a long-run elasticity of −0.60. Other Greek studies found short-run price elasticities of −0.01 and −0.08 (Stavrinos, 1987) while Koutsoyiannis (1963) and Cameron (1997) found price to be insignificant.

Lanoie and Leclair (1998) is a Canadian study that aimed to deal with the problem of cigarette smuggling using annual time series data from 10 Canadian provinces from 1980 to 1995. During this time period the volume of smuggled cigarettes in Canada grew rapidly. The existence of a large illegal market is likely to result in overstated price elasticities (in absolute terms). Lanoie and Leclair estimated two models, one with legal cigarette consumption as the dependent variable and the second using an estimation of total cigarette consumption by adding estimates of the volume of illegal cigarettes to the volume of legal cigarettes. The elasticities using only the legal consumption were found to be significantly greater in absolute terms (both the short-run and long-run, −0.34 versus −0.11 and −0.61 versus −0.28 respectively) than the model using the total consumption. Gruber *et al.* (2003) also tackled the issue of the impact of smuggling on elasticities in Canada, and found that elasticities are larger, in absolute terms, when including provinces and years in which smuggling was known to be present (−0.72 versus −0.47).

Bardsley and Olekalns (1999) estimated a rational addiction model in Australia, and while they found support for rational addiction between 1963 and 1996, their interesting innovation was how they specified the model in linear terms to investigate how elasticities changed over time. They found that both short- and long-run elasticities in absolute terms grew significantly over time, meaning that consumption became more responsive to changes in price. The short-run elasticity ranged between −0.2 and −0.3 between 1963 and the early 1980s, but increased rapidly to −1.2 between 1982 and 1996. The long-run elasticity ranged between −0.5 and −0.6 in the first period, and increased rapidly to −3.0 in the later period. Escario and Molina (2004), however, reported that elasticities have, in absolute terms, fallen over time in Spain.

Studies in high-income countries have found similar results to those in the USA. The variation in countries considered results in some variation in results, although the general range is similar.

Low- and middle-income countries

As pointed out in the introduction to this chapter, tobacco use is shifting from the developed to the developing world. Before 1990 the economics of tobacco control in developing countries received practically no attention from either policymakers or academic researchers. The fall of communism and rapid globalization created opportunities for multinational cigarette companies to diversify their markets into a rapidly growing developing world, particularly in eastern Europe and Asia. The USA used the threat of trade sanctions to prise open the markets in Thailand, Japan, the Republic of Korea and Taiwan, China to foreign cigarettes (Chaloupka and Laixuthai, 1996). Developing countries did not have effective tobacco control policies in place, and presumably many developing countries did not see the need for measures that were imposed in rich industrialised countries but that were deemed unnecessary in developing countries. Against this background an empirical literature on the demand for tobacco in developing countries developed.

A chronological summary of studies that investigated the demand for tobacco is provided in Table 4.3. The first attempt was by Chapman and Richardson (1990), who used annual time series data to estimate the response in tobacco demand to a change in tobacco excise taxes. They used cigarette excise taxes as a proxy for cigarette prices, because the latter were unavailable. They found that the “excise tax elasticity” was about −0.7 for cigarettes and −0.5 for other forms of tobacco. Subsequent studies, also based on time series data, estimated price elasticity estimates for Argentina (Gonzáles-Rozada, 2006), Bangladesh (Ali *et al*., 2003), Bolivia (Alcaraz, 2006), Brazil (Da Costa e Silva, 1998, Iglesias, 2006), Chile (Debrott Sanchez, 2006), China (Hu and Mao, 2002, Yuanliang & Zongyi, 2005), Taiwan, China (Hsieh *et al*., 1999, Lee, 2007, Lee and Chen, 2008), Egypt (Hanafy *et al*., 2011), Estonia (Taal *et al*., 2004), Indonesia (Djutaharta *et al*., 2005), Malaysia (Ross and Al-Sadat, 2007), Morocco (Aloui, 2003), Poland (Florkowski and McNamara, 1992), South Africa (Reekie, 1994, Van Walbeek, 1996, Economics of Tobacco Control in South Africa Project (ETCSA),1998, Boshoff, 2008), Republic of Korea (Wilcox *et al*., 1994, Kim and Seldon, 2004), Turkey (Tansel, 1993, Onder, 2002, Yurekli *et al*., 2010), Ukraine (Peng and Ross, 2009), Uruguay (Ramos, 2006) and Zimbabwe (Economics of Tobacco Control in South Africa Project 1998). Guindon *et al*. (2003) performed a multi-country study in Bangladesh, Indonesia, Maldives, Myanmar Nepal, Sri Lanka and Thailand.

The fact that cigarette demand in developing countries is more elastic than in developed countries was predicted by Warner (1990), on the grounds that cigarettes are generally less affordable in developing countries, given their much lower per-capita income levels (confirmed by Blecher and van Walbeek, 2004 and 2009). Warner (1990) argued that, like the lower social classes in the United Kingdom and teenagers in the USA, tobacco users in developing countries have relatively lower incomes, and consequently price increases for goods in their budgets impinge more significantly on their ability to purchase other goods and services (Warner, 1990).

Since the mid-1990s, tobacco control research in developing countries has received substantial financial and institutional support from organizations including Research for International Tobacco Control, the Tobacco-Free Initiative of the World Health Organization and the World Bank. More recently, support has come from the Bloomberg Initiative to Reduce Tobacco Use via the Campaign for Tobacco Free Kids and the International Union Against Tuberculosis and Lung Disease as well as the Bill and Melinda Gates Foundation. These organizations realized that there was a need for country-specific analytic work with a strong policy focus (De Beyer & Waverley Brigden, 2003). As is to be expected, policymakers in developing countries were unwilling to impose tobacco control policies in their countries solely on the grounds that they were successful in developed countries. They wanted research that took cognisance of the uniqueness of their countries.

The research performed under the auspices of these organizations attempted to address such policymakers’ concerns. Countries that were investigated in this research drive and that used aggregate data in the analysis included

Table 4.3. Studies employing aggregate data in low- and middle-income countries

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Chapman and Richardson (1990)	Papua New Guinea	-0.50 for non-cigarette tobacco -0.71 for cigarettes (Important: these are "excise elasticities": see Comments)	1.37 for non-cigarette tobacco 0.86 for cigarettes	Price of substitutes (positive), Trend (negative)	Log linear static OLS	Annual time series from 1973 to 1986	First study conducted in a low-and-middle-income country. Excise tax data, rather than price data, were used because of data unavailability; as a result the price elasticities are larger than the "excise elasticities" estimated in the study
Florkowski and McNamara (1992)	Poland	-0.11	0.43	Price of substitutes, urban/rural population, trend for addiction	Linear static SUR system	Annual time series data from 1959 to 1985	System included vodka, wine and beer
Tansel (1993)	Turkey	**Short-run** -0.21 **Long-run** -0.37	**Short-run** 0.41 **Long-run** 0.71	Anti-smoking campaign dummy variable (negative), health warning dummy variable (negative)	Myopic addiction model	Annual time series data from 1960 to 1988	The first study to look at the time series effects in a developing country
Reekie (1994)	South Africa	-0.88	0.59	Advertising expenditures (insignificant)	Log linear static OLS	Annual time series data from 1970 to 1989	The demand equation was used to estimate the size of the consumer surplus
Wilcox *et al.* (1994)	Republic of Korea	Significantly negative (but elasticity estimate not shown)	Significantly positive (but elasticity estimate not shown)	Advertising expenditure (generally insignificant), population (insignificant), health warnings (insignificant)	Linear static stepwise OLS	Monthly time series data from July 1988 to April 1992	Regressions on aggregate and brand-level data
Van Walbeek (1996)	South Africa	**Short-run** –0.32 and –0.99 **Long-run** –0.53 and –1.52	**Short-run** 0.48 to 0.58	Time trend	Linear dynamic OLS	Annual time series data from 1960 to 1990	
Da Costa e Silva (1998)	Brazil	**Short-run** between –0.11 and –0.35 **Long-run** between –0.48 and –0.80	**Short-run** between 0.23 and 0.31 **Long-run** between 0.76 and 0.80	Unknown	Rational addiction	Annual time series data from 1983 to 1994	Lack of explanation precludes evaluation and unable to replicate

Table 4.3. Studies employing aggregate data in low- and middle-income countries

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Economics of Tobacco Control in South Africa Project (1998)	South Africa	**Short-run** between –0.57 and –0.59 **Long-run** -0.69	**Positive** *Long-run income elasticity* 1.70	Advertising expenditure (positive)	Myopic addiction Error Correction Model and long-run cointegrating VAR	Annual time series data from 1970 to 1994	Model included a supply side equation
	Zimbabwe	**Short-run** -0.52 **Long-run** -0.85	**Positive** *Long-run income elasticity* 1.67		Rational addiction OLS	Annual time series data from 1970 to 1996	
Hsieh *et al.* (1999)	Taiwan, China	Between –0.6 and –0.7, depending on specification	Positive	Market share of low tar cigarettes, female labour force participation rate, market share of imported cigarettes		Annual time series data from 1966 to 1995	Quoted in Chaloupka *et al.* (2000b)
		Between -0.56 and -0.73 for local brands; Between -1.08 and -1.28 for imported brands	Between 0.22 and 0.26, but centring on 0.22 for local brands; around 1.42 for imported brands.	Dependent variable = per capita (adult, 15+) consumption; Independent variables: Real price, subdivided into local and imported brands; market share of low-tar brands as proxy for health awareness; dummy variable (1991-1995 = 1) to account for warning labels; market share of imported cigarettes; female labour force participation rate	Dynamic OLS, 2SLS and SUR	Annual times series data from 1966 to 1995	Domestic and imported cigarettes are considered substitutes
Hu and Mao (2002)	China	**Short-run** -0.35 **Long-run** -0.66	Positive	Time trend	Dynamic semi log	Annual time series data from 1980 to 1997	
Onder (2002)	Turkey	**Static** *OLS* -0.31 to -0.41 *GLS* -0.19 to -0.28 **Dynamic** -0.09 to -0.12	**Static** *OLS* 0.27 to 0.29 *GLS* 0.23 to 0.25 **Dynamic** 0.10 to 0.17	Regulation index (not significant), Trend (not significant), Price of substitute cigarettes (varying)	Log linear static OLS and GLS	Annual time series data from 1960 to 2000	

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Ali *et al.* (2003)	Bangladesh	-0.27 (but not statistically significant)	0.62	None	Log linear static OLS	Annual time series data from 1983 to 1999	
Aloui (2003)	Morocco	**Short-run** between –0.51 and –0.73 **Long-run** between –1.36 and –1.54	**Short-run** between 0.32 and 0.56 **Long-run** between 0.87 and 1.04	Dummy variable to indicate tobacco control legislation (insignificant)	Myopic addiction linear and log linear OLS	Annual times series data from 1965 to 2000	
Guindon *et al.* (2003)	Bangladesh, Indonesia, Nepal, Sri Lanka, Thailand, Maldives and Myanmar	**Elasticities based on conventional demand specification** between –0.60 and –0.90 **Elasticities based on myopic addictive model** *Short-run* between –0.10 and –0.65 *Long-run* between –0.80 and –1.40	**Elasticities based on conventional demand specification** between 0.28 and 0.99 **Elasticities based on myopic addiction model** *Short-run* between 0.04 and 1.03 *Long-run* between 0.28 and 1.72	Appropriate dummy variables to account for political crises	Various techniques: OLS, GLS and 2SLS, controling for time-specific and period-specific effects	Annual time series data from 1970 to 2000	
Kim and Seldon (2004)	Republic of Korea	**Short-run** -0.28 **Long-run** -0.35	Insignificant	Health warnings	Myopic addiction log linear OLS	Annual time series data from 1960 to 1997	
Taal *et al.* (2004)	Estonia	**Short-run** -0.32 to -0.34	**Short-run** 0.09 to 0.18 (not significant)	Quarterly dummies, time trend	Myopic addiction model Log linear OLS	Monthly time series data from 1992 to 1999 and annual time series data from 1993 to 2000	
Djutaharta *et al.* (2005)	Indonesia	**Annual data** -0.35 on preferred model; for other specifications elasticity varies from -0.33 to -0.47 **Monthly data** -0.32 on preferred model; for other specifications elasticity varies from -0.32 to -0.43	**Annual data** 0.47 on preferred model; for other specifications elasticity varies from 0.14 to 0.51 **Monthly data** no specification yielded significant results	Economic crisis dummy (1997-2001 = 1); trend; health warning dummy (1991-2001 = 1); for monthly analysis similar variables were used	Log linear static OLS	Monthly time series data from January 1996 to June 2001 and annual time series data from 1971 to 2001	Tested for endogeneity of price

Table 4.3. Studies employing aggregate data in low- and middle-income countries

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Yuanliang and Zongyi (2005)	China	-0.84	0.90	Education, regional dummies (fixed effects) average propensity to consume	Static OLS with fixed effects	Pooled annual data from 1997 to 2002	Cross-sections are provincial and spatial municipalities
Alcaraz (2006)	Bolivia	[-0.78 to -2.18]	[0.56 to 0.71]	Some dummies	Static, dynamic and rational addiction models. Some IV techniques	Annual time series data from 1988 to 2002	Elasticity values in [ ] computed at the mean by the Working Group
Debrott Sanchez (2006)	Chile	**Short-term** -0.22 **Long-term** -0.45	**Short-term** 0.11 **Long-term** 0.22	Trend variable, seasonal dummy variable and a dummy reflecting tobacco and health information campaigns	Myopic addiction model	Quarterly time series data from 1993 (Q1) to 2003 (Q4)	
Iglesias (2006)	Brazil	**Short-run** -0.25 **Long-run** -0.42	0.05 to 0.36	Trend variable, smoking restriction index, seasonal dummy	Log linear OLS estimation. Dynamic myopic addiction	Quarterly time series data from 1991 to 2003	Tests endogeneity of price
Gonzáles-Rozada (2006)	Argentina	-0.23 to -0.27	0.45 to 0.49	Some dummies	Log linear dynamic model. Cointegrating VAR	Monthly time series data from Jan 1996 to June 2004	
Ramos (2006)	Uruguay	**Short-term** -0.34 to -0.49 **Long-term** -0.39 to -0.55	**Short-term** 0.51 to 0.65 **Long-term** 0.59 to 0.73	Real bilateral exchange rate with Argentina, Brazil and Paraguay	Log linear myopic addiction model using IV, SURE, 2SLS, 3SLS	Quarterly time series data from 1991 to 2003	
Lee (2007)	Taiwan, China	-0.66		Expenditure, substitutes (alcohol and betel nuts)	Log linear SUR demand system	Annual time series data from 1972 to 2002	
Ross and Al-Sadat (2007)	Malaysia	**Short-run** -0.08 **Long-run** -0.54 to -0.76	**Short-run** 0.03 **Long-run** 1.40 to 1.5	Tobacco control policies (negative and significant)	Dynamic log linear ECM	Annual time series data from 1990 to 2004	
Boshoff (2008)	South Africa	Short-run elasticities not estimated **Long-run** -0.16 to -0.66	**Long-run** 0.37 to 0.73	Market share of light cigarettes, smoking restrictions dummy	Dynamic VAR	Annual times series data from 1996–2006	
Lee and Chen (2008)	Taiwan, China	-0.49 to 0.81		Expenditure, substitutes (imported, domestic cigs and cigars), smoking risk information	Log linear SUR demand system	Annual time series data from 1987 to 2000	

Study	Country	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Peng and Ross (2009)	Ukraine	Insignificant	0.30	Advertising	Static log linear GLS-AR process	Monthly time series data from January 1997 to May 2006	
Yurekli *et al.* (2010)	Turkey	-0.33 to -0.44	0.56	Economic crisis, time trend	Log linear static GLS	Annual time series data from 1960 to 2006	
Hanafy *et al.* (2011)	Egypt	-0.47	1.60	Dummy for Fatwa prohibiting smoking	Log linear static OLS	Annual time series data from 1990 to 2006	

For quarterly data, corresponding quarter specified in parenthesis.Values in [ ] calculated by the Working Group using data reported in corresponding studies.
ECM, error correction models estimates; GLS, generalized least squares estimates/estimator; GLS-AR, generalized least squares - auto regression process; IV, instrumental-variable estimation/estimator; OLS, ordinary least squares estimates; SUR, seemingly unrelated system of equations; SURE, Spanish acronym for SUR; VAR, vector autoregression; 2SLS, 2-stage least squares estimates; 3SLS, 3-stage least squares estimates/estimator

Turkey, Morocco, China, Egypt and Bangladesh.[12]

Some studies in low- and middle-income countries are of specific interest. South Africa has contributed the largest number of studies to the literature (Reekie, 1994, Van Walbeek, 1996, Economics of Tobacco Control in South Africa Project (ETCSA), 1998, Boshoff, 2008), and most are noteworthy. Reekie's (1994) uniqueness lies in the attempt to use the demand estimation to calculate the consumer's surplus. He estimated the price elasticity and based on this, together with some fairly strong assumptions about the shape of the demand function, was able to derive a value for the consumer surplus. Van Walbeek (1996) used a demand model to calculate the revenue-maximizing excise tax rate of a cigarette-specific Laffer curve. Finding the price elasticity to range between −0.32 and −0.99 (depending on the data source), he suggested that the government maximize its tax revenue by raising the excise tax so that it occupied 46% of the retail price. Boshoff's (2008) study is the most methodologically sound of any study in a low- or middle-income country, applying a dynamic specification of demand and estimating this specification using a cointegrating Vector Autoregressive (VAR) model (one of the most advanced time series techniques available). However, this technique only yields a long-run rather than the conventional short-run price elasticity, ranging between −0.16 and −0.66. Although many studies in low-and-middle-income countries now employ dynamic specifications, few consider the time series properties of the data and apply appropriate techniques to account for these properties.

Hsieh *et al.'s* (1999) Taiwan, China study was also novel in that it estimated separate price and income elasticities for domestic and imported cigarettes. They found that consumers of imported cigarettes were more price responsive than consumers of domestic cigarettes.

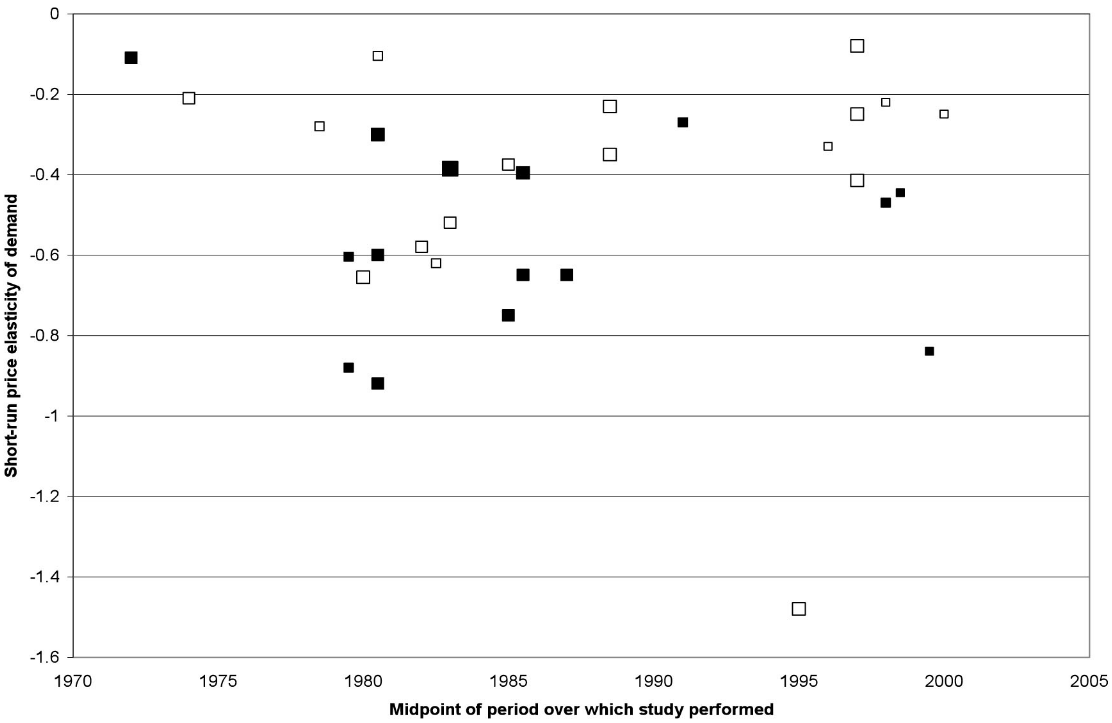
This should be expected since imported cigarettes are more expensive than domestic cigarettes. The estimated price elasticities for imported cigarettes ranged between −1.08 and −1.28, while the price elasticities for domestic cigarettes ranged between −0.56 and −0.73. Domestic and imported cigarettes were also found to be substitutes in consumption.

Two recent studies in Taiwan, China employed a systems approach to understand the substitutive behaviour between cigarettes, alcohol and betel nuts (Lee, 2007) and between imported cigarettes, domestic cigarettes and cigars (Lee and Chen, 2008). Lee (2007) found both alcohol and betel nuts to be complements in consumption to cigarettes. Lee and Chen (2008) found that imported and domestic cigarettes are substitutes, as expected. Imported cigarettes and cigars were also found to be substitutes in consumption, while domestic cigarettes and cigars were found to be complements in consumption.

The primary aim of most of these studies was to estimate the price elasticity of demand. The elasticity estimates varied significantly from one country to another, but as was the case with the earlier studies on the demand for tobacco in developing countries, they practically all found a relatively inelastic demand for cigarettes.

[12] These studies were, respectively, by Onder (2002) and Yurekli *et al.* (2010), Aloui (2003), Hu and Mao (2002), Hanafy *et al.* (2011) and Ali *et al.* (2003).

Figure 4.3. Price elasticity estimates for low- and middle-income countries, based on time series studies. White squares are dynamic studies and solid black squares are static studies.



Sources: Figure generated by the Working Group.
Note: The studies referred to in the figure can be found in Table 4.3. The table only includes short-run elasticities. The years refer to the middle year under investigation, hence the two most recent studies (Hanafy et al., 2011, and Yurekli *et al*., 2010) include data from 1990 to 2006 and 1960 to 2006 respectively and thus they are listed in 1998 and 1993 respectively.

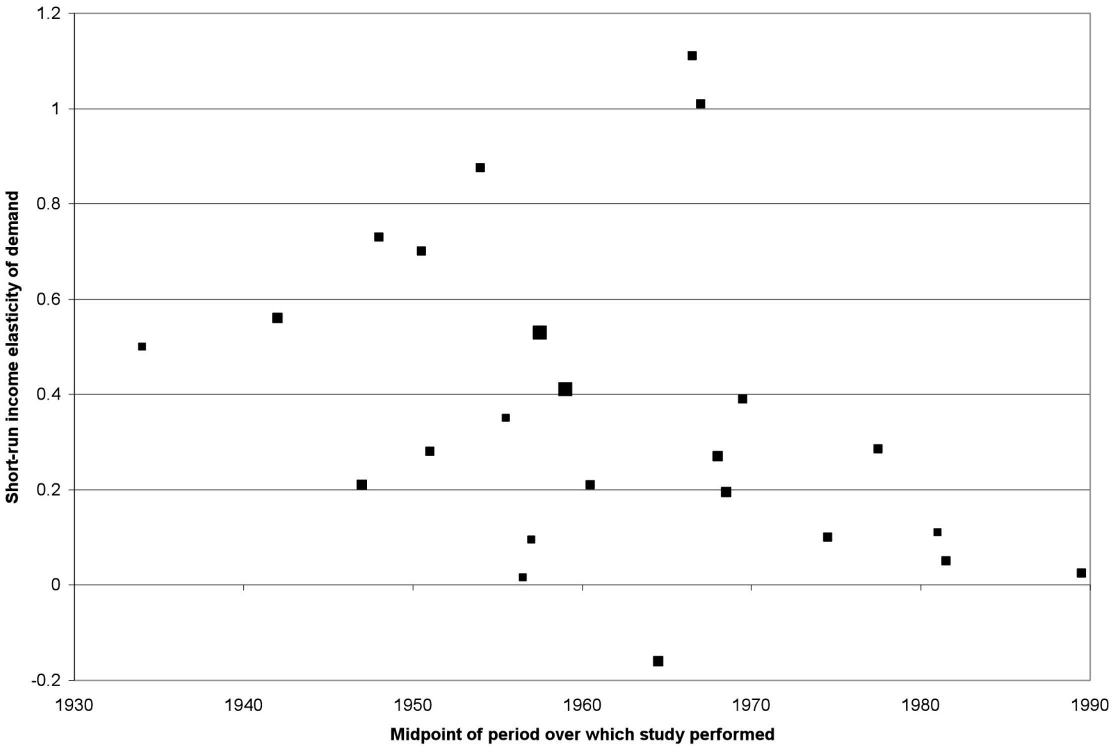
Figure 4.3 graphs all price elasticity studies in developing countries. It separates those studies which assume static specifications of demand (i.e. which do not control for the addictiveness of tobacco), represented by the solid black squares from those which assume dynamic specifications of demand (i.e. which control for the addictiveness of tobacco), represented by the white squares. Again, the larger data points represent a longer period under consideration in the study. The shortest time period is 5 years and the longest 46 years. When looking at only the static estimates, we find that the price elasticity of demand varies over a wide range between −0.2 and −1.0. However, when including only the dynamic estimates we find a narrower range of estimates between −0.1 and −0.7 (there is one outlier which is ignored). First, it is important to again confirm that all estimates indicate that tobacco is price-inelastic. Second, the range of elasticities differs somewhat between the static and dynamic specifications, with dynamic specifications resulting in a tighter range than static specifications.

Income elasticities

Most studies discussed have estimated income elasticities (the responsiveness of consumption as a result of a change in income). While this is generally not the intention of the studies, it is methodologically important to control for changes in income over time. Almost all of these studies find that tobacco is a normal good in that income has a positive impact on consumption, although this impact is not always statistically significant. The three figures below indicate the income elasticities estimated in the studies considered in the previous section and their evolution over time, Figure 4.4 for those studies in the USA, Figure 4.5 for other high-income countries and Figure 4.6 for low- and middle-income countries.

Almost all studies in the United States find that the income elasticity is positive and thus cigarettes are a normal good. Prior to 1970 the range of estimates was fairly wide (between 0 and 1.2) but has narrowed significantly since. Only

Figure 4.4. Income elasticity estimates for the USA, based on time series studies



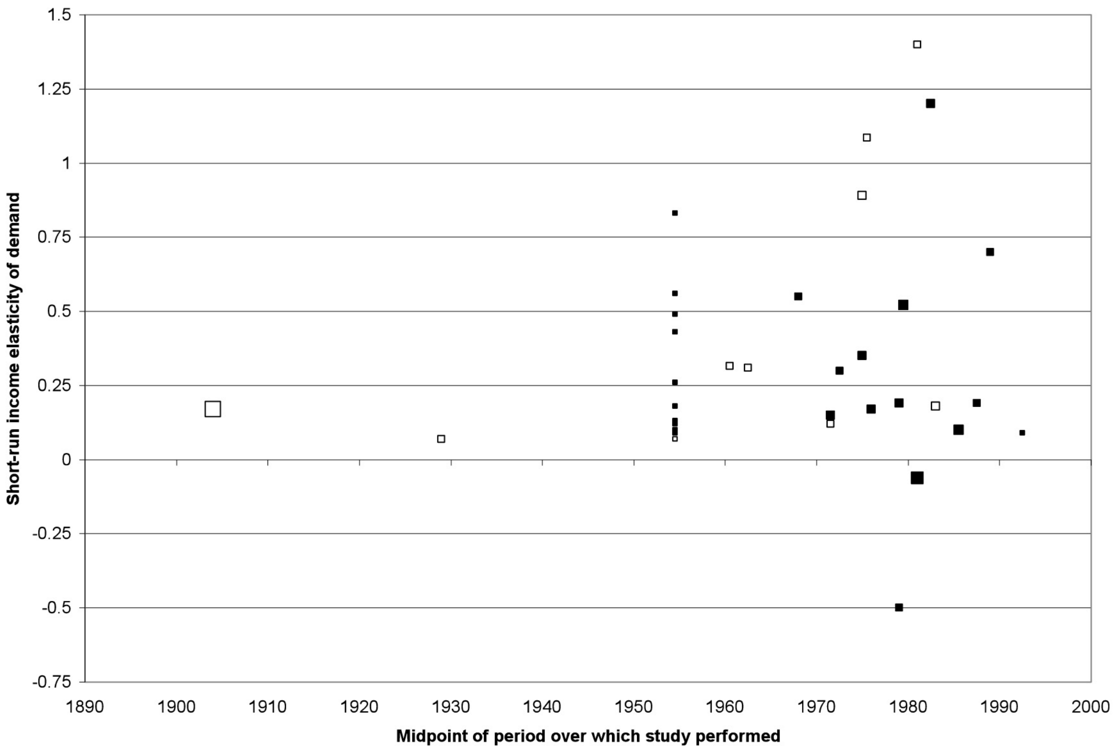
Sources: Figure calculated by the Working Group. The studies referred to in the figure can be found in Table 4.1. The table only includes short-run elasticities. The years refer to the middle year under investigation, hence the most recent study (Goel, 2009) includes data from 1975 to 2004 and is thus listed in 1989/90.

four studies found, in some but not all specifications, that the income elasticity is negative (Schmalensee, 1972, Porter, 1986, Baltagi *et al.*, 2000, Goel, 2009). Only one study (Porter, 1986) finds that the income elasticity is negative in all specifications. Figure 4.4 provides some evidence that income elasticities in the USA have fallen over time, indicating that consumption has become less sensitive to changes in income. This is not an unexpected result since higher incomes are associated with higher education, and higher education in itself is associated with lower consumption (presumably through a better understanding of the health consequences of smoking) (Kenkel and Chen, 2000).

From Figure 4.5 one can see that, for the most part, tobacco is a normal good in other developed countries. The figure separates the estimates for the United Kingdom (white squares) and other developed countries (solid black squares), and shows that all estimates in the United Kingdom are positive. In other developed countries negative estimates are found in two countries: New Zealand (Chetwynd *et al.*, 1988, Harrison *et al.*, 1989) and Italy (Pierani and Tiezzi, 2009). It is not possible to generalize the trends in elasiticites over time in developed countries although one may say with a fair degree of confidence that tobacco is a normal good in developed countries and that income elasticities tend to lie between 0 and 1.

All estimates of the income elasticity of demand in developing countries are positive, indicating that tobacco is a normal good (see Figure 4.6). Since developing countries are poorer and in an earlier stage of the tobacco epidemic (Lopez *et al.*, 1994), one would expect increases in income to be associated with greater tobacco consumption. When one considers estimates that employed a static specification of demand (i.e. not accounting for the addiction of tobacco, indicated by solid black squares) we find a broad range of results between 0.2 and 1.0 and two higher outliers. However, when one considers only dynamic specifications (i.e. accounting for addiction through a myopic or rational addiction model – white squares) we

Figure 4.5. Income elasticity estimates for other high-income countries, based on time series studies. White squares are United Kingdom studies and solid black squares are other high-income countries.



Sources: The studies referred to in the figure can be found in Table 4.2. The table only includes short-run elasticities. Estimates for several countries come from a single study by Koutsoyiannis (1963) and result in a grouping on the midpoint 1954/1955. The years refer to the middle year under investigation, hence the most recent study (Pierani and Tiezzi, 2009) includes data from 1960 to 2002 and is thus listed in 1981.

find estimates between 0 and 0.6. However, since many developing countries are growing rapidly, large increases in tobacco consumption are likely to occur in a relatively short period of time. For example, annual GDP growth of 8% may result in an annual increase in tobacco consumption of 4.8% (assuming an income elasticity of 0.6). Given the impact of compounding, this could result in a doubling of consumption in 15 years.

Affordability

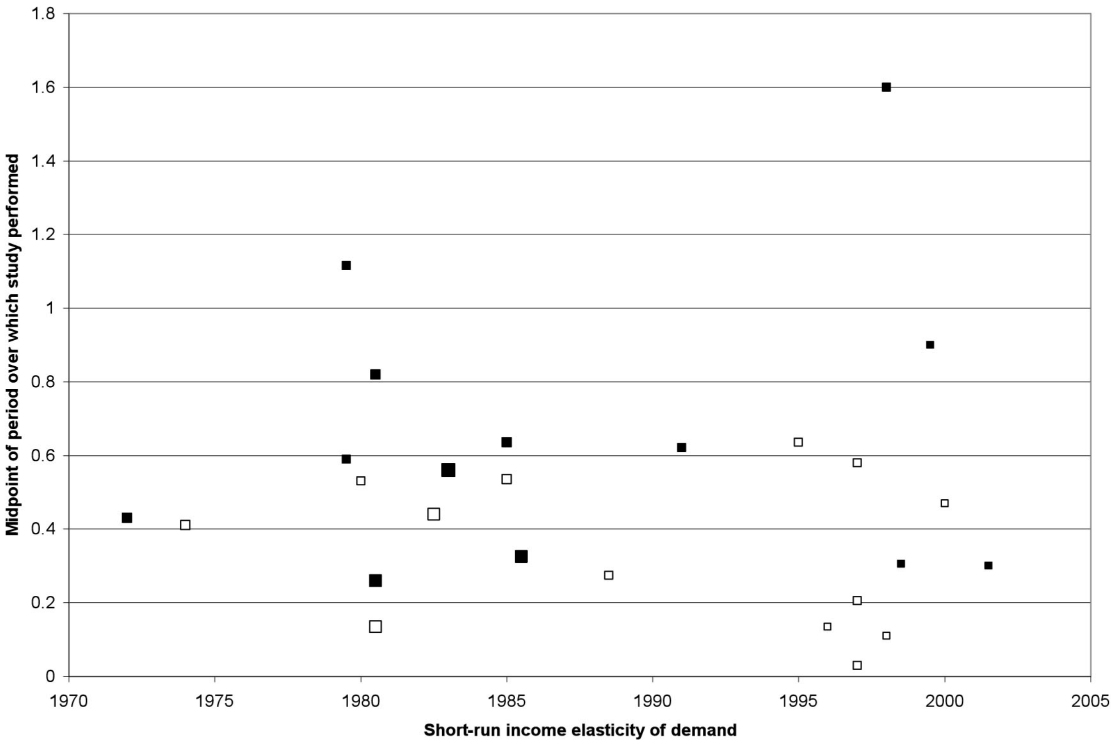
The studies reviewed typically do not focus on the impact of changes in income on the demand for cigarettes. Most studies include income in the demand specification as a control variable. Even if one knew by how much cigarette consumption changes in response to a change in income, few people would argue against economic growth on the grounds that it would increase the demand for cigarettes.

In recent decades some countries, mainly in Asia, have achieved rapid economic growth rates. In China, India, Indonesia, Viet Nam and Bangladesh, real per-capita gross domestic product (GDP) has grown at annual rates of 6% or more (Blecher and van Walbeek, 2009). The literature shows that as incomes rise, so does the consumption of tobacco products.

Affordability considers the simultaneous effect of income and cigarette price, whereas conventional studies consider the effect of price and income in isolation. One can investigate the level of affordability (in a cross-sectional context) or inter-temporal changes in affordability. Affordability refers to the quantity of resources (not exclusively monetary) required to purchase tobacco products.

A limited number of published studies have explicitly investigated the affordability of cigarettes (Scollo, 1996; Lal and Scollo, 2002; Guindon *et al.*, 2002; Blecher and van Walbeek, 2004,2009; Kan, 2007). Guindon *et al.* (2002) and Kan (2007) define affordability as the time worked to purchase a pack of cigarettes. Guindon *et al.* (2002) found that cigarettes became less

Figure 4.6. Income elasticity estimates for low- and middle-income countries, based on time series studies. White squares are dynamic studies and solid black squares are static studies.



Sources: Figure calculated by the Working Group. The studies referred to in the figure can be found in Table 4.3. The table only includes short-run elasticities. The years refer to the middle year under investigation, hence the two most recent studies (Hanafy *et al.*, 2011, and Yurekli *et al.*, 2010) include data from 1990–2006 and 1960–2006 respectively; thus they are listed in 1998 and 1993 respectively.

affordable in most countries studied (both high-income and low- and middle-income countries) between 1990 and 2000. Kan, focusing on cities rather than countries, and on lower-income occupations, came to a similar result.

Blecher and van Walbeek (2004) considered a larger sample of countries, most of which were low- and middle-income countries. They defined affordability in terms of per-capita gross domestic product (GDP), and found that cigarettes were generally more affordable in high-income countries relative to low- and middle-income countries. They found that during the 1990s cigarettes became less affordable in high-income countries and more affordable in low- and middle-income countries. Furthermore, they found that cigarette affordability is inversely related to consumption, and that the affordability elasticity of demand is about −0.5. This is similar to the consensus price elasticity estimates in the previous sections. In a subsequent study, they updated their earlier study and found that cigarettes have become more affordable in low- and middle-income countries at an increasingly rapid rate since 2000. In almost all countries where cigarettes became less affordable, the real price increased; in most countries where cigarettes became more affordable, real price decreased.

The implication of international comparisons is that cigarette prices should not only be viewed in monetary terms but also in terms of their affordability. Fast-growing countries face greater tobacco control challenges, since rising incomes increase the affordability of cigarettes. The fact that cigarettes have become increasingly affordable in most low-income and middle-income countries is a major tobacco control failure.

A more recent paper by Blecher (2010) uses the concept of affordability to asses the risks of aggressive economic growth on tobacco consumption. Using the case study of South Africa he proposes that cigarette taxation be linked to changes in affordability rather than simply targeting the price or excise tax incidence (the percentage of the retail price that is taken up by excise). He also points out that simply maintaining affordability will result in increases in consumption and that cigarettes must become less affordable to maintain or reduce consumption. Furthermore, this is especially important when taking cognisance that tobacco consumption is more responsive to increases in income in low- and middle-income countries relative to high-income countries.

Other recent applications of affordability include the tax reports commissioned by the Bloomberg Initiative to Reduce Tobacco Use (see for example Hu *et al*., 2008 or Guindon *et al*., 2010), the WHO MPOWER package (World Health Organization, 2008) and the Tobacco Atlas (Shafey *et al*., 2009).

Cross-country studies

Some studies have not focused on an individual country but rather on a group of countries. countries (Table 4.4). Such pooled or cross-country studies have generally, although not exclusively (Gallus *et al*., 2006), been used to consider the impact of advertising bans on tobacco consumption. Gallus *et al*. (2006) provides a cross-sectional view of demand in Europe (including 52 countries), finding price to be inelastic with estimates ranging from −0.46 to −0.74 with higher absolute elasticities in the non-European Union countries (−0.8 versus −0.4). This falls in line with the generalizations of the results in individual country studies. Even though the study uses aggregate data, the interpretation of the elasticity is not strictly comparable with the time series studies. Income is excluded from the analysis rather controlling for purchasing power parity in the price, and the model is estimated using a static specification. Furthermore, annual data are from different years.

The first cross-country study to analyse the impact of advertising restrictions was by Laugesen and Meads (1991), who investigated the impact of advertising restrictions on cigarette consumption in 22 OECD countries (all developed countries). They found that adverting restrictions significantly reduced tobacco consumption, and that the impact of these restrictions became more pronounced after 1970. Furthermore, they found cigarettes to be price-inelastic, and a global price elasticity of −0.20 and income elasticity of 0.28, in line with the single country studies in developed countries. In response, Stewart (1993) performed a similar study to that of Laugesen and Meads (1991) and found that advertising bans did not have a significant impact on cigarette consumption. A global price elasticity of demand of −0.31 was estimated (again in line with single-country studies in high-income countries) while income was excluded from the specification.

Economists have noted that partial advertising bans are relatively ineffective in reducing tobacco consumption, while comprehensive bans seem to be much more effective (Jha and Chaloupka, 1999). Using data from 22 OECD countries, Saffer and Chaloupka (2000) found that the imposition of comprehensive advertising bans would reduce cigarette consumption while partial advertising bans did not have a significant impact. A global price elasticity of demand was estimated to lie between −0.41 and −0.55, with income having a positive impact on consumption.

Nelson (2003) used a cross-country model to test whether advertising bans are endogenously determined with consumption. Nelson indicates that the most comprehensive advertising bans only came into being once large-scale decreases in consumption had occurred. To test this hypothesis, he estimated a two-stage model treating advertising restrictions endogenously. Nelson found the price elasticity to range between −0.26 and −0.44 and the income elasticity to range between 0.09 and 0.28. However, he did not find advertising restrictions to be significant although the consistent negative coefficients decreased over time, indicating that advertising restrictions have become less important in determining consumption over time. Nelson was unable to reject the null hypothesis that advertising bans and restrictions were exogenous.

Blecher (2008) advanced the literature further by including 30 developing countries in addition to 21 developed countries in the cross-section of countries. Blecher followed the Saffer and Chaloupka (2000) model of analysing both limited and comprehensive advertising bans, finding that advertising bans reduce consumption and specifically that comprehensive bans are more effective than limited bans. Furthermore, Blecher found the price elasticity of demand to range between −0.09 and −0.13 and income elasticities between 0.07 and 0.21. The absolute magnitudes of the elasticities were significantly smaller in the Blecher study compared to the other studies.

All of these studies estimated a global elasticity rather than individual country elasticities. This may be appropriate in high-income countries but when low-and-middle-income countries are included this may not be appropriate due to larger inter-country differences in low- and middle-income countries. The use of a model that does not impose homogeneity and a global elasticity might result in estimates that fall within the expected range.

Table 4.4. Cross-country studies employing aggregate data

Study	Countries	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Laugesen and Meads (1991)	22 OECD countries	-0.20	0.28	Advertising restrictions score (negative), Female labour participation rate (negative), Manufactured cigarettes as fraction of total tobacco consumption (positive)	Static pooled log linear GLS	Pooled annual data from 1960 to 1986	The advertising restriction score is problematic as well as the pooling of the data with no fixed effects. Thoroughly critiqued by Stewart (1992 and 1993), High (1999), Saffer & Chaloupka (2000), Blecher (2008).
Stewart (1993)	22 OECD countries	**All countries** -0.31 for middle year, but was decreasing (in absolute terms) over time **Individual countries** *Austria* (-0.34) *Australia* (insig.) *Belgium* (-0.61) *Canada* (-0.37) *Denmark* (-0.29) *Finland* (-0.45) *France* (-0.23) *Greece* (-0.35) *Iceland* (-0.32) *Ireland* (-0.30) *Italy* (-0.39) *Japan* (-0.18)	Not included	Advertising ban (insignificant), Quadratic trend (varied for different countries)	Static pooled non-linear OLS	Pooled annual data from 1964 to 1990	In response to Laugesen and Meads (1991). Thoroughly critiqued by Saffer & Chaloupka (2000), and by Blecher (2008). The advertising restrictions are accounted for poorly and the method is unreplicable. Was paid by the industry and did not disclose funding

Table 4.4. Cross-country studies employing aggregate data

Study	Countries	Estimated price elasticity	Estimated income elasticity	Control variables	Estimation method	Data	Comments
Stewart (1993) (contd)		*Netherlands* (-0.69) *New Zealand* (-0.25) *Norway* (-0.49) *Portugal* (insig.) *Spain* (-0.16) *Sweden* (-0.45) *Switzerland* (-0.83) **UK** (-0.55) *US* (-0.29) *West Germany* (-0.54)					
Saffer and Chaloupka (2000)	22 OECD countries	-0.41 to 0.55	Positive (significant in some specifications)	Advertising bans (negative), unemployment rate, percent of filter cigarettes, time fixed effects	Static log linear static fixed effects panel OLS	Pooled annual data from 1970 to 1992	Categorizes advertising bans as weak, limited or comprehensive
Nelson (2003)	20 OECD countries	-0.26 to -0.44	0.09 to 0.28	Advertising bans, warnings, unemployment rate, percent filtered cigarettes	Static log linear fixed effects panel OLS	Pooled annual data from 1970 to 1995	Tested endogeneity of advertising bans
Gallus *et al.* (2006)	52 European countries	-0.40 to -1.00 (higher in non-EU member countries)	Not included	Male to female smoking prevalence ratio (generally insignificant)	Static log linear pooled OLS	Cross sectional data for 2000 or nearest year	Income is excluded from the model in order to calculate a GDP-PPP adjusted price (essentially a measure of affordability)
Blecher (2008)	51 countries	-0.09 to -0.13	0.07 to 0.21	Advertising bans (negative)	Static log linear fixed effects panel OLS	Pooled annual data from 1990 to 2003	Includes 30 low- and middle-income countries

GLS, generalized least square estimates; OLS, ordinary least square estimates

Country differences include differing demographics, availability of substitutes and different tobacco products, tax structures and affordability.

The cross country literature is at a relatively early stage; thus most of the studies have varied significantly in methodology. Laugesen and Meads (1991) and Stewart (1993) employed pooled models including both cross-sections and time series. Saffer and Chaloupka (2000), Nelson (2003) and Blecher (2008) employed panel models by including country and/or time period fixed effects. Methodologically, the simple pooled models are not appropriate since they do not control for the vast differences between countries. The panel models do, but also make assumptions regarding homogeneity. Baltagi *et al*. (2000) tested this homogeneity assumption in a panel model using US states, finding that homogenous estimators are preferred to heterogeneous estimators. However, US states are more similar than different countries. Cross-country differences may not be significant in the studies that only include OECD countries, but this is likely to pose a far more significant problem in studies that include both developing and developed countries, or those that include only developing countries. Furthermore, all the cross-country models assume static specifications of demand, most likely as a result of the difficulties of estimating dynamic panel models where an instrumental variable technique is required.

Advertising bans comprises more than just bans on advertising, but other types of marketing including sponsorships. Measures of advertising bans do not capture price-based marketing measures including price discounts, price promotions, multiple pack purchases, etc. The global price and income elasticity estimates fall into the same ranges as those in individual country studies in high-income countries, although not in low-and-middle-income countries, likely the result of methodological and estimation issues rather than fundamental differences.

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Chapter 5
Tax, price and adult tobacco use

Introduction

Two broad types of data have been used in international studies of the demand for cigarettes, namely aggregate data and survey data. In general, it is easier and less costly to collect aggregate data than individual or household survey data. Both types of data have their advantages and drawbacks. The previous chapter presents the evidence from studies employing time-series or pooled time-series cross-sectional aggregate data. This chapter reviews the evidence from studies using individual-level and household-level survey data to examine the effects of tax and price on the demand for tobacco products among adults. Studies that focus on tobacco demand among young people are reviewed in Chapter 6 and tobacco demand among the poor in Chapter 7.

Individual-level and household-level cross-sectional data are collected in large nationally representative (or sometimes regionally representative) surveys. Depending on the nature of the survey and the size of the questionnaire, researchers are able to gather a vast array of information about the survey respondents. Some surveys are designed with a focus on tobacco (e.g. the Global Adult Tobacco Survey), while other surveys are more generic, and incorporate questions about tobacco use as part of the greater whole (e.g. National Health and Nutrition Examination Survey in the USA). In some cases the same respondents are interviewed again in subsequent waves of the survey. Such surveys are called longitudinal, panel or cohort surveys and are particularly useful in seeing how individuals' tobacco use behaviours change over time.

Analyses that employ survey data to study the demand for tobacco products are based on the same theoretical framework discussed in Chapter 4. However, studies that have used survey data can answer more nuanced questions than studies that have used aggregate data. For example, studies based on aggregate data, which are usually derived from tax paid sales data, cannot determine *why* tobacco consumption falls in response to an increase in tobacco product prices. Is it because fewer people are using these products (i.e. a decrease in smoking prevalence), because those who use tobacco are consuming less (i.e. a decrease in smoking intensity), or some combination of the two? Studies based on survey data are better able to address these questions. The most common approach, described in more detail below, is to separate individual tobacco consumption decisions into different stages, e.g. the decision to initiate smoking, the decision to continue smoking, the decision about how much to smoke when being a smoker, and the decision to quit smoking. With individual-level data, and especially with longitudinal individual data, these questions can be answered not only for the whole population, but also for different socioeconomic and demographic groups, such as those defined by gender, age, education, income, race/ethnicity or other factors.

Studies based on aggregate data often find that the correlation between independent variables is high. The high degree of correlation complicates the estimation process and can result in unstable estimates (coefficients) and wide confidence intervals. In contrast, the correlation between independent variables in a cross-sectional analysis of survey data is generally lower, resulting in smaller standard errors and more stable coefficients.

Studies based on aggregate data often suffer from simultaneity bias, as market-level price and quantity are jointly determined through the interaction of supply and demand. Thus, the price variable may be endogenous. Standard Hausman tests can be used to test whether price is endogenous. If this is indeed found to be the case, price endogeneity can be corrected using instrumental variables methods. However, when using survey data, the problem of price endogeneity is less of a concern because no individual tobacco user or potential user consumes enough to influence the market price. Thus, from the perspective of any individual, the price variable is exogenously determined. This simplifies the estimation process.

However, while individual or household survey data have some clear advantages relative to aggregate data, they also have several limitations. First, the survey data are subject to reporting biases, in that people tend to underreport tobacco use and consumption (Warner, 1978; Slattery *et al.*, 1989; Gallus *et al.*, 2011). Typically researchers assume that people underreport their consumption by the same percentage of their actual consumption. This is a strong assumption, and to the extent that it is violated, it will bias the estimated coefficients. Second, many macro-level determinants of the demand for tobacco, like advertising expenditures and/or advertising restrictions, availability of tobacco products, and the strength of anti-tobacco (or pro-tobacco) sentiment, are often not captured in the surveys. If information on these determinants are not obtained from other sources, the coefficient estimates may be biased due to omitted variables.

This chapter reviews several issues related to the impact of taxation of cigarettes and other tobacco products, and tobacco products prices, on tobacco use among *the adult population*. In the following section, the estimation techniques applied in studies based on survey data are discussed in some detail. This is followed by a comprehensive review of the evidence on the impact of price on cigarette smoking among adults, including the impact of price on smoking prevalence and intensity. A similarly comprehensive but shorter review of the relatively scarce evidence on price and non-cigarette tobacco use follows. This is followed by a discussion of the existing empirical literature on smoking cessation. The chapter concludes with a discussion of the more limited research on the relationships of tax and price with other outcomes related to tobacco use for adults, including attitudes and perceptions about prices of tobacco products.

Empirical strategies for estimating demand with individual-level data

Data

Individual- and household-level data, usually obtained from surveys, rely on self-reported measures of tobacco use. The measures of tobacco use typically collected in surveys include information on the prevalence and intensity of tobacco use and sometimes on tobacco consumption histories. Two basic types of surveys are typically employed when examining the impact of price or tax on adult tobacco use: cross-sectional and longitudinal. A cross-sectional survey is used to gather information on a population at a single point in time, and many cross-sectional surveys are repeated regularly. Often, researchers use pooled cross-sectional data. Pooled cross-sections combine multiple cross-sections at a single point in time (such as comparing cross-sections of the populations of multiple countries). They can also be a single cross-section over time with data collected at multiple time points, such as studying a sample from a single country over a period of multiple years (this form of pooled cross-sectional data is often referred to in the literature as repeated cross-sectional data). Pooling different cross-sections has the benefit of a larger sample size (or a higher number of subjects studied) beyond what would be available in a single cross section, thus allowing researchers to examine different determinants of tobacco use over time like prices of tobacco products and tobacco control policies by studying a sample at multiple time points. Longitudinal data, on the other hand, follows each subject (either an individual or household) over time. The advantage of longitudinal data is that changes in individual (or household) tobacco use measured as smoking prevalence and intensity can be examined, and the impact of price or tax on tobacco-use transitions such as tobacco initiation and cessation can be quantified.

Measuring the price of tobacco products

In contrast to aggregate databased studies, studies that rely on survey data can consider many more variables in the analysis. For example, individual (or household) characteristics such as disposable income, age, gender, level of education, employment status, marital status, family structure, religiosity and various other socioeconomic and demographic characteristics can be incorporated in the analysis.

Of particular importance to this research is the role of tobacco prices in affecting adult tobacco demand. As increases in tobacco taxes are expected to increase tobacco prices, tobacco taxes are a policy mechanism with which governments can affect adult consumption of tobacco (see Chapter 2 for a discussion on tobacco taxes and prices). As *IARC Handbooks of Cancer Prevention: Tobacco Control, Volume 12* points out (IARC, 2008), several sources of tobacco price data have been used in prior research. Some studies have used cigarette prices that are collected in retail outlets or reported by households/individuals that use scanner-based technologies that utilize universal product codes (UPCs). The major advantages of using prices collected using scanner technology is that brand- and package-specific information can be extracted, and that the final purchase price will capture the presence of sale promotions affecting price. Unfortunately, there is limited availability of this technology in many countries, particularly in low- and middle-income countries. Even in high-income countries, these systems typically do not provide comprehensive geographic coverage. Moreover, even in covered areas, some outlets that sell tobacco products do not participate in scanner data collection efforts, generating tobacco price data that may not be completely representative of all tobacco sales.

Another approach to obtain tobacco price information is to use observational data collection methods in which trained individuals visit tobacco vendors and collect price information by observing what the posted prices are, asking the vendor what the price is when the price is not posted, and sometimes purchasing the product. These prices typically produce the same measure of price and account for price-related promotions. Observational data collection involves several limitations, including limited geographic coverage, and the use of a convenience sample of stores (i.e. inadequate sample frame and hence a sample that may not be representative of all retail stores). Use of data collected with this approach can also create an aggregate price measure that does not account for the share of sales of the brands collected and the share of sales from different types of outlets.

The final method to collect tobacco prices is through the use of mail and telephone surveys. These surveys are conducted on tobacco product vendors, the general population and the population of smokers. The surveys on tobacco vendors face limitations similar to the observational data collection methods described above.

Information obtained in population surveys is useful in developing aggregate measures of price (such as at the national or subnational levels). However, the use of individual's self-reported price in analyses to examine the respondent's smoking behaviour may be problematic due to the endogeneity of this price variable. That is, holding other things constant, heavy smokers may be more likely to consume cheaper brands of cigarettes, purchase cigarettes in greater quantities, look for lower-priced retailers, engage in tax-avoiding behaviours, and take advantage of price promotions than individuals who smoke fewer cigarettes. Treating an individual's self-reported price as an exogenous variable in an equation that examines his or her tobacco consumption will lead to a biased (over-) estimate of the impact of price on consumption.

In some analyses, efforts have been made to derive cigarette prices from household expenditure surveys that collect expenditure information on a wide variety of goods and services including tobacco products. Price is typically derived by dividing household consumption expenditures on tobacco products by the total amount/quantity of these products consumed. In addition to the endogeneity problems discussed above, there are other reasons why these price measures should be used with caution. First, one member of the family typically reports total household expenditures on tobacco and quantity purchased, leading to potential reporting errors. The extent of reporting errors depends on how well informed the individual is about the consumption expenditures and quantities purchased by other household members. Caution should also be used because sometimes only broad information on tobacco expenditures and amount purchased are collected, while only composite prices that combine all tobacco products can be generated. Finally, it is very important to account for the effects of inflation when evaluating the impact of tobacco prices on tobacco demand and demand-related outcomes when multiple years of data are employed, given that inflation can significantly affect the price of tobacco products relative to the price of other goods and services.

Methods

When using individual-level survey data, economists have traditionally used a two-part model of demand developed by Cragg (1971), in which tobacco prevalence and tobacco intensity are modelled separately. The rationale for the two-part model is that a person faces two sequential decisions. First, s/he has to decide whether or not to consume tobacco. Then, among those who have decided to consume tobacco, there is a decision on how much tobacco to be consumed. The first decision is a dichotomous decision and is typically estimated using a probit or logit specification (logistic regression models). For the second decision, on how much tobacco to be consumed, ordinary least squares (OLS) techniques (linear regression models) on a log-transformed dependent variable are usually used. The resulting price elasticity derived from the first step is known as the price elasticity of prevalence, whereas the resulting price elasticity from the second step is known as the price elasticity of intensity. Combining the price elasticity of prevalence and the price elasticity of intensity will yield the total price elasticity of tobacco demand.

A potential problem with the standard approach of estimating the second part of the two-part model is that the estimates have to be retransformed back from log scale to original scale. The retransformation factor that is employed in the retransformation process must reflect any heteroscedasticity in the conditional smoking equation if the derived elasticities are to be consistent. An alternative estimator that Blough, Madden and Hornbrook (1999), Manning and Mullahy (2001) and Tauras (2006) proposed is the generalized linear model (GLM). While OLS models estimate expectation of the log-transformed variable $E(\ln(Y|X))$ and then require retransformation back to $\ln(E(Y|X))$, GLM models directly estimate $\ln(E(Y|X))$ and consequently obtain expectation $E(Y|X)$ directly and thus preclude the need to retransform[1].

While the two-part technique discussed above is the most frequently used method to estimate tobacco prevalence and intensity demand equations using survey data, numerous other methods have been employed. Due to limited computing power, some early studies used a linear probability model (i.e. an OLS technique) instead of limited dependent variables techniques for the first part of the two-part model. Other researchers have combined both separate models of the two-part model into a one-part model and apply an OLS regression. The limitation of this approach is that researchers cannot disentangle the effects of changes in prices or taxes on tobacco prevalence and intensity—a distinction that is often very important for policy-making purposes. Other researchers have used sample selection models, such as Heckman's (1979) two-step correction model. Heckman's model corrects the second part of the two-part model for self-selection by using a transformation that is the predicted probability of each individual to use tobacco as an additional variable in the second equation. Still other researchers reformulate the tobacco demand equation into latent consumption (i.e. latent demand) instead of the actual consumption. As the latent demand measures willingness to consume tobacco, those individuals who hate tobacco would likely make negative scores for willingness to consume. Since negative latent demand is reflected by zero actual consumption, the dependent consumption variable is left censored at zero. Tobit models have been used by researchers to account for the censored nature of the tobacco consumption data. Finally, numerous extensions to Cragg's (1971) model have been proposed and employed to examine the determinants of both prevalence and intensity of tobacco use. This class of models has become known as double-hurdle models (Jones, 1989). A thorough discussion on the variants of the double-hurdle models can be found in Jones and Yen (2000).

Researchers have also used longitudinal data to examine the impact of price or tax on tobacco-use transitions such as tobacco initiation, tobacco use escalation, and tobacco cessation. Both discrete-time and continuous-time hazard models have been used to estimate the equations specified for those tobacco-use transitions. The discrete time model usually takes the form of a probit or logit specification to estimate the probability of making a transition from one discrete state to another (such as from non-smoking to smoking) between waves of data collection. Cox's (1972) partial likelihood method has also been used to estimate continuous hazard models. Cox's (1972) model is appealing because it examines the effects of the covariates on tobacco use without making any assumptions about the underlying baseline hazard. Other researchers have used continuous time parametric models that have assumptions about the shape of the baseline hazard.

Estimation issues

A central issue to consider when estimating empirically cigarette-demand equations for adults is how to account for tobacco sentiment or the social acceptability of smoking. Indeed, accounting for this condition is important because it may be the sentiment towards tobacco that is driving changes in tobacco consumption and in tobacco taxes as well as in other tobacco control policies. If not controlling for tobacco sentiment, this overlook may result

[1] Y is the dependent variable, X is a vector of explanatory variables, ln is a natural logarithm transformation, and $E(Y|X)$is the expectation of Y conditional on X.

in an omitted variable bias that produces a spurious negative relationship between price or tax and tobacco demand. This spurious negative relationship results in price elasticity estimates that are biased away from zero.

Several strategies have been put forth to account for antismoking sentiment in adult smoking equations. One approach that can be applied to cross-sectional data, pooled cross-sectional data and longitudinal data is to include a variable as an explanatory variable in the cigarette demand equation to capture the economic importance of tobacco growing and production in the area (such as a state, region, province, etc.) where the individual/household resides. To the extent that residing in a tobacco producing location proxies for positive sentiment towards tobacco, the inclusion of these variables in the regression model will mitigate some bias generated by the omitted variables on the price elasticity estimates.

Another approach that can be applied to pooled cross-sectional and longitudinal data is to use location-specific dummy variables as covariates. The use of location-specific dummies will help to eliminate all time-invariant, unobserved and location-specific heterogeneity. To the extent that sentiment towards tobacco within a location is time-invariant during the period under investigation, then including those explanatory dummy variables will eliminate bias on the price elasticity estimates due to the omitted variables. The use of location-specific dummy variables relies on within-location variation in cigarette prices or taxes over time (as opposed to inter-location differences in prices and taxes) to quantify the effect of price on consumption. However, for the location-specific dummy variable approach to be viable, researchers must use multiple years of cross-sectional data—one year of cross-sectional data would result in perfect multicollinearity between the location specific taxes (or prices) and the dichotomous location indicators. Moreover, even if multiple years of data are employed, there must be reasonable variation in tax (or price) over time within locations to avoid collinearity issues with the tax (or price) variable.

The final approach that has been used is to approximate the magnitude of anti-tobacco sentiment within a location using individual's attitudes towards smoking and beliefs about tobacco control policies from survey data. The derived tobacco sentiment variable would then be included as an explanatory variable in the tobacco demand equation. Some caution should be used with this approach because the derived tobacco sentiment variable may be endogenous, particularly if the same survey data are used both to estimate the tobacco demand equations and to derive the tobacco sentiment variable.

It is also important to control for other tobacco control policies in the tobacco demand equations to avoid an omitted variable bias. The omission of other tobacco control policies will bias the price elasticity estimates away from zero if both tobacco prices and tobacco control policies affect tobacco consumption and they are correlated to each other. One potential limitation of including tobacco prices and tobacco control policies simultaneously in the same equation is multicollinearity. That is, as part of a comprehensive tobacco control effort, governments may increase tobacco taxes and impose stronger restriction on tobacco consumption simultaneously. If both the tax and policy levers are pulled simultaneously, it may become difficult to disentangle the individual effects of taxes from those effects of other tobacco control policies on tobacco consumption.

It is also important to account for tax avoidance opportunities to purchase tobacco products when estimating tobacco demand equations using individual-level data (see Chapter 8 for a more complete discussion of tax avoidance and evasion). Cross-border shopping opportunities created by substantial differences in tax rates or other factors that determine prices across political jurisdictions are one form of tax avoidance. If opportunities to purchase less expensive tobacco exist but are not accounted for in the specification of the demand equation, biased price elasticity estimates may result, as the full price elasticity estimates in absolute value will tend to be understated. That is, individuals living close to a border of a lower-price location may in fact purchase tobacco from the lower-priced jurisdiction. The price they pay for tobacco bought is smaller than the price that is assigned to those individuals simply on the basis of their residence.

Numerous strategies have been put forth to address cross-border purchases using individual-level data. Several main strategies can be named: first, including a covariate that represents the lowest price of tobacco in a neighbouring jurisdiction; second, including a covariate that represents the weighted average price of tobacco (or average price differential) in all neighbouring jurisdictions where the weights are based on the populations close to the borders; third, omitting all individuals who reside in locations that are within a certain distance from the border of a lower-priced jurisdiction; fourth, running separate regressions on individuals who reside in locations where the tax difference between any neighbouring jurisdiction and their own is below and above a certain threshold; and fifth, including a covariate that represents the distance to the lowest tax location in the area. While imperfect, these efforts have significantly reduced the biases in price elasticity estimates.

Summary

Using individual or household-level survey data to analyse the impact of tax and price on the demand for tobacco products has several advantages over the use of more aggregated data, including the ability to disentangle the impact of tax and price on prevalence, initiation, uptake, cessation and intensity. At the same time, using survey data introduces several empirical challenges that, if not accounted for, can produce biased estimates of the impact of tax and price on tobacco use.

Evidence on the impact of tax and price on the demand for tobacco products among adults

Identification of relevant studies

For the review contained in this chapter, a systematic search was conducted to identify all publications providing evidence on the effects of price and tax on tobacco consumption among adults, using individual-level or household-level data on adults. A MEDLINE search in PubMed up to February 2010 was performed using the string "(price[title] OR prices[title] OR elasticity[title] OR elasticities[title] OR tax[title] OR taxes[title] OR fiscal[title]) ("lung cancer"[title] OR smoking[title] OR cigarette[title] OR cigarettes[title] OR tobacco[title]) adults." Two members of the Working Group selected the papers identified by this search strategy that reported original data on the issue. Moreover, we checked the reference lists of the identified articles, a meta-analysis (Gallet and List, 2003), a comprehensive review of the literature (Chaloupka and Warner, 2000), a review on developing countries from Guindon *et al.*, (2003), and World Bank publications on tobacco (such as the papers in the World Bank's Health, Nutrition, and Population (NHP) working paper series). Many relevant and appropriate articles were added later based on the references of the articles read. No study was excluded a priori because of weaknesses in design and/or data quality. Studies reporting estimates only on youth, adolescents and young adults were not considered for the present chapter, as these are reviewed in detail in Chapter 6. Similarly, studies that focus on differences in responses based on income, socioeconomic status, or related factors are not discussed in this chapter, as these are comprehensively reviewed in Chapter 7.

Systematic review of the scientific literature: Impact of tax and price on the prevalence and intensity of adult tobacco use

In contrast to the studies based on aggregate data, studies based on survey data did not begin to emerge until the early 1980s. Prior to this time, the computing power necessary to conduct econometric and other statistical analyses of large survey data was not generally available to researchers. As survey data and the computing power needed to analyse them became more widely accessible to researchers, this began to change and the earliest studies of demand for cigarettes and other tobacco products based on survey data began to appear. Continued growth in and access to computing power, particularly in the past decade, led to the development of more sophisticated econometric methods and software, allowing for more sophisticated analyses of larger and more complex survey data and a tremendous increase in the number of studies based on survey data.

As was true for the demand studies based on aggregate data, most of the earliest demand studies based on survey data were conducted in the USA, but studies based on US data are also the most prevalent. This is true for many reasons, including several ones described in Chapter 4. First, a variety of high-quality, nationally representative surveys that collect information on tobacco use have been conducted for many years in the USA, such as the National Health and Nutrition Examination Surveys, the National Health Interview Survey, the Tobacco Use Supplement to the Current Population Survey, several state-specific surveys (e.g. the California Tobacco Survey). Second, the academic researchers who conduct these studies have access to high-powered computing technology through their universities and to the public and private funding sources that provide the financial research resources needed. Finally and perhaps most importantly, as with the aggregate demand studies based on state-level data, the cross-sectional differences in state and local taxes and prices of tobacco products as well as the frequent changes in national, state and local taxes provide considerable variation in taxes and prices needed to most effectively conduct this type of research.

As survey data and access to sufficient computing power have become more widely available in several countries, including many low- and middle-income countries, demand studies based on individual or household-level survey data have been produced for a growing number of countries. Table 5.1 provides a detailed summary of the existing evidence on the demand for tobacco products from studies that are based on survey data. Studies are organized by country, with those from the USA presented first, followed by those from other high-income countries, and then by those from low- and middle-income countries. Within a certain country, studies are presented chronologically, from oldest to most recent. Table 5.1 also includes details on each identified study including the data used in the study, basic information on the theoretical and empirical approach, estimates of price elasticities for overall demand, prevalence (often referred to as participation in this literature) and intensity (often referred to as conditional demand). In addition, for studies that estimate demand for various subpopulations, the estimated elasticities for these populations are presented. The narrative review below follows the organization of the table, providing a discussion of seminal studies or those that are unique in some other way, rather than a discussion of each of the studies contained in the table. However, it limitedly discusses differences in price elasticities based on age or income or socioeconomic status, as these are discussed more fully in subsequent chapters.

United States of America

Lewit and Coate (1982) published the first analysis of cigarette demand based on individual-level survey data from the USA. They analysed data on 19 266 respondents ages 20–74 years from the 1976 wave of the National Health Interview Survey. They used prices matched to the survey data on the basis respondents' state of residence. Using a two-part model, they first estimated the impact of price on the decision to smoke and then the impact of price on cigarette consumption among smokers. In addition to estimating price elasticities for the overall sample, they also produced separate estimates for subsamples based on age groups (20–25 years, 26–35 years, and older than 35 years) and sex. Lewit and Coate (1982) obtained an overall price elasticity for their full sample of −0.221, with a prevalence elasticity of −0.135 and an intensity elasticity of −0.037.

Given the potential for tax avoidance through cross-border shopping for cigarettes, Lewit and Coate (1982) restricted their sample to respondents for whom the price in the area where they resided was lower than the price in nearby jurisdictions. For this restricted sample, they obtained an overall price elasticity of cigarette demand of −0.416, with a prevalence elasticity of −0.264 and an intensity elasticity of −0.103. The differences between the two sets of estimates clearly illustrate how failing to account for opportunities for tax avoidance can bias price elasticity estimates. In addition, Lewit and Coate (1982) found that smoking was more responsive to price among younger persons than among older persons, with overall price elasticities of −0.89, −0.47, and −0.45 for persons having ages 20–25, 26–35, and over 35, respectively. Similarly, they found that the effect of price on the decision to smoke among younger persons accounted for more of the overall impact of price on cigarette demand than it did among older persons (prevalence elasticities of −0.74, −0.44, and −0.15 for the three age groups, respectively). Finally, they found that men, particularly younger men, were more responsive to changes in cigarette prices than were women.

Mullahy (1985) built on the Lewit and Coate (1982) analyses by estimating cigarette demand models that accounted for the addictive nature of tobacco use. Mullahy (1985) assumed myopic behaviour, such that individuals' current cigarette consumption depended on their past cigarette consumption and that smokers ignored the future consequences of their smoking decisions. Applying two-part methods to data from the 1979 US Health Interview Survey, Mullahy (1985) estimated separate demand equations for men and women. He obtained a total price elasticity of −0.47, similar to that of Lewit and Coate (1982), and found that men were somewhat more price-sensitive than women.

A few years later, Chaloupka (1990, 1991 and 1992) produced a series of papers that applied Becker and Murphy's (1988) rational addiction model to examine adult cigarette demand (ages 17–73 years). He used individual-level, cross-sectional survey data from the Second National Health and Nutrition Examination Survey, conducted from 1976 to 1980. He used information on smoking at the time of the survey, smoking one year before the survey, and past smoking. He applied two-stage least squares models that accounted for the endogeneity of past and future smoking in the rational addiction model. He matched prices to the survey databased on an individual's area of residence, with the price measure accounting for potential cross-border shopping by averaging prices in the individual's own state and lower prices in nearby states.

Table 5.1. Summary of studies on the effects of cigarette price on adults' demand for tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
USA						
Lewitt & Coate (1982) USA	Cross-sectional Health Interview Survey (HIS) 1976 N=28 033 (20–74 yrs) Analysis sample: Entire: n=19 266 Restricted: n=11 052 (20–74 yrs)	Two models were considered: i) an OLS (ordinary least squares); ii) a two-part model: 1) OLS; 2) OLS Adjusted for family income, education, age, sex, marital status, health status, race/ethnicity, family size, employment status, region and urbanicity Demand equations were estimated across three age groups in the restricted sample by another two-part model: 1) a logit; 2) an OLS Price: composite price in cents per pack of cigarettes a consumer faces in his immediate area	**Entire sample** -0.221 **Restricted sample** *Overall* -0.416 **By age (in years)** *20–25* -0.89 *26–35* -0.47 *>35* -0.45 **By sex and age (in years)** ***Males*** *20–25* -1.401 *26–35* -0.320 *>35* -0.658 ***Females*** *20–25* -0.302 *26–35* -0.577 *>35* -0.118	**Entire sample** -0.135 **Restricted sample** *Overall* -0.264 **By age (in years)** *20–25* -0.74 *26–35* -0.44 *>35* - 0.15 **By sex and age (in years)** ***Males*** *20–25* -1.276 *26–35* -0.292 *>35* -0.246 ***Females*** *20–25* -0.136 *26–35* -0.388 *>35* + 0.066	**Entire sample** 0.037 **Restricted sample** *Overall* -0.103 **By age (in years)** *20–25* -0.20 *26–35* -0.04 *>35* -0.15 **By sex and age (in years)** ***Males*** *20–25* -0.171 *26–35* + 0.029 *>35* -0.204 ***Females*** *20–25* -0.025 *26–35* -0.134 *>35* -0.077	Restricted sample was obtained by deleting from the full sample individuals in Primary Sample Units where the own average price was greater than the price within the 20-mile band
Mullahy (1985) USA	National Health Interview Survey, 1979 N= 13 794 (≥ 17 yrs)	A two-part model: 1) a probit; 2) an OLS and instrumental variables method	**Overall** -0.47 **By sex** *Men* -0.56 *Women* -0.39			Cigarette demand was estimated based on a myopic demand model. The results supported the hypothesis that cigarette smoking is an addictive behaviour
Chaloupka (1990) USA	Cross sectional NHANES II (1976–1980) N=28 000 (6 months to 74 yrs) Analysis sample: 14 305 (17–73 yrs) Men: n=6569 Women: n=7736	Two-stage least squares model for current cigarette consumption Adjusted for real family income, education, age, age2, race, marital status, employment status	**Long-run price elasticity** *By sex* *Men* -0.55 to -0.69 *Women* +0.37 to 0.63			Ranges of elasticity estimates obtained according to different rates of depreciation on the addictive stock

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Chaloupka (1990) (contd) USA		Cigarette price: state-specific weighted average price. Cigarette price and excise tax adjusted for the national monthly consumer price index and a local price index				
Chaloupka (1991) USA	Cross sectional NHANES II (1976–1980) N=28 000 (6 months to 74 yrs) Analysis sample: 14 005 (17–73 yrs)	Two-stage least squares model for current cigarette consumption Adjusted for real family income, education, age, age2, race, marital status, employment status Cigarette price: state-specific weighted average price. Cigarette price and excise tax adjusted for the national monthly consumer price index and a local price index	**Long-run price elasticity** ***Overall/Full sample*** -0.274 to -0.359 ***Ever smokers*** -0.348 to -0.482 ***Current smokers*** -0.296 to -0.890 ***By education*** *<high school* -0.587 to -0.618 *≥high school* +0.135 to +0.268 ***By age (in years)*** *17–24* -0.103 to +0.050 *25–64* -0.315 to -0.454 *65–73* -0.029 to +0.166			Ranges of elasticity estimates obtained according to different rates of depreciation on the addictive stock
Wasserman *et al.* (1991) USA	Repeated cross sectional NHIS (1970 to 1985) N=207 647 [seven surveys] Analysis sample: 84 301 (either >17 yrs or >20 yrs, depending on year of survey)	Two models were considered: 1) Two part model: i) logistic regression (smoking prevalence); ii) simple OLS (smoking intensity) 2) Generalized linear model (GLM) with an iterative weighted least squares technique Adjusted for income, education, age, gender, family size, marital status, race, , cohort of birth, interactions of age and sex, interactions of birth cohort and sex, and regulation index Price: weighted average state-specific price	**Two-part model** ***By survey year*** *1970*: +0.072 *1974*: -0.013 *1976*: -0.057 *1979*: -0.124 *1980*: -0.147 *1983*: -0.217 *1985*: -0.263 **GLM** ***By survey year:*** *1970*: +0.059 *1974*: -0.017 *1976*: -0.055 *1979*: -0.112 *1980*: -0.131 *1983*: -0.188 *1985*: -0.226 *1988*: -0.283	**Two-part model** ***By survey year*** *1970*: +0.059 *1974*: +0.002 *1976*: -0.028 *1979*: -0.074 *1980*: -0.098 *1983*: -0.139 *1985*: -0.171	**Two-part model** ***By survey year*** *1970*: +0.013 *1974*: -0.015 *1976*: -0.029 *1979*: -0.050 *1980*: -0.057 *1983*: -0.078 *1985*: -0.092	**Income elasticity obtained from the GLM** ***By survey year*** *1970*: +0.051 *1974*: +0.01 *1976*: +0.021 *1979*: +0.007 *1980*: +0.002 *1983*: 0.013 *1985*: 0.023 *1988*: 0.038 Predicted elasticities for year 1988 might not be valid

Table 5.1. Summary of studies on the effects of cigarette price on adults' demand for tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Chaloupka (1992) USA	Cross sectional NHANES II (1976–1980) N=28 000 (6 months to 74 yrs) Analysis sample: 14 005 (17–73 yrs)	Two-stage and restricted two-stage least squares model for current cigarette consumption Adjusted for real family income, gender, education, age, age^2, race, marital status, labour force status & state clean indoor laws Cigarette price: state-specific weighted average price. Cigarette price and excise tax: adjusted for the national monthly consumer price index and a state-specific price index	**Long-run price elasticity** ***Overall/Full sample*** -0.268 to -0.322 ***Ever smokers*** -0.344 to -0.422 **By sex** *Men* -0.425 to -0.505 *Women* +0.852 to +1.410 **Restricted model** *Overall/Full sample* -0.308 to -0.357 *Ever smokers* -0.326 to -0.433			Ranges of elasticity estimates obtained according to different rates of depreciation on the addictive stock
Ohsfeldt & Boyle (1994) USA	Cross-sectional CPS (1985) n=100 000 in file Analysis sample: only men (≥16 yrs) (n not reported)	Multivariate regression (for (i) snuff use, (ii) chewing tobacco use, and (iii) any smokeless tobacco use) Adjusted for per-capita income, education, state population characteristics (residence, race, religious denomination, and divorce rate), men aged 16–17, and existing state tobacco regulation Price of smokeless tobacco products: border-adjusted state smokeless tobacco average excise tax		**Tax elasticity** ***Snuff*** -0.41 to -0.61 ***Chewing tobacco*** -0.56 to -0.63 ***Smokeless tobacco (both snuff and chewing tobacco)*** -0.55		Ranges of tax elasticities obtained according to both full and restricted models Cross-tax elasticities of demand for smokeless tobacco with respect to the cigarette tax: +0.39 to +0.62 (see Table 5.3)
Hu *et al.* (1995) USA California	Cross-sectional (pooled surveys) California BRFSS (1985–1991) N=13 531 (≥18 yrs)	Two-part model: 1) logistic model; and 2) OLS Adjusted for income, sex, age, ethnicity, education, family	-0.46 (after being controlled for "other health behaviours")	-0.54 (overall) -0.33 (after being controlled for "other health behaviours")	-0.22 (overall) -0.20 (after being controlled for "other health behaviours")	

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Hu *et al.* (1995) (contd) USA California		income, employment status, marital status, health status, "other health behaviours" (alcohol, exercise, and BMI) Price: average price (monthly price index of tobacco products for Los Angeles)				
Ohsfeldt *et al.* (1997) USA	Cross-sectional CPS (1985) n=100 000 in file Analysis sample: only men (16–64 yrs) (n not reported)	Logit regression model (for (i) cigarette use, (ii) snuff use, (iii) chewing tobacco use, and (iv) any smokeless tobacco use) Adjusted for real family income, age, marital status, race, ethnicity, employment status, education, occupation, metropolitan, religion, and tobacco control policy Price of smokeless tobacco products: border-adjusted state average smokeless tobacco excise tax		**Cigarettes** ***Overall*** -0.05 ***By age (in years)*** *16-24* -0.07 *≥25* -0.05 **Snuff** ***Overall*** -0.27 ***By age (in years)*** *16-24* -0.31 *≥25* -0.13 **Chewing tobacco** ***Overall*** -0.13 ***By age (in years)*** *16–24* -0.07 *≥25* -0.16 **Any smokeless tobacco** ***Overall*** 0.15 ***By age (in years)*** *16–24* -0.09 *≥25* -0.11		Cross-tax elasticities of demand for smokeless tobacco with respect to the cigarette tax: Snuff: +0.13 Chewing tobacco: +0.09 Any smokeless tobacco: +0.10 See Table 5.3
Evans & Farrelly (1998) USA	Cross-sectional (pooled surveys) NHIS supplements: 1979 (smoking) and 1987 (cancer control)	Two-part model: 1) probit (smoking prevalence); 2) OLS (cigarette demand) Adjusted for age,		**Pooled model 1979-87** ***Tax*** *Overall* -0.214 ***Price***	*Tax* *Overall* -0.330 **For 1987 NHIS** ***Tax***	The models describe compensating behaviours. Taxes reduce cigarette consumption, but do not affect daily tar and nicotine intake

Table 5.1. Summary of studies on the effects of cigarette price on adults' demand for tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Evans & Farrelly (1998) USA (contd)	N=48 314 (≥18 yrs) Analysis sample: 1979 NHIS: n=24 092 1987 NHIS: n=22 043	age2, income, family size, region, sex, race, marital status, urban centres and education Two models for smoking intensity are considered: a pooled time-series cross-sectional regression, and a fixed effect model [controlled for state and year]. Three OLS models for smoking intensity by age group were estimated using only the 1987 data Cigarette prices per pack in constant 1982–1984 cents Cigarette excise taxes per pack (state and federal) in constant 1982–1984 cents		*Overall* –0.156 **Fixed effect model 1979-87** ***Tax*** *Overall* +0.160 ***Price*** *Overall* +0.344 ***Tax*** *By age (in years) for the 1987 data:* 18–24: -0.575 25–39: -0.434 40+: +0.142	*By age (in years)* 18–24: -0.223 25–39: -0.325 40+: -0.498 ***Price*** *Overall* –0.352 (using a two-stage least squares regression)	
CDC (Farrelly & Bray), (1998) USA	Cross-sectional (pooled six surveys 1976–1993) from NHIS Analysis sample: N=355 246 (≥18 yrs)	Two-part model for cigarette use: 1) probit (smoking prevalence); 2) OLS (smoking intensity) Adjusted for region of the country, real family income, education, sex, age, race/ethnicity, marital status, urbanicity and year of interview Price: state-specific average price adjusted for inflation	**Overall** -0.25 **By age (in years)** ***18–24*** -0.58 ***25–39*** -0.42 ***≥40*** -0.10 **By sex** ***Men*** -0.26 ***Women*** -0.19 **By income** ***Low*** -0.29 ***High*** -0.17 ***Missing*** -0.25 **By ethnicity** ***White*** -0.14 ***Black*** -0.32 ***Hispanic*** -1.89	**Overall** -0.15 **By age (in years)** ***18–24*** -0.37 ***25–39*** -0.25 ***≥40*** -0.06 **By sex** ***Men*** -0.18 ***Women*** -0.09 **By income** ***Low*** -0.20 ***High*** -0.05 ***Missing*** -0.23 **By ethnicity** ***White*** -0.05 ***Black*** -0.36 ***Hispanic*** -1.31	**Overall** -0.10 **By age (in years)** ***18–24*** -0.21 ***25–39*** -0.17 ***≥40*** -0.04 **By sex** ***Men*** -0.08 ***Women*** -0.10 **By income** ***Low*** -0.09 ***High*** -0.12 ***Missing*** -0.02 **By ethnicity** ***White*** -0.09 ***Black*** +0.04 ***Hispanic*** -0.58	

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Evans *et al.* (1999) USA	Cross sectional (pooled surveys) BRFSS (1985–1995) Analysis sample: N=812 185 (≥18 yrs)	Two-part model: 1) linear probability model; 2) OLS Adjusted for state and year effects, age, age2, sex, annual income, marital status, race, education, work status, and race/ethnicity Price: real tax in 1997 cents per pack	**Real tax** ***Overall*** -0.293 **Average of tax and lag tax** ***Overall*** -0.406	**Real tax** ***Overall*** -0.144 **Average of tax and lag tax** ***Overall*** -0.255	**Real tax** ***Overall*** -0.149 **Average of tax and lag tax** ***Overall*** -0.151	**Total income elasticity estimates** ***Real tax*** *Income missing* 0.65 *Lowest 50%* –0.32 *Next group* 0.17 **Average of tax and lag tax** *Income missing* 0.73 *Lowest 50%* 0.53 *Next group* –0.13
Ohsfeldt *et al.* (1999) USA	Cross-sectional (pooled surveys) CPS (1992–1993) Analysis sample: 165 653 males, either white or black (≥16 yrs) Nationally representative samples	Multivariate regression Adjusted for price (tax) of snuff, index of smoking regulation, family income, age, occupation and education, ethnicity, marital status, per capital income, poverty, unemployment rate, and religion Prices of cigarettes and snuff were mutually adjusted Price: real federal excise tax rate		**Cigarette use** ***Overall*** -0.15 ***By age (in years)*** *16–24* -0.22 *25–44* -0.11 *≥45* -0.07 **Snuff use** ***Overall*** -0.01 ***By age (in years)*** *16–24* -0.24 *25–44* -0.05 *≥45* +0.003		Cross-elasticities of demand for cigarettes and snuff were also analyzed. See Table 5.3 Laws restricting smoking in public places affect both cigarette and snuff use
Hersch (2000) USA	Cross-sectional (pooled surveys) CPS (1992–1993) Nationally representative samples of households Analysis sample: 25 726 men and 28 699 women (18–65 yrs)	Two-part model: 1) probit and 2) OLS Adjusted for real family earning/income, education, age, marital status, race, presence of children by age group, labour market status, and smoking restriction at work Price: average statewide price per		**Men** -0.54 ***By income*** *Low* -0.58 *Middle* 0.40 *High* -0.25 **Women** -0.38	**Men** -0.43 ***By income*** *Low* -0.60 *Middle* 0.44 *High* -0.13 **Women** -0.57	In both sexes, higher elasticity in more educated subjects

Table 5.1. Summary of studies on the effects of cigarette price on adults' demand for tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Hersch (2000) (contd) USA		pack (generic cigarettes were included in the sample of cigarettes, and the prices reflected both state and federal taxes)		***By income*** *Low* -0.99 *Middle* 0.06 *High* +0.58 **Among workers** ***Men*** -0.28 ***Women*** -0.21	***By income*** *Low* -0.72 *Middle* 0.55 *High* -0.30 **Among workers** ***Men*** -0.46 ***Women*** -0.38	
Farrelly *et al.* (2001) USA	Cross sectional (pooled seven surveys 1976–1980, 1983, 1985, 1987–1993) from NHIS N=367 106 (≥18 yrs) Analysis sample: n=354 228 (≥18 yrs)	Two-part model for cigarette use: 1) probit (smoking prevalence); 2) OLS (smoking intensity) Adjusted for state, real family income, education, sex, age, race/ethnicity, family size, marital status, urbanicity, year of interview, and state-specific effects Price: state-specific average retail price adjusted for inflation	**Overall** -0.28 **By age (in years)** ***18–24*** -0.55 ***25–39*** -0.53 ***≥40*** 0.00 **By sex** ***Men*** -0.18 ***Women*** -0.32 **By income** ***Low income*** -0.43 ***High income*** 0.00 **By ethnicity** ***White*** -0.15 ***Black*** -0.35 ***Hispanic*** -0.93	**Overall** -0.13 **By age (in years)** ***18–24*** -0.30 ***25–39*** -0.25 ***≥40*** -0.02 **By sex** ***Men*** -0.03 ***Women*** -0.19 **By income** ***Low income*** -0.21 ***High income*** +0.01 **By ethnicity** ***White*** -0.08 ***Black*** -0.20 ***Hispanic*** -0.62	**Overall** -0.15 **By age (in years)** ***18–24*** -0.25 ***25–39*** -0.28 ***≥40*** -0.06 **By sex** ***Men*** -0.18 ***Women*** -0.13 **By income** ***Low income*** -0.22 ***High income*** -0.11 **By ethnicity** ***White*** -0.15 ***Black*** -0.15 ***Hispanic*** -0.31	Data and analysis are very similar to those of the previous papers
Farrelly *et al.* (2004) USA	Longitudinal analysis from COMMIT study (1988 and 1993) N=11 966 smokers (25–64 yrs) Wave of 1988: 3675 smokers (25–64 yrs)	Three linear fixed effects regression models for average cigarette smoked per day by age group Adjusted for race, sex, marital status, education, gross			**Price elasticity** ***By age (in years)*** *25–34* -0.235 *35–44* -0.115 *45–64* -0.110	Smokers respond to higher cigarette prices by reducing intensity, but also by switching to cigarettes with higher levels of tar and nicotine Tar elasticities: +0.041 to +0.364

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Farrelly *et al.* (2004) (contd) USA	Analysis sample (both waves): n=9087 smokers (25–64 yrs)	household income, clean air laws index, age, the year 1993, nicotine and tar Price: average price of all types of cigarettes at the state level				Nicotine elasticities: +0.035 to +0.306
Sheu *et al.* (2004)	Pooled survey data BRFSS (1996–1999) N=16 260 Analysis sample: n=11 180 (Whites, blacks and Hispanics from selected areas with available information on cigarette price) Cigarette price information from the Bureau of Labor Statistics 1996–1999	Zero-inflated negative binomial (ZINB) regression model1) logit and 2) negative binomial (NB) For comparison purpose, also the two-part model was considered: 1) logit; 2) NB or OLS Adjusted for race, age, sex, marital status, education, income, employment status, health status and year of interview Price: average price (monthly price index of tobacco products for Los Angeles, San Diego and San Francisco)		**ZINB** ***Logit*** *Overall* +0.135 **Two-part model** ***Logit*** *Overall* +0.056	**ZINB** ***NB*** *Overall* 0.459 **Two-part model** ***Overall*** *NB* -0.417 *OLS* 0.474	Given the relatively low smoking prevalence, price increases are becoming less effective for hard-core smokers to quit. Price increases may not be an effective strategy to let occasional smokers quit
Sloan & Trogdon (2004)	Cross-sectional (13 surveys pooled) Behavioural Risk Factor Surveillance System BRFSS (1990–2002) N=1 761 686 (≥18 yrs) Surveys representative samples of the US adult population	Probit (smoking prevalence) Adjusted for socioeconomic and demographic factors, ethnicity, health insurance and behaviour, tobacco control policies and border prices Cigarette price: state-specific weighted average real price		**By age (in years)** ***18–20*** -0.26 ***21–24*** -0.11 ***25–44*** -0.10 ***45–64*** -0.10 ***≥65*** -0.25		Review authors computed elasticity estimates based on the resulting marginal effects for smoking prevalence
Tauras (2004) USA	National Health Interview Surveys (NHIS) (1991, 1993, 1994) Age: 18–64 years	A three-part model: 1) a probit for a current smoker 2) a probit for a some-day smoker (conditional on current smoking)		**Average current smoking participation price elasticity** -0.265	**Average some-day smoking conditional demand elasticity** 0.375	For each part of the three-part model, three models were estimated. Estimated elasticities obtained for each part were: -0.333; -0.112; -0.328

Table 5.1. Summary of studies on the effects of cigarette price on adults' demand for tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Tauras (2004) (contd) USA		3) a generalized linear model (GLM) with log link and gamma distribution for estimating average number of cigarettes consumed monthly among some-day smokers Explanatory variables: age, sex, real family income, race/ethnicity, education, marital status, metropolitan area, employment status, clean indoor index, and year of interview, price of a pack of 20 cigarettes and survey year Price: real annual, sales-taxed weighted average price for a pack of 20 cigarettes at state level		**Average price elasticity of some-day smoking participation conditional on current smoking** +0.860		0.904; 0.590; 0.977 -0.479; -0.202; -0.444
Tauras (2006) USA	Cross-sectional (pooled surveys) Tobacco Use Supplements to the CPS (1992–1999) Nationally representative surveys Analysis sample: N=545 603 (≥ 18 yrs)	A two-part model: 1) a probit (smoking prevalence); 2) a generalized linear model (GLM) with log-link and Gaussian distribution (smoking intensity) Adjusted for age, sex, real family income, race/ethnicity, education, marital status, metropolitan area, employment status, clean indoor index and year of interview Time and state fixed effects included in regressions Real price: average statewide price		**Overall** -0.120 to -0.129	**Overall** -0.071 to -0.073	Three different models were estimated according to whether the smoke-free law in each state was included More restrictive smoke-free air laws decrease average smoking by adults but have little impact on prevalence

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Franks *et al.* (2007) USA	Cross sectional (pooled surveys) BRFSS (1984–2004) N=over 2.6 million (≥18 yrs) Nationally representative telephone survey	Fixed-effects logistic regression (for smoking prevalence) Adjusted for sex, age, race/ethnicity, education (years of schooling), number of adults in the household, consumer price index, household income, survey year and state Pack price at the year preceding the survey year. Price elasticities were provided before and after the Master Settlement Agreement (MSA) Price: real state-specific cigarette tax		**By income quartile** ***Period 1984–1996*** *Lowest (95% CI)* -0.45 (-0.67, -0.22) *All other quartiles (95% CI)* -0.22 (-0.35, -0.10) ***Period 1997–2004*** *Lowest (95% CI)* -0.14 (-0.36, +0.08) *All other quartiles (95% CI)* -0.07 (-0.18, +0.05)		Using cigarette pack tax instead of pack price brought to greater differences between the two periods By income quartile: Period 1984–1996: Lowest: -0.07 All other quartiles: 0.06 Period 1997–2004: Lowest: 0.00 All other quartiles: 0.04
Stehr (2007) USA	Cross-sectional (pooled surveys) Behavioral Risk Factor Surveillance System BRFSS (1985–2000) N=1 339 459 (≥18 yrs) Men: n=571,631 Women: n=767,872	Two-part model for cigarette use: 1) probit (smoking prevalence); 2) log-log OLS (smoking intensity) Adjusted for gender-specific state fixed effects, income, education, sex, age, ethnicity, and year of interview Price: state-specific average cigarette tax	**Overall** 0.36 **Males** -0.26 ***Income (quartile)*** *1st*: -0.36 *2nd*: -0.11 *3rd*: -0.21 *4th*: -0.23 **Females** -0.51 ***Income (quartile)*** *1st*: -0.59 *2nd*: -0.30 *3rd*: -0.47 *4th*: -0.53	**Overall** -0.25 **Males** -0.16 ***Income (quartile)*** *1st*: -0.23 *2nd*: -0.07 *3rd*: -0.09 *4th*: -0.15 **Females** -0.40 ***Income (quartile)*** *1st*: -0.43 *2nd*: -0.25 *3rd*: -0.30 *4th*: -0.43	**Overall** -0.10 **Males** -0.09 ***Income (quartile)*** *1st*: -0.13 *2nd*: -0.03 *3rd*: -0.013 *4th*: -0.07 **Females** -0.12 ***Income (quartile)*** *1st*: -0.16 *2nd*: -0.05 *3rd*: -0.16 *4th*: -0.10	When gender-specific state fixed effects are included, women were twice as responsive to cigarette taxes
DeCicca & McLeod (2008) USA	Cross-sectional (5 surveys) BRFSS (2000–2005) Telephone interview; a representative sample of the US population Analysis sample: N=543 384 (45–64 yrs); 435 973 (45–59 yrs)	Two-way fixed effects models Adjusted for sex, age, race, education, income, marital status, health status, unemployment rate, state ban in workplaces and restaurants, and state-level effects Price: real monthly state-specific cigarette		**By age (in years)** ***Smoking all days*** *Overall* -0.21 to -0.22 *45–59* -0.29 to -0.31 ***Smoking some days*** *Overall*: 0.20 to -0.21 *45–59* -0.24 to -0.28		Sensitivity analyses (for 3 models and two age groups) resulted in almost identical elasticities Price elasticities of smoking prevalence by health status: Unhealthy: -0.54 Healthy: -0.11

Table 5.1. Summary of studies on the effects of cigarette price on adults' demand for tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
DeCicca & McLeod (2008) (contd) USA		excise tax rates per pack in 2001 dollars		**By sex** ***Men*** -0.31 ***Women*** -0.27 **By education** ***Low*** -0.43 ***High*** -0.12 **By income** ***Low*** -0.39 ***High*** -0.09 **By health status** ***Unhealthy*** -0.54 ***Healthy*** -0.11		
Farrelly & Engelen (2008) USA	Cross-sectional (pooled surveys) BRFSS (1990–2006) N=over 2.5 million (≥18 years)	Replication of the previously described analysis (Franks *et al.*, 2007) in different periods Pack price at the year of the survey. Price elasticities provided before and after the Master Settlement Agreement (MSA)		**Total price elasticity** ***Before MSA (1990-1998)*** -0.22 (-0.15; -0.28) ***After MSA (1999-2006)*** -0.09 (-0.04; -0.13) ***By income quartile*** *Period 1990–1998* Lowest: -0.16 Middle 2: -0.34 Highest: -0.14 *Period 1999–2006* Lowest: -0.11 Middle 2: -0.06 Highest: -0.02		-0.22 (-0.15; -0.28) After MSA (1999-2006) -0.09 (-0.04; -0.13) By income quartile Period 1990–1998 Lowest: -0.16 Middle 2: -0.34 Highest: -0.14 Period 1999–2006 Lowest: -0.11 Middle 2: -0.06 Highest: -0.02
Franz (2008) USA	Cross-sectional (8 surveys from BRFSS (1993–2000) Analysis sample: N=1 000 013 (≥18 yrs)	Two models were considered: i) A simple OLS ii) A two part model: 1) OLS; 2)OLS Adjusted for sex, health status, age, race, education, marital status, income, region and year effects Price: state-level average real price of a pack of cigarettes	**Overall** -0.374 **By age (in years)** ***18–29*** -0.518 ***30–39*** -0.360 ***40–64*** -0.327 ***≥65*** -0.458	**Overall** -0.193 **By age (in years)** ***18–29*** -0.289 ***30–39*** -0.176 ***40–64*** -0.201 ***≥65*** -0.331	**Overall** -0.191 **By age (in years)** ***18–29*** -0.184 ***30–39*** -0.192 ***40–64*** -0.158 ***≥65*** -0.154	Overall price elasticity for cessation: 0.375

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Dinno & Glantz (2009) USA	Cross-sectional survey Tobacco Use Supplement (TUS) of the CPS (February 2002) N=54 024 A representative sample of the US population (15–80 years)	Two-part model: 1) fixed effect logistic regression (current smoking prevalence); 2) fixed effect linear regression (smoking intensity; cigarettes/day among current smokers) Adjusted for education, household income, sex, age, race/ethnicity, and clean indoor air law Price: state-specific average cigarette price		**States with average cigarette price per pack <$3.28** OR for an increment of 0.10 cents = 0.95 (95% CI 0.93; 0.97) OR for the highest vs. lowest price = 0.83 (95% CI 0.78; 0.88) **States with average cigarette price per pack ≥ $3.28** OR not significant (estimates not reported) **Price elasticity** ***For people living in states with price ≤$3.28*** -0.41 ***For people living in states with price ≤$3.17*** -0.99	**States with average cigarette price per pack < $3.17:** A change of 1.16 cigarettes/day (95% CI-0.40; 2.03) Effect of clean indoor air legislation: 2.36 cigarettes/day **States with average cigarette price per pack ≥ $3.17** No significant change in cigarette consumption (estimates not reported)	Prevalence: The association of price with smoking prevalence did not change with educational attainment, household income or race/ethnicity. No statistically significant interaction between cigarette price and clear indoor air coverage Consumption: No statistically significant interaction between price and educational attainment, household income or race/ethnicity was found
Other high-income countries						
Australia						
Cameron & Williams (2001) Australia	National Drug Strategy Household Surveys (NDSHS) for 1988, 1991, 1993 and 1995 Nationally representative surveys of the Australian population ≥14 yrs Analysis sample: n=9744 (≥20 yrs)	A probit model for cigarette use (smoking prevalence) Adjusted for age, sex, marital status, employment status, education, capital city, number of children legal sanctions against cannabis use in the state of residence, survey years, real price index of alcohol, real predicted price of a gram of head of marijuana, and interaction terms of pairs of real prices Real price index of cigarettes		**Overall** -0.436		Two probit equations for two other discrete choice dependent variables: (i) using cannabis and (ii) using alcohol were used Cannabis and cigarettes were found to be complements. Similarly, alcohol and cigarettes were complements

Table 5.1. Summary of studies on the effects of cigarette price on adults' demand for tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Zhao & Harris (2004) Australia	Australian National Drug Strategy Household Surveys (NDSHS, 1995, 1998, 2001) N> 40 000 individuals (≥14 yrs) Nationally representative surveys of the Australian population ≥14 yrs	Multivariate probit for three discrete choice dependent variables: (i) using any tobacco products (smoking prevalence), (ii) using marijuana, and (iii) using alcohol Adjusted for survey years, age, sex, marital status, legal status of the state of residence, employment status, education, capital city, Aboriginal or Torres Strait Islander origin, home language, number of children, real household income, real price of marijuana, and real price index of alcohol Real price index of tobacco		**Overall** -0.863		A complementary relationship between alcohol and tobacco and the similar relationship between marijuana and tobacco were found in the participation decisions
Harris & Zaho (2007) Australia	Australian National Drug Strategy Household Survey (NDSHS, 1995, 1998, 2001) N>40 000 individuals (≥14 yrs) Nationally representative surveys of the Australian population ≥14 yrs n=28 813 individuals	A double-hurdle model. The two hurdles were: i) decision to participate; ii) level of consumption that also included zero consumption A zero-inflated ordered model combining a split probit model and an ordered probit model Four discrete variables (0, 1, 2, and 3) describing different levels of tobacco consumption Covariates: age, age squared, sex, marital status, education, region of residence, employment status, language spoken			**Marginal effect of tobacco price on zero consumption** +0.145 **Marginal effect of tobacco price on non-zero consumption by level of consumption** ***1st level (lowest)*** +0.005 ***2nd level*** -0.070 ***3rd level (highest)*** -0.081	**Marginal effect of personal income on non-participation** +0.027 **Marginal effect of personal income on non-participation zero consumption** -0.017 **Marginal effect of personal income on non-zero consumption** ***1st level (lowest)*** -0.003 ***2nd level*** -0.007 ***3rd level (highest)*** 0.000

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Harris & Zaho (2007) (contd) Australia		at home, real price index of alcohol, real price of marijuana, real personal annual before-tax income, and an indicator of females younger than 26 years Real prices and personal income were log-transformed				
Siahpush *et al.* (2009) Australia	Face-to-face population survey conducted in the 5 largest Australian capital cities (1991-2006) Sample size: 515,866 individuals (≥18 yrs)	Dependent variable: monthly smoking prevalence Poisson regression Adjusted for income, interaction between price and income category, education, age, sex and time trend Cigarette price: state-specific average real price of the two top-selling Australian brands (Peter Jackson and Winfield)		**By income group** ***Low*** -0.32 ***Medium*** -0.04 ***High*** -0.02		The results suggest that increasing the real prices of cigarettes is an effective tobacco control strategy to lower smoking prevalence and may provide a means of reducing social disparities in smoking
Canada						
Hamilton *et al.* (1997) Canada	Longitudinal (retrospective) Survey on Smoking in Canada (1994/1995) Follow up 4 times during one year 11 119 respondents (≥ 15 yrs) Telephone survey Population in the provinces with tobacco tax cut : 5 770 100; population in the provinces without tobacco tax cuts: 7 019 200	No multivariate regression analysis Simple descriptive analysis No computation of elasticities		Smoking prevalence in provinces where taxes were not cut declined more (from 29.0% to 24.9%) vs. smoking prevalence in provinces without taxes cut (from 31.0% to 28.3%)		Rates of starting cigarette smoking were higher (ranges: 0.9–1.7% vs. 0.7–1.2%) and smoking quit rates were lower (ranges: 2.5–10.3% vs. 5.7–10.7%) in the provinces where taxes had been cut than in those where taxes had not been cut
Stephens *et al.* (1997) Canada	Cross-sectional General Social Survey (GSS; 1991) n=11 652 households (individuals ≥ 15 yrs)	Logistic regression (current smoking status) Adjusted for age, sex, marital status, education, policy		OR of smoking vs. non-smoking (never and former together) Smoking prevalence associated with		No mention of adjustment for the analysis using the 1990 HPS data Smoking prevalence associated with infrequent

Table 5.1. Summary of studies on the effects of cigarette price on adults' demand for tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Stephens *et al.* (1997) (contd) Canada	National representative of householders at a provincial level Health Promotion Survey (HPS; 1990) n=14 000 No details on interview procedure	variables (tobacco price, percent increase of price over 1 year and 10 years, percentage of population covered by no-smoking laws) Price of 200 cigarettes Percentage increase in the price over 1 year and 10 years		relatively low prices (OR=1.26; 95% CI 1.11-1.43) No association with price increase		smoking regulations (OR=1.21; 95% CI 1.08-1.36) [according to results from the analysis using the 1991 GSS data]
Gruber *et al.* (2003) Canada	Canadian Survey of Family Expenditure (FAMEX) 8 pooled household surveys (1982–1998) Analysis sample: 81 479 observations	Dependent variables: (1) total household spending on cigarettes, (2) any spending on cigarettes (prevalence) and (3) level of spending on cigarettes (intensity) Two kinds of models: 1) an OLS for total spending 2) a two-part model: (i) OLS for prevalence, and (ii) OLS for intensity Controlled for fixed effects for regions, years, region-specific linear time trends, and household characteristics (after-tax income, sex of the household head, and family size) Cigarette price was instrumented using the cigarette excise and sales tax rate	**Overall** -0.45 **By income quartile** ***1st*** -0.99 ***2nd*** -0.45 ***3rd*** -0.31 ***4th*** -0.36 **By expenditure quartile** ***1st*** -0.92 ***2nd*** -0.73 ***3rd*** -0.20 ***4th*** -0.37	Overall: -0.02	Overall: -0.41	When smuggling provinces and years were excluded from the models, the price estimates were similar. As the price elasticity of intensity was large, all of the response of consumption occurred through reductions in consumption Using legal sales data, overall price elasticity was 0.72, and declined to -0.47 when excluding smuggling provinces and years.
Gospodinov & Irvine (2009) Canada	Cross-sectional Health Canadian Tobacco Use Monitoring Survey (CTUMS) (2000-2005) Analysis sample: 90 850 (≥20 yrs)	Two-part model: 1) Probit; 2) OLS Adjusted for health warnings, year of interview, household size, sex, education, age, sex, profession, language and region Price: retail price of a pack of cigarettes	**Overall** -0.299 **By education** *< High school* -0.299 ***High school*** -0.333 ***College*** -0.300			Another computational method based on the median instead of average of the partial effects evaluated at all observations provided similar elasticities

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Italy						
Aristei & Pieroni (2009) Italy	Cross-sectional The 2000 Italian survey on Health status and use of health services (HSHS) Analysis sample: N=47 777 ever smokers (current and former) Men: n=31 912 Women: n=15 865	Box-Cox double-hurdle model: 1) smoking prevalence; 2) smoking intensity Adjusted for age, education, sex, marital status, social and occupation status, health status, smoking habit, BMI, chronic illness, physical activity, children, and number of earners and other smokers in the household Price: weighted average price of national per pack prices (including excise taxes) of both domestic and imported cigarettes			**Overall** -0.24 **By sex** ***Men*** -0.13 ***Women*** -0.65	Definition of age and education: Age = age in years Education = years of formal education Reported results were obtained from the IV Box-Cox double hurdle models in which peer effects were treated as endogenous variables The presence of smokers (peer measures) significantly increased the probability of remaining a smoker and smoking intensity
Republic of Korea						
Chung *et al.* (2007) Republic of Korea	Telephone interview survey Analysis sample: 3000 males (≥20 yrs)	Two-part model: 1) logistic regression (smoking prevalence); 2) OLS (smoking intensity) Adjusted for age, education, religion, occupation, family income, marital status, children, area of residence, lifestyle habits, BMI, health status, health perception, age at starting smoking, and parental and friend's smoking No experienced smoker is excluded	**Overall** -0.66	**Overall** -0.02	**Overall** -0.64	Three logistic regressions and four OLS models were run with different number of covariates included The inclusion of other behavioural risk factors substantially reduced the price elasticity of prevalence but had no effect on the price elasticity of intensity
Spain						
García & Labeaga (1996) Spain	Spanish Households Budget Surveys (EPF) 1980–1981 n=23 669 households	A double-hurdle model Covariates: total real expenditure, occupation,			**Price elasticities** ***Base*** -0.24	Elasticities of total expenditure: Base: +0.03 Lowest education: +0.01 Highest education: +0.12

Table 5.1. Summary of studies on the effects of cigarette price on adults' demand for tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
García & Labeaga (1996) (contd) Spain		employment status, education, size of the town of residence, age and age squared, and household size Price: retail price index (base year=1976)			***Lowest education*** -0.52 ***Highest education*** +0.07 Unemployed -0.31 The head aged < 25 years old: 0.70	Unemployed: +0.09 Head of household aged <25 years old: +0.18 Base: a household having four members, the head was a non-manual worked age 50 who had secondary education and lived in an Andulusian town of 50 000–500 000 inhabitants For comparison estimation results, a Tobit model was also estimated
Jiménez-Martín *et al.* (1998) Spain	Spanish Continuous Family Expenditure Surveys (ECPF) 1985–1995 Individual data that were used to construct population averages for smoking prevalence and intensity per household were from 38 quarterly cross-sections of the ECPF for 1985(1)–1994(2) Two samples of cohort data were formed based on (*) the date of birth of the head of the household (sample 1) and both on (*) and on his/her education level (sample 2). Both samples contained 456 cell means total	A double-hurdle model: (i) probability of smoking (participation rate), and (ii) intensity (budget share on tobacco per smoking household) Adjusted for education, employment status, rural/urban area, number of dependents in the household, an indicator describing the anti-tobacco legislative measures, and quarterly dummies Tobacco expenditure: weekly expenditures on any kind of tobacco grossed up to the quarter Reported results here were obtained from the static pooled within-groups models (WG static models) and from the dynamic pooled within-groups models accounting for cohort fixed effects (WG dynamic models)		**Probability of smoking** ***WG static model*** *Sample 1* -0.16 *Sample 2* -0.14 ***WG dynamic model*** *SR elasticity* Sample 1 -0.13 Sample 2: -0.11 *LR elasticity* Sample 1 -0.20 Sample 2 -0.16	**Intensity** ***WG static model*** *Sample 1* -0.47 *Sample 2* -0.40 ***WG dynamic model*** *SR elasticity* Sample 1 -0.21 Sample 2 -0.22 *LR elasticity* Sample 1: -0.56 Sample 2: -0.50	The Almost Ideal Demand System was applied. A lagged smoking/consumption was used as an independent variable in the dynamic model Elasticity estimates obtained from the static OLS models using pooled data: Prevalence Sample 1: -0.28 Sample 2: -0.72 Intensity Both samples: -0.54 Price elasticities obtained from the models using aggregate individual data and the heterogenous models (cohort by cohort estimated) varied much and were not reported here

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Labeaga (1999) Spain	The Spanish Permanent Survey of Consumption (EPC) Unbalance panel of households n=34 413 households	A double-hurdle rational addiction model with heterogeneity A two-step structural model using a generalized method of moments (GMM) within-groups estimator Covariates: sex, occupation, employment status and education of the head, number of members over 16 yrs, household composition, age and age squared of the head and the spouse, region of residence, and housing tenure dummy variables. Lags and leads of real prices and income appeared in several models. Income was also considered as endogenous in some models	Price: real price of tobacco (price of tobacco was deflated by means of a weighted average of prices of nine goods)	**Model where total expenditure was endogenous** ***Short-run price elasticities*** *Overall* -0.27 *Ever smoker* -0.17 ***Long-run price elasticities*** *Overall* -0.36 *Ever smoker* -0.23	**Model where total expenditure was endogenous** ***Short-run price elasticities*** *By education* No studies: -0.30 <High school: -0.28 University: -0.21 *By age (in years)* < 25: -0.26 ≥ 60: -0.34 *By income decile* D1 poorest: -0.50 D10 richest: -0.17 Manual workers: -0.267 ***Long-run price elasticities*** *By education* No studies: -0.40 <High school: -0.37 University: -0.28 *By age in years* < 25: -0.34 ≥ 60: -0.50 *By income decile* D1 poorest: -0.67 D10 richest: -0.23 Manual workers: -0.36	**Model where total expenditure was strictly exogenous** ***Short-run price elasticities*** *Overall* -0.27 *Ever smoker* 0.17 *By education* No studies: -0.30 <High school: -0.28 University: -0.21 *By age in years* < 25: -0.26 ≥ 60: -0.34 *By income decile* D1 poorest: -0.50 D10 richest: -0.17 Manual workers: -0.267 ***Long-run price elasticities*** *Overall* -0.36 *Ever smoker* -0.23 *By education* No studies: -0.40 <High school: -0.37 University: -0.28 *By age in years* < 25: -0.34 ≥ 60: -0.50 *By income decile* D1 poorest: -0.67 D10 richest: -0.23 Manual workers: -0.36
United Kingdom						
Jones (1989) United Kingdom	Household survey data 1954–1986 consisted of the annual series published by the Tobacco Advisory Council 1954–1974 and the bi-annual data from the General Household Survey (GHS) 1972–1986 The data were used to derive the proportion of	A double-hurdle approach A seemingly unrelated regression for (i) participation rate and (ii) budget share of cigarettes (intensity) Covariates in the two equations: price of cigarettes and total consumers' expenditure per capita at constant	**Price elasticity of per capital demand at 1986 values** -0.562	**Elasticity of participation rate at 1986 values** -0.192	**Elasticity of intensity at 1986 values** -0.370	Equation of budget share was similar to the Almost Ideal Demand System model

Table 5.1. Summary of studies on the effects of cigarette price on adults' demand for tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Jones (1989) (contd) United Kingdom	cigarette smokers in the adult population aged over 16 years old	prices, and dummies capturing both permanent effects of three health events and returning trends of the health scares				
Low- and middle-income countries						
Bulgaria						
Sayginsoy *et al.* (2002) Bulgaria	The study is based on a 1995 household survey and encompasses 2259 households	Control variables: Income, Average age of household members, highest education of a household member, alcohol consumption, ratio of adult males in household	**Overall** -0.80 **Low- and lower-middle- income earners** -1.33 **Upper-middle- income earners** -1.02 **High-income earners** -0.52			HNP study
China						
Mao & Jiang, (1997) China	Random cluster sampling in Sichuan Province (1995) N=2431 subjects (≥15 yrs), including 1412 men and 921 women.	Two-part model for cigarette use: 1) logit (smoking prevalence); and 2) OLS (smoking intensity)	**Overall** -0.69			
Mao *et al.* (2003) China	National Smoking Consumption Survey (1998) N=24 641 adults (≥20 yrs), including 12 854 men and 11 786 women	Two-part model and two-stage least square method Adjusted for gender, race, education, occupation, income, age, price, area, perception of risk, knowledge, propaganda of tobacco control Price: expenditure of tobacco/consumption of tobacco (packages)	**Overall** -0.513 **By sex** ***Men*** -0.45 ***Women*** -0.69 **By income group** ***Poverty*** -1.906 ***Low-income*** -0.774 ***High-income*** -0.507			Poverty group: <200 RMB household income per month; Low-income group: <500 RMB household income per month; High-income group: >500 RMB household income per month;

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Lance *et al.* (2004) China	China Health & Nutrition Survey (1989–1993 waves) Cross-sectional (from follow-up studies) N=8557 men (≥13 yrs)	Two-part model for cigarette use: 1) logit (smoking prevalence); and 2) OLS (smoking intensity) Adjusted for wealth, age, education, household size, community, price deflator and survey year Price: cigarette price of local market where participants resided		**Overall** -0.019 **With fixed effects (province and urbanicity)** -0.045 **With fixed effects (community-level)** -0.034	**Overall** -0.063 **With fixed effects (province and urbanicity)** -0.056 **With fixed effects (community-level)** +0.027	Included in the same study with the Russian analysis above
Lee *et al.* (2004) China (Taiwan)	Two random samples of smokers: 1488 in 2000–2001 and 1014 in 2002–2003 (17–69 yrs) Annual face-to-face interview Analysis sample: 2502 current smokers (4 surveys)	(1) OLS for smoking intensity by smoker group Current smokers were categorized by age, sex, education, monthly income, and amount of cigarettes smoked. Price and income were mutually adjusted. No additional covariates were added into the model New tax scheme in 2002 (2) OLS for smoking intensity by time period Adjusted for sex, age, education, monthly income, and smoking degree Cigarette price: average retail price of the top three most consumed cigarettes			**Overall** ***By survey year*** *2000*: -0.31 *2001*: -0.37 *2002*: -0.53 *2003*: -0.31 **Period 2001–2002** ***Overall*** -0.34 ***By sex*** *Men*: -0.31 *Women*: -0.12 **Period 2002–2003** ***Overall*** -0.41 ***By sex*** *Men*: -0.39 *Women*: -0.14	In 2002, after Taiwan, China had enacted the new tax scheme, there was an increase in cigarette price elasticity Higher elasticity for men, for lower-income men, and for smokers of light cigarettes. No specific pattern in strata of age and education Income elasticity provided negligible estimates (ranging from 0.00 to +0.03)
Tsai *et al.* (2005) China (Taiwan)	Two-year follow-up cohort (face-to-face survey); 2001 and 2002 surveys Analysis sample: n=501 male smokers (≥18 yrs)	Logistic regressions (for behavioural change (i) reduction of smoking, and (ii) brand switching). Odds ratios were obtained Adjusted for demographic factors, individual income, smoking behaviour,		For reduced smoking with respect to increased retailed cigarette price by 1 NT$: OR = 1.03		For brand smoking with respect to higher retail cigarette price: OR = 1.07 Overall, 17.4% switched brand, 18.8% reduced smoking, 8.4% both types of behavioural changes The study also used independent linear regressions and the Zeller's seemingly

Table 5.1. Summary of studies on the effects of cigarette price on adults' demand for tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Tsai *et al.* (2005) (contd) China (Taiwan)		living area, expense on smoking, addiction level, advertisement, and favourite cigarette brand Change in smoking behaviour before (2001) and after the introduction of a new cigarette tax scheme (year 2002)				unrelated regression for modelling changes of smoking behaviour
Bishop *et al.* (2007) China	1995 Chinese Household Income Project (10 provinces) Urban adult males Province and county: N=4051 County only: N=1963	A two-part model: (i) a probit model (smoking prevalence); (ii) a linear regression model Explanatory variables: income, education, age, marital status, number of children in the household, and mean price Price = household expenditures on cigarettes/total number of packs used by a household	**Province and county** -0.463 **County only** -0.511	**Province and county** -0.213 **County only** -0.209	**Province and county** -0.250 **County only** -0.303	The estimated price elasticity of demand obtained from an estimated Tobit model was 1.5. This was not considered, as the fat tail of the smoking distribution violated the normality assumption of Tobit.
Mao *et al.* (2007) China	National Smoking Prevalence Survey (NSPS; 2002) Face-to-face interview. A national representative sample N=16 056 (≥16 yrs)	A two-part model for cigarette use: 1) logit (smoking prevalence); and 2) OLS (smoking intensity) Adjusted for sex, age, education, family income, residence area and smoking initiation age Cigarette price: average market price (computed as the average of the self-reported prices among smokers) assigned to the participants by their residence location	**Overall** -0.154 **By income group** ***Poor*** -0.589 ***Low*** -0.234 ***Middle*** -0.018 ***High*** +0.257	**Overall** -0.064 **By income group** ***Poor*** -0.478 ***Low*** -0.199 ***Middle*** +0.093 ***High*** +0.340	**Overall** -0.090 **By income group** ***Poor*** -0.111 ***Low*** -0.035 ***Middle*** -0.111 ***High*** -0.083	

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Chang & Chiang (2009) China (Taiwan)	Cross-sectional National Survey on Knowledge, Attitude and Practice of Health Promotion (2002–2003) Face-to-face interview Representative sample Analysis sample: 13 030 men (≥18 yrs)	OLS models (smoking intensity) with a double log specification for: i) depressive smokers ii) non-depressive smokers iii) all smokers Adjusted for age, education, income, marital status, and urbanization Cigarette price = ratio of cigarette expenses to the number of cigarettes smoked (per day)			**All male smokers** -0.40 **Depressive male smokers** -0.82 **Non-depressive male smokers** -0.41	The sample was limited to men because of low prevalence of smoking among women
Estonia						
Taal *et al.* (2004) Estonia	Monthly household data from the Household Income and Expenditure Study, 1992 to 1999	Myopic addiction model A log-linear model for smoking intensity (average monthly cigarette consumption) Explanatory variables: Average real income per household member, real tobacco product price index, quarterly dummies, time trend, lagged consumption	**Price elasticity** -0.34			HNP study
Egypt						
Nassar (2003) Egypt	The study considered the 1995–6 and 1999–2000 household expenditure surveys.	Control variables: Income quartile (poorer households have higher price elasticity), education Expenditure elasticities were calculated by expenditure groups, educational level, work status and urban/rural area	**National average price elasticity for "tobacco", not only cigarettes** -0.40 **Urban households** -0.41 **Rural households** -0.39			HNP study
India						
John (2008) India	Cross-sectional survey (1999–2000) N=120 309 households Household with zero	OLS regression Price of each tobacco product: average unit values (self-reported			**Rural (own elasticities)** ***Bidis*** -0.91	Own- and cross-price elasticities considered A demand system model Spatial variation in prices of

Table 5.1. Summary of studies on the effects of cigarette price on adults' demand for tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
John (2008) (contd) India	consumption of tobacco (37% from rural and 60% from urban) were excluded from the analyses Unit of analysis: household	expenditure divided by quantity)			***Cigarettes*** -0.41 ***Leaf tobacco*** -0.87 **Urban (own elasticities)** ***Bidis*** -0.87 ***Cigarettes*** -0.179 ***Leaf tobacco*** -0.877 When symmetry restrictions were imposed (for the unique substitution complementary patterns), own price elasticity estimates: **Rural** ***Bidis*** -0.92 ***Cigarettes*** -0.34 ***Leaf tobacco*** -0.87 **Urban** ***Bidis*** -0.86 ***Cigarettes*** -0.20 ***Leaf tobacco*** -0.87	tobacco products were used to estimate own- and cross-price elasticities See also Table 5.3
Indonesia						
Adioetomo *et al.* (2005) Indonesia	Study using the 1999 National Socio-Economic Survey (Susenas), collected by the Central Bureau of Statistics.	Control variables: Cigarette price in rupiah per pack of 16 cigarettes (expenditure on cigarettes divided by the quantity of cigarettes consumed), per capita household income per day in rupiah, dummy for urban/rural location, dummies for education, profession, age and sex	**Overall price elasticity** -0.61 **By income groups (lowest to highest)** ***Q1***: -0.67 ***Q2***: -0.33 ***Q3***: -0.31			HNP study

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Mexico						
Jiménez-Ruiz *et al.* (2008) Mexico	Cross sectional (7 surveys) National Household Income and Expenditure Survey (1994–2005) N=109 089 households (individuals aged ≥15 yrs) Nationally representative samples Unit of analysis: household	Two-part model for cigarette use: 1) probit (smoking prevalence); 2) log-log OLS (smoking intensity) Adjusted for household income, education, sex, age of the household head, alcohol intake, number of adults in the household, and year of interview Price: ratio of total expenditure on cigarettes per week to the number of cigarettes smoked. Average price paid by each household	**Overall** -0.52	**Overall** -0.06	**Overall** -0.45	**Income elasticity** ***Overall*** +0.49 ***For prevalence*** +0.25 ***For smoking intensity*** +0.24
Myanmar						
Kyaing (2003) Myanmar	The survey was performed in 2001 and includes 9847 households	The price elasticity of demand was estimated using the two-step procedure described in Onder (2002). Control variables: Income, price, age, education and literacy, gender, marital status and urban/rural residence The study considered the household expenditure on cigarettes, cheroots and *phet kyan* (tobacco covered with *thenatphet* leaves).	**Total price elasticity** -1.62	Price elasticity of smoking participation: -1.28 average, but varies from –1.09 for poorest quintile to -1.41 for middle quintile	Conditional price elasticity of demand: -0.34 average, but varies from –0.42 for poorest quintile to –0.24 for richest quintile	HNP study In Myanmar tobacco is consumed primarily in the form of cheroots
Kyaing *et al.* (2005) Myanmar	Household survey undertaken for the study among low-income groups in two peri-urban communities and four townships. The data was collected among tobacco users	A log-log OLS model was used for the estimation Control variables: Income, addiction, gender, marital status, education and occupation			**Conditional price elasticity for all tobacco products** -0.11 **Conditional price elasticity for cheroots** -0.36	HNP study

Table 5.1. Summary of studies on the effects of cigarette price on adults' demand for tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Kyaing *et al.* (2005) (contd) Myanmar	only (2414 tobacco users interviewed)				**Conditional price elasticity for cigarettes** -0.25	
Nepal						
Karki *et al.* (2003) Nepal	For this study 1400 households (about 4000 people) were interviewed.	Based on the cross-sectional study a two-step procedure, similar to that of Onder (2002) was applied to determine the price elasticity of smoking participation and the conditional price elasticity of demand. In this comprehensive study price elasticities were estimated to determine the likely impact of price and tax increases on consumption and government revenue. Control variables: Income, age, gender, literacy, education level, occupation, urban/rural, number of years that the person has smoked	**Total price elasticity (average)** -0.88 Total price elasticity among youth (aged 15-24) was much higher than the average (-1.88)	**Price elasticity of smoking participation** -0.46	**Conditional price elasticity of demand** -0.42	HNP study
Poland						
Gardes & Starzec (2004) Poland	Polish Consumption Panel database (1987–1990) 3630 households	Three different models: 1) Tobit 2) Probit (long-run elasticity) 3) Frisch direct method. Adjustment for location, education dummies, logarithmic equivalence scale, log age, proportion of children, quarter dummies	**Average elasticity from the 3 models** ***Short-run*** -0.4 ***Long-run*** -0.7			

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Russia						
Ogloblin & Brock (2003) Russia	Cross-sectional The Russia Longitudinal Monitoring Survey (RLMS); two waves of data collected in1996 and 1998–1999 N=4718 households (individuals ≥18 yrs) Analysis sample: Men: N=6015 Women: N=8457	Probit models for men and women Computation of price elasticity of smoking prevalence by using the resulting marginal effects Adjustment for age, age2, community type, marital status, education, occupation, real income, alcohol drinking and BMI Price: geometric average of 4 real prices: lowest price of domestic cigarettes, highest price of domestic cigarettes, lowest price of imported cigarettes and highest price of imported cigarettes		**Overall** ***Men*** -0.085 ***Women*** -0.628 **For 1996** ***Men*** -0.046 ***Women*** -0.430 **For 1998** ***Men*** -0.120 ***Women*** -0.919		Income elasticity overall: Men: -0.007 Women: +0.047
Lance *et al.* (2004) Russia	Russian Longitudinal Monitoring Survey (1996, 1998, 2000) N=10 638 men (>13 yrs)	Two-part model: 1) logit (smoking prevalence); and 2) OLS (smoking intensity) Adjusted for wealth, age, education, household size, community, price deflator and survey round Price: cigarette price of local market where participants resided		**Overall** -0.106 **With fixed effects (province x urbanicity)** -0.101 **With fixed effects (community-level)** -0. 050	**Overall** -0.026 **With fixed effects (province x urbanicity)** -0.026 **With fixed effects (community-level)** 0.000	Included in the same study with the Chinese analysis below
South Africa						
Berg & Kaempfer (2001) South Africa	Living Standard Measures Survey (LSMS), 1993 Study population: 1131 black households and 998 white households	Censored maximum likelihood (ML) and censored least absolute deviation (LAD) estimation techniques Adjusted for prices of various food items, number of adults and children, and income	**By ethnicity** ***Black*** -0.80 ***White*** -1.79		**By ethnicity** ***Black*** +0.34 ***White*** +0.09	

Table 5.1. Summary of studies on the effects of cigarette price on adults' demand for tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Van Walbeek (2002) South Africa	Income and expenditure surveys (IES) of 1990, 1995 and 2000 Analysis unit: household Analysis sample: 1990: N=14 332 1995: N=16 903 Only households that lived in urban areas and had (positive) expenditure for cigarettes were analyzed	Cigarette demand (intensity) was determined by the real price of cigarettes and real income Price elasticity for each income quartile was estimated as the net change in cigarette consumption divided by the change in the real price of cigarettes The tax burden with respect to income, i.e. the ratio of household's total annual expenditure on cigarettes to household income, was estimated in the first place Price: retail price each year			**Price elasticity of smoking intensity for the period 1990–1995** ***By income quartile Q*** *Q1 lowest:* 1.39 *Q2*: 1.13 *Q3*: 1.08 *Q4 highest:* 0.81	**Income elasticity** ***By year and income quartile Q*** *1990* Q1 lowest: +0.27 Q2: +0.48 Q3: +0.40 Q4 highest: +0.08 *1995* Q1 lowest: +0.52 Q2: +0.41 Q3: +0.54 Q4 highest: +0.24 Cigarette price increases did not fall disproportionately heavily on the poor during 1990–1995
Sri Lanka						
Arunatilake & Opatha (2003) Sri Lanka	Survey data of about 7500 households.	Control variables: Income, occupation, education, male ratio (males smoke more)	**Overall price elasticity** -0.53 **By expenditure quintile** ***Q1 (poorest)*** -0.64 ***Q2*** -0.55 ***Q3*** -0.60 ***Q4*** -0.68 ***Q5*** -0.29			HNP study The aim of the study was to determine the impact of price increases on smoking prevalence and smoking intensity of different expenditure quintiles. The price elasticity of smoking participation was generally small and insignificant (and sometimes even positive), but the conditional elasticities are as expected
Thailand						
Sarntisart (2003) Thailand	A sub-sample of 11 968 households that bought cigarettes from 24 747 households surveyed in the 2000 household	Using a linear expenditure system (LES) approach, the study estimated price, cross-price and income	Average price elasticity: -0.39; price elasticity varies between –1.00 for poorest urban households and –0.04			HNP study Demand for cigarettes among rural households is generally less elastic than among urban households.

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Sarntisart (2003) (contd) Thailand	socioeconomic survey	elasticities of 12 different categories of household goods and services Control variables: Expenditure on cigarettes and other tobacco products, household income, prices of 12 consumer goods, age, education, dummy: urban/rural	for richest urban households			
Turkey						
Onder (2002) Turkey	This part of the study considered the 26 166 households covered in the 1994 Household Expenditure Survey	Using a two-step model, the determinants of smoking participation were estimated first, using a logit model. In the second step, the conditional price elasticity of demand was estimated for those households that decide to smoke. The results were used to determine the impact of a change in the tax rate on cigarette consumption, government tax revenue and the regressivity of the tax. Control variables: Income, education, age, geographic region.	**Total price elasticity** -0.41	Price elasticity of smoking participation: -0.03 average, but varies from –0.32 for second poorest quintile to 0.15 for richest quintile	Conditional price elasticity of demand: -0.39 average, but varies from –0.58 for second poorest quintile to –0.30 for richest quintile	HNP study
Bilgic *et al.* (2009) Turkey	National household expenditure survey (2003) n=22 208 households Families with teenagers: 7844 Families without teenagers: 14 364	A zero-inflated negative binomial model: 1) logit (for non-smoking prevalence); 2) parent negative binomial (for number of cigarette packs purchased per week)	Covariates in the equations: age, sex and education of the head of the household, household income, households' socioeconomic characteristics, age groups, special health insurance status, number of members having regular medication, share of		**Price elasticities of smoking intensity** ***Family with teenagers*** -0.264 ***Family without teenagers*** -0.221	**Income elasticities of smoking intensity** ***Family with teenagers*** +0.075 ***Family without teenagers*** +0.058

Table 5.1. Summary of studies on the effects of cigarette price on adults' demand for tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Bilgic *et al.* (2009) (contd) Turkey			health care expenditure, alcohol intake, number of smokers in the family, and regional variables Price: price of cigarette pack in Turkish Liras in 2003			
Ukraine						
Krasovsky *et al.* (2002) Ukraine	The study used data from a survey of individuals (both smokers and non-smokers) conducted in all regions of Ukraine (2700 individuals)	A two-part model: 1) probit (smoking prevalence); 2) OLS (smoking intensity) Control variables: For smoking prevalence: age, sex, education, marital status, urban/rural region, smoking status of a close relative or a friend, and income For smoking intensity: age, sex, price, household income, strength of addiction (assuming that on average heavily addicted smokers smoke more), region (assuming that smoking patterns may differ across regions of Ukraine), and dummy reflecting whether a smoker has under-age children		**Price elasticity of smoking prevalence** ***Overall*** -0.47 ***By income group*** *High income* -1.1 *Low-income* -0.27	**Price elasticity of smoking intensity** ***By income group and age in years*** *High income* 14–17: -0.52 18–28: -0.24 28+: -0.15 *Middle income* 14–17: -0.7 18–28: -0.42 28+: -0.33 *Low income* 14–17: -0.65 18–28: -0.37 28+: -0.28	HNP study
Viet Nam						
Van Kinh *et al.* (2006) Viet Nam	Household-level cross-sectional data from Viet Nam Living Standards Survey (VLSS; 1997–1998) N=6000 households with 28 518 individuals (≥15 yrs)	Two-part model: 1) Linear probability model (smoking prevalence); 2) OLS (smoking intensity) Adjusted for price of pipe tobacco, annual per capita	**VINATABA price** ***Overall*** -1.41 ***By income*** *Two low quintiles* -1.77 *Two high quintiles* -1.17	**VINATABA price** ***Overall*** -0.94 ***By income*** *Two low quintiles* -1.16 *Two high quintiles* -0.75	**VINATABA price** ***Overall*** -0.47 ***By income*** *Two low quintiles* -0.61 *Two high quintiles* -0.42	The coefficients of the 555 brand price resulting from the linear probability model were not statistically significant at the 10% level, and the estimated price elasticities of smoking prevalence were not provided

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Van Kinh *et al.* (2006) (contd) Viet Nam		income, individual characteristics (sex, age, education, work experience, occupation), household characteristics (household size, and sex, age, education, occupation of the household head), and geographic and commune characteristics Price: price of cigarettes at the commune level (price of VINATABA brand, price of 555 brand, and average price of the two brands)			**555 price** ***Overall*** -0.54 ***By income*** *Two low quintiles* -0.57 *Two high quintiles* -0.37 **Communal average price:** ***Overall*** -0.50 ***By income*** *Two low quintiles* -0.85 *Two high quintiles* -0..35 **Average price elasticity** ***Overall*** -0.50 ***By income*** *Two low quintiles* -0.59 *Two high quintiles* -0.40	

NHANES: National Health and Nutrition Examination Survey; CPS: Current Population Survey; NHIS: National Health Interview Survey; BRFSS: Behavioural Risk Factor Surveillance System; COMMIT: Community Intervention Trial for Smoking Cessation; HNP: Health, Nutrition and Population

He used alternative specifications of the rational addiction model and estimated these models for the full sample, the sample of those who ever smoked, and the sample of current smokers. For these three samples, he obtained overall long-run price elasticities of cigarette demand in the range from −0.27 to −0.36, −0.35 to −0.48, and −0.30 to −0.89, respectively (Chaloupka, 1991). Consistent with the predictions of the rational addiction model that individuals with a greater preference for present would respond more to price, Chaloupka found that smoking among less-educated persons was influenced more by price than was smoking among more educated persons. In contrast to the predictions of the rational addiction model and to Lewit and Coate's (1982) finding that younger populations were more sensitive to price than were older populations, Chaloupka (1991) found that young adults (17–24 years) were less responsive to price than middle-aged adults (25–64 years). Chaloupka (1990) used similar models for men and women and found that cigarette demand was significantly more responsive to price among men than among women. Finally, Chaloupka (1992) estimated additional specifications of these models that included explanatory variables to control for the presence of various state-level restrictions on smoking in public places. Estimated price elasticities obtained from these models were comparable to those described above. This result suggests that there were no significant omitted variables biases in the price elasticity estimates when the smoking restrictions were excluded from the models.

At about the same time, Wasserman and his colleagues (1991) pooled seven waves of the National Health Interview Survey conducted between 1970 and 1985 to examine how the price elasticity of adult cigarette demand was changing over time. Using two alternative models (a two-part model that looked separately at prevalence and intensity, and a generalized linear model that looked at the overall impact), Wasserman and colleagues (1991) found that cigarette demand was becoming increasingly responsive to price over time, going from virtually insensitive to price in the early/mid-1970s to a predicated overall elasticity of −0.26 to −0.28 by 1985–88. Consistent with Lewit and Coate (1982), Wasserman and colleagues (1991) found that price had a greater impact on smoking prevalence (elasticity of −0.17 in 1985) than on smoking intensity (elasticity of −0.09 in 1985).

Hu and his colleagues (1995) were the first to estimate the price elasticity of adult cigarette demand using state-specific individual-level survey data. They pooled the 1985 through 1991 waves of the California Behavioural Risk Factor Surveillance System survey. They used two-part models of cigarette demand that controlled for other health behaviours, in addition to the typical controls included in prior studies. Their estimates for California were consistent with those obtained from previous studies for the USA, with an overall price elasticity of −0.46. Price had a somewhat greater impact on smoking prevalence than on intensity.

In a series of papers using different waves of the Tobacco Use Supplement to the Current Population Survey, Ohsfeldt and his colleagues (1994, 1997, 1999) were the first to estimate the impact of smokeless tobacco taxes on smokeless tobacco use in the USA. Because of the very low prevalence of smokeless tobacco use among women in the USA, Ohsfeldt and colleagues (1994, 1997, 1999) focused their analyses on men. Given the lack of data on smokeless tobacco prices, they employed state-level taxes on smokeless tobacco products (typically *ad valorem* taxes applied at the wholesale level) as their proxy for price, using the resulting estimates and information on the share of price accounted for by tax to produce price elasticity estimates for snuff and chewing tobacco. They found consistent evidence that higher smokeless tobacco taxes were associated with reduced prevalence of any smokeless tobacco use among men, with prevalence elasticities in the range from −0.15 to −0.55.

In the most comprehensive analyses to that point, Farrelly and Bray (Centers for Disease Control and Prevention, 1998) and Farrelly and his colleagues (2001) pooled multiple waves of the National Health Interview Survey conducted between 1976 and 1993 to estimate cigarette demand for US adults, as well as for multiple subpopulations defined by gender, race/ethnicity, income and age. They used two-part models that controlled for a variety of individual characteristics and for region. They obtained overall price elasticities of adult cigarette demand in the range from −0.25 to −0.28, with similar elasticities estimated for smoking prevalence (−0.13 to −0.15) and smoking intensity (−0.10 to −0.15). Consistent with Lewit and Coate (1982), they found that cigarette demand became more inelastic with age and that smoking was more responsive to price among men than among women. They also found relatively greater sensitivity to price of cigarette use among minority populations (Hispanics and blacks) than among the majority population (whites) and among those in lower-income households compared to those in higher-income households.

Several studies of US adult cigarette demand have been published over the past decade. These more recent studies have taken advantage of the numerous and often large local, state and federal cigarette tax increases, increases in prices due to the pass-through of costs from settlements of legal challenges against the tobacco industry (most notably the 1998 Master Settlement Agreement that led to an immediate 45-cent increase in prices), and other factors that have contributed to increasing price variation over time. At the same time, many of the more recent studies have pooled numerous survey waves, with estimation samples exceeding one million respondents in some (e.g. Sloan & Trogdon, 2004; Franks *et al.*, 2007; Stehr, 2007; Farrelly & Engelen, 2008; Franz, 2008). The use of multiple survey waves over a period where taxes and prices have changed considerably in many states has allowed researchers to better control for a variety of other tobacco control policies[2] and underlying sentiment towards tobacco. Nevertheless, the findings from these more recent studies are remarkably similar to those from the earlier studies. They consistently suggest that higher cigarette taxes and prices lead to reductions in the prevalence and intensity of smoking among US adults. A few of these more recent studies are described briefly below.

Sloan and Trogdon (2004) assessed the impact on smoking prevalence among different age groups of the large price increases in the US in the late 1990s that followed the settlement of state lawsuits with tobacco companies, using data from the 1990 through 2002 Behavioural Risk Factor Surveillance System. Consistent with the early estimates of Lewit and Coate (1982), they found that higher cigarette prices significantly reduced smoking prevalence among all age groups. Interestingly, however, the oldest group they examined (65 years and older) was as price-responsive as the youngest group (18–20 years), with estimated prevalence price elasticities of −0.25 and −0.26, respectively. The prevalence elasticity values for the age groups in between were less than half of those values reported in the oldest and the youngest groups.

Over the past two decades, smoking prevalence among those who smoked less than daily increased considerably, with almost one in five smokers smoking less than daily in 2006–07. Tauras (2004) was the first to assess the impact of price on the decision to smoke daily versus less than daily, using data from the 1991, 1993 and 1994 US National Health Interview Surveys. Tauras (2004) found that higher prices increase the likelihood that a smoker will smoke less than daily in addition to reducing smoking prevalence and average cigarette consumption. His price elasticity estimate of some day smoking conditional on current smoking is 0.86, while his estimates for smoke-free air policies were generally small and statistically insignificant. These findings suggest that much of the observed increase in prevalence of less than daily smoking resulted from the impact of tax and price increases rather than from the impact of other tobacco control policies on smoking.

Stehr (2007) focused on gender differences in the price sensitivity of US cigarette demand. As described above, most previous studies found that cigarette smoking among men was somewhat more sensitive to price than was cigarette smoking among women. Stehr (2007) argues, however, that this is due to an omitted variables bias resulting from a negative correlation between gender differences in smoking prevalence and cigarette taxes. Using data from the 1985 through 2000 Behavioural Risk Factor Surveillance System, Stehr (2007) developed gender-specific two-part models that include gender-specific state fixed effects to account for this correlation. He found that smoking among women was significantly more responsive to price than was smoking among men. For women, his estimated prevalence and total price elasticities were −0.40 and −0.51, and for men the corresponding estimates were −0.16 and −0.26.

DeCicca and McLeod (2008) similarly used multiple waves of the Behavioural Risk Factor Surveillance System data from 2000–2005 to examine differences in price elasticity among a variety of US population subgroups. Consistent with Sloan and Trogdon (2004), they found that smoking among older adults was more responsive to price than previously thought, suggesting that higher taxes and prices increase the likelihood of smoking cessation at all ages. Among other subgroups in older adults, they found that higher taxes have their greatest impact on smoking among those in poor health, among those on lower incomes (explored more fully in Chapter 7), and among those with fewer years of education.

Summary

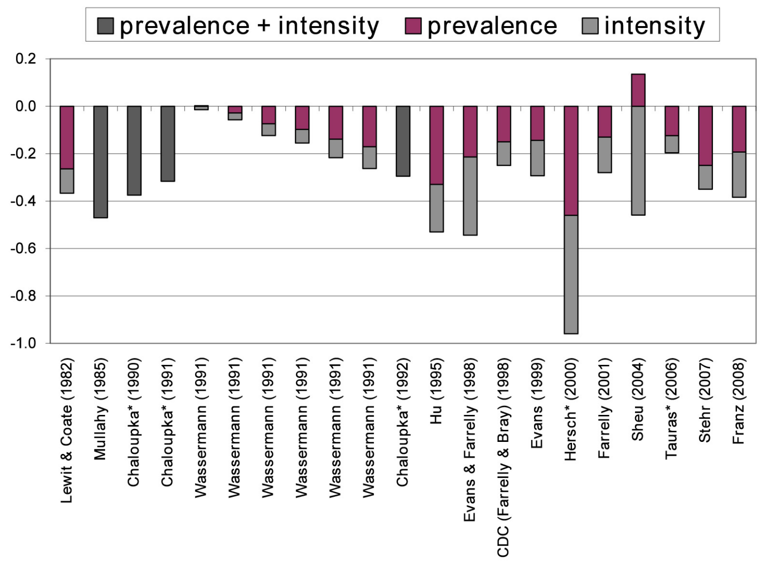
Over the past three decades, numerous studies of adult cigarette demand based on individual-level survey data have been produced in the USA (see 26 studies in Table

[2] Most notably smoke-free air policies targeting various venues, such as workplaces, bars and restaurants, and funding for comprehensive tobacco control programmes.

5.1). Over time, the econometric methods used in these studies have become more sophisticated, and the amount of data used to for analysis has increased exponentially. As with the estimates from the aggregate demand analyses for the USA reviewed in Chapter 4, these studies consistently find that higher cigarette taxes and prices reduce cigarette consumption, with most overall price elasticity estimates in the range from −0.2 to −0.5 (Chapter 4). As shown in Figure 5.1, studies that examine both smoking prevalence and intensity generally find that the effects of price on consumption are about evenly split between the effect of price on smoking prevalence and the effect of price on intensity of smoking among those who smoke. More recent studies also find evidence that higher prices increase the likelihood that smokers will smoke less than daily.

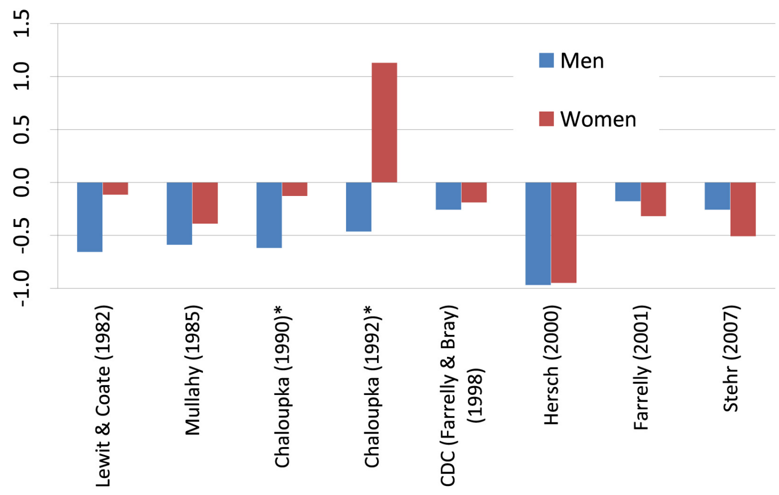
In general, earlier US studies that have examined gender differences in price elasticity found that smoking is more sensitive to price among men than among women. However, studies conducted on more recent data obtained at a more advanced stage of the tobacco epidemic (Lopez *et al.*, 1994), and consequently displaying a narrower gap between men and women on smoking prevalence and consumption, failed to find differences in elasticities (Figure 5.2). Moreover, Stehr's (2007) more recent study provides a compelling explanation for why earlier estimates were likely to be biased, along with estimates that smoking among women is roughly twice as responsive to price as is smoking among men once potential bias due to the omitted variables is accounted for. The current evidence suggests no major differences between sexes according to responsiveness to changes in cigarette prices.

Figure 5.1. Price elasticity for total cigarette consumption (prevalence and intensity) from 16 studies conducted in the USA



* elasticities estimated as the mean value between the upper and the lower limits of a range of estimates and/or as the mean value between men and women's estimates

Figure 5.2. Gender-specific price elasticities for total cigarette consumption (prevalence and intensity) from 8 studies conducted in the USA



* elasticities estimated as the mean value between the upper and the lower limits of a range of estimates

Similarly, most US studies that have considered differences in the price elasticity of cigarette by age find that smoking among younger age groups is more price-sensitive (described more fully in Chapter 6). However, price elasticity of demand generally becomes monotonically more inelastic among older age groups. Sloan and Trogdon (2004) find that this is not the case among those over 65, perhaps due to the more constrained resources for retirees on fixed incomes.

Other high-income countries

There have been several studies that examine the effects of price on consumption of cigarettes and other tobacco products in other high-income countries (see Table 5.1). These have been many fewer than the number of studies conducted in the USA due to the fact that there is limited within-country variability in tobacco product taxes and prices in most of those countries. Many of these studies use data taken from household consumption expenditures surveys. Information on spending and consumption is used to derive price measures for use in empirical analyses. Such price measures are likely to be endogenous because they at least in part reflect tobacco use behaviours (e.g. heavier consumers purchase cheaper brands), leading to biased estimates of price elasticity. Others take advantage of survey data on smoking and other tobacco use, comparable to those price measures used in the US studies, linked with market-level measures of prices based on respondents' place of residence.

Four studies have examined cigarette demand in Canada. Differences in Canadian provincial cigarette excise taxes provide significant cross-sectional variation in prices, while substantial increases and reductions in taxes provide considerable intertemporal variation. Stephens and colleagues (1997) used data from two cross-sectional surveys of Canadian adults, the 1990 Health Promotion Survey and the 1991 General Social Survey, to study the impact of cross-sectional variability in prices and changes in prices over time on adult smoking prevalence. They found that smoking prevalence was higher for respondents residing in provinces where cigarette prices were lower.

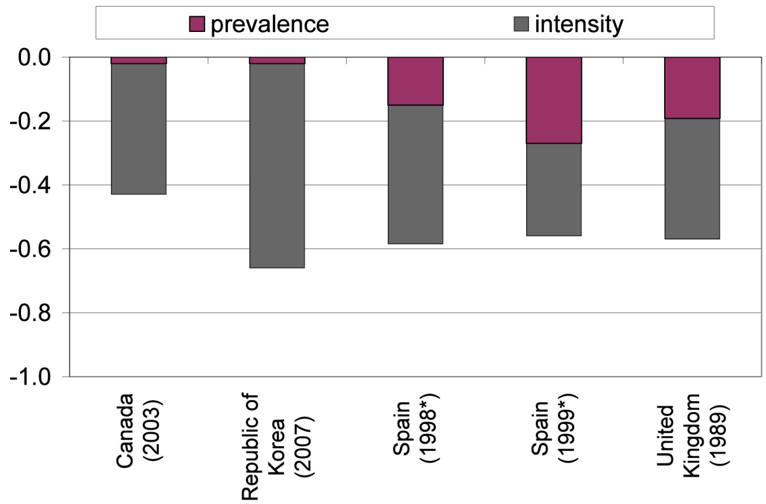
Hamilton and colleagues (1997) conducted a similar comparison across provinces, focusing on the significant reductions in taxes that were made in some provinces in early 1994. They used cohort data from the Survey on Smoking in Canada collected over four waves in 1994 and 1995, with the baseline survey collecting data on smoking status on 1 January 1994, before the tax cuts. To assess the impact of the tax cuts on smoking prevalence, they compared changes in smoking prevalence in provinces where taxes were cut with smoking prevalence in other provinces (in provinces where taxes were not cut). Hamilton and colleagues (1997) found that smoking prevalence fell in all Canadian provinces between January 1994 and February 1995, which was attributed to the implementation of various tobacco control efforts throughout Canada. However, smoking prevalence was reduced more in the provinces that did not cut taxes than in the provinces that cut taxes (a 4.1 percentage point reduction versus a 2.7 percentage point reduction).

More recently, Gruber and colleagues (2003) conducted a more rigorous, econometric analysis of cigarette demand. They used data from all eight waves of the Canadian Survey of Family Expenditure conducted between 1982 and 1998, with tax rates matched to the survey databased on respondents' region and acknowledging the need to take into account the presence of significant smuggling of tobacco products. They used two different sets of data, household-level expenditures on smoking from all households and another sample that excluded provinces and years where cigarette smuggling was thought to be a significant problem. For both samples, they obtained an overall price elasticity of cigarette demand of −0.45, which is quite consistent with the estimates described above for the USA. These results suggest that the availability of smuggled cigarettes had little impact on price elasticity in Canada. Additionally, they found that nearly all of the effect of price is on household cigarette consumption, with little impact on smoking prevalence. Furthermore, smoking was more responsive to price among the lowest-income households than among higher-income households (see more detail in Chapter 7).

Most recently, Gospodinov and Irvine (2009) explored cigarette demand among Canadian adults, using data from the Canadian Tobacco Use Monitoring surveys conducted from 2000 through 2005 and applying two-part models. Consistent with Gruber and colleagues (2003), Gospodinov and Irvine (2009) found little impact of price on smoking prevalence in Canada, but did find that higher prices significantly reduce cigarette consumption, with an estimated price elasticity of intensity in the range from −0.28 to −0.30. However, they found little difference in price elasticity estimates of demand for socioeconomic groups defined by educational attainment (Gruber *et al.*, 2003).

Similarly, Australian researchers have taken advantage of differences

Figure 5.3. Price elasticity for total cigarette consumption (prevalence and intensity) from five studies conducted in high-income countries other than the USA



* elasticities estimated as the mean value between the upper and the lower limits of a range of estimates

in cigarette prices across states to assess the impact of price on smoking among adults (see Table 5.1). For example, Cameron and Williams (2001) used data from multiple waves of the National Drug Strategy Household Surveys conducted in the late 1980s and 1990s that were matched with state-level price data. They obtained a price elasticity of smoking prevalence of −0.436. More recently, Zhao and Harris (2004) used the 1995, 1998 and 2001 waves of the same surveys, finding an even greater impact of tobacco product prices on prevalence of tobacco use (prevalence elasticity of −0.863) as well as a significant negative impact of price on the level of tobacco consumption. Most recently, Wakefield and colleagues (2008) used monthly data on smoking prevalence collected in the five largest Australian cities between June 1995 and December 2006 to examine the impact of changes in cigarette prices relative to income (a measure of affordability, as described in the previous chapter) on smoking prevalence during this period. Their finding implies that relatively small changes in affordability would reduce prevalence.

There are relatively few other studies from high-income countries that use individual-level or household-level data to investigate the impact of taxes and prices on adult tobacco use (one from Italy, 1 from the Republic of Korea, three from Spain and one from the United Kingdom). These studies identified by the search strategy described above are summarized in Table 5.1 and in Figure 5.3.

Summary

Overall, 14 studies on adult cigarette demand using individual or household level survey data exist for high-income countries other than the USA. These studies are generally consistent with those from the USA in concluding that higher tobacco product taxes and prices lead to reduced smoking among adults. While estimates of price elasticity from these studies are more variable than those from studies based on US data, they do indicate that tobacco use in high-income countries is inelastic with respect to price, and that price influences both the prevalence and intensity of tobacco use. However, in contrast with evidence from the USA, in other high-income countries the effect of price changes on smoking intensity appears to be stronger than that on smoking prevalence (Table 5.3).

Low- and Middle-Income Countries

Prior to the publication of the World Bank's *Curbing the Epidemic* report (Jha and Chaloupka, 1999), there were almost no survey-based studies on the impact of tax and price on tobacco use in low- and middle-income countries. Since then, however, a rapidly growing body of evidence has emerged from studies that use individual-level and/or household-level data collected in low- and middle-income countries, with studies available for countries in all regions. Much of this research has been produced with support from the World Bank, the World Health Organization, and other international organizations; publications are available in the *Economics of Tobacco Control* Discussion Paper series produced by the Health, Nutrition and Population Family (HNP) of the World Bank's Human Development Network. A smaller number of these studies have been published in peer-reviewed journals.

As with the demand studies based on aggregate data from low- and middle-income countries described in the previous chapter, there is also considerable variation in the quality of the data and methods used in these studies (Chapter 4). Many studies employ household-level consumption expenditure data that often reflects all tobacco consumption, making it difficult to disentangle the effects of prices on use of different tobacco products, on use by different members of the household, and on prevalence and intensity of use. In many of these countries, there is considerable variability not only in the taxes on and prices of different tobacco products, but also in the taxes and prices of different brands for the same product. This situation creates significant endogeneity problems for measures of price that are derived from self-reported prices or from self-reported information on the consumption expenditures and consumption quantities. This typical endogeneity almost certainly results in biased price elasticity estimates when it is not accounted for in the estimation. Many of the studies described below address this problem by trying to assess the endogeneity of self-reported price using a Hausman or other test. However, these efforts are often hampered by appropriate instrument variables for price being unavailable in the survey data. Others address this by using a measure of average prices that is derived from the self-report data and averaged over respondents in the same location and/or based on other factors (e.g. income). Still others apply two-stage least squares models to first predict price (based on taxes, location, income, and other factors), then use the predicted price in the demand models. Where secondary sources for prices are available, other potential problems arise. For example, given the extensive variability in availability and prices of various tobacco products/brands and the limited within-country variation both in taxes and in prices for a particular product/brand, matching price data from other sources to the survey data can introduce its own measurement errors that can bias price elasticity estimates towards zero. Due to these potential problems, much care and caution must be taken when assessing the findings from these studies.

Given the variety of research available, the discussion below will briefly summarize the evidence by region, highlighting seminal studies and those that are most methodologically sound. Table 5.1 contains a more comprehensive listing of the studies identified by the search strategy described above.

Asia. Several studies have examined the impact of tax and price on tobacco use in various Asian countries, including China, India, Viet Nam, Thailand, Indonesia, Myanmar and Nepal. Mao and Jiang (1997) were the first to estimate the price elasticity of cigarette demand using individual-level data for a low- or middle-income country, using cross-sectional survey data for adults in the Sichuan province that were augmented with price data collected from retailers selling cigarettes in the survey respondents' locations. They used a two-part model of cigarette demand, producing elasticity estimates of −0.89 for smoking prevalence and −0.18 for smoking intensity. In follow-up studies using nationally representative data for China, they found that cigarette demand in China was becoming increasingly inelastic, with a price elasticity of −0.06 for smoking prevalence and that of −0.09 for cigarette consumption among smokers (Mao *et al.*, 2007). These recent estimates were based on data from the National Smoking Prevalence Survey conducted in 2002, with the cigarette price measure based on the average of prices self-reported by respondents who resided in the same geographic region (Mao *et al.*, 2007).

Others have produced similar estimates for the price elasticity of Chinese cigarette demand. Bishop and colleagues (2007) used data on adult urban males in ten provinces taken from the 1995 Chinese Household Income Project. Prices that were assigned to individuals were based on the average self-reported prices for respondents from the same province (which allows for more observations to be used in computing price) or county (which reduces the number of observations used to estimate price, but adds to the variability in the resulting price measure). They estimate two-part models using each of the alternative measures of price. Interestingly, the estimated elasticities with the two price measures are relatively similar, with prevalence elasticities around −0.21 and intensity elasticities in the range from −0.25 to −0.30. In contrast, Lance and colleagues (2004), using data from multiple waves of the China Health and Nutrition Surveys that were supplemented with locally collected prices from markets in the communities where respondents lived, concluded that cigarette demand in China was much less elastic. Their prevalence elasticities ranged from −0.02 to −0.04 and intensity elasticities from 0.03 to −0.06. However, as Bishop and colleagues (2007) note, the price measure employed by Lance *et al.* (2004) ignores the fact that many smokers buy cigarettes from nearby wholesalers rather than from local markets, introducing measurement error that can bias price elasticities towards zero.

At least four studies from Taiwan, China have examined the impact of taxes and prices on tobacco use. They generally take advantage of large price changes that followed the large tax increases implemented in 2002. For example, Lee and Colleagues (2004) used survey data collected by the Taiwan, China National Health Research Institutes between 2000 and 2003 that were augmented with monthly data on average prices of leading brands to estimate the price elasticity of cigarette consumption among current smokers before and after the tax increase for a variety of population subgroups. Overall, their estimated price elasticities range from −0.31 to −0.53, with the greatest price elasticity in the year following the tax increase. In a follow-up study using survey data collected by phone in 2004, Lee (2008) used information from responses to a question about a hypothetical price increase and obtained a price elasticity of cigarette consumption of −0.29. This was consistent with that obtained from survey databased on actual experiences with tax and price increases. Related studies by Tsai and colleagues (2003, 2005) concluded that the 2002 tax increases altered other aspects of smoking behaviour in Taiwan, China, including brand choice and likelihood of purchasing smuggled cigarettes.

In general, and consistent with the estimates from studies based on aggregate data described in the previous chapter, it appears that cigarette demand in China has become less sensitive to price over the past two decades. One likely explanation for these increasingly inelastic price estimates for cigarette demand in China is the trend towards increased affordability of cigarettes in the country, as real household disposable incomes have increased much more rapidly than real cigarette prices. This trend is consistently described by the significant, positive income elasticities generally obtained in these studies.

John (2008) conducted the only survey-based study that produces estimates of price elasticity of adult tobacco use in India. Using data from the 55th round of the National Sample Survey Organization survey, a household expenditure survey conducted from July 1999 through June 2000, he examined the effect of price on demand for cigarettes, bidis and leaf tobacco separately for urban and rural populations. Using an empirical approach developed by Deaton (1988), he constructed unit values by dividing the self-reported individual household consumption expenditure to consumption quantity. The unit values reflect the averages for individual households in the same geographic areas and account for variations in the quality of the tobacco products consumed (John, 2008). Since this analysis was limited to households that consumed tobacco products, the price elasticity estimates reflect the impact of price on consumption by households that use these products, thus understating the full impact of price on tobacco demand in India. John's (2008) analysis produced significantly negative own-price elasticities of demand for each of the three tobacco products considered, with less inelastic estimates for bidis (ranging from −0.86 to −0.92 according to rural/urban area) and leaf tobacco (−0.87 to −0.88) and a relatively inelastic estimates for cigarettes (ranging from −0.18 to −0.34). John attributes the differences in the price elasticity estimates to the differences in income among those households who consume cigarettes and those who consume other products, with cigarettes generally consumed by higher-income households, while bidis and leaf tobacco are typically consumed by low-income households. For bidis and leaf tobacco, little difference in price elasticities is found among urban and rural households. For cigarettes, consumption decisions made by rural households are significantly influenced by cigarette prices, but the same is not true for consumption decisions made by urban households (John, 2008).

Several demand studies published in the *Economics of Tobacco Control* HNP Discussion Paper series are based on household expenditure or other survey data for various other Asian countries. These studies produce a range of estimates, generally confirming that higher taxes and prices will lead to reductions in tobacco use. Kyaing (2003) and Kyaing and his colleagues (2005), for example, used two expenditure surveys to estimate price elasticity of adult tobacco use in Myanmar. Kyaing (2003) uses a two-part model to examine the impact of price on the use of cigarettes, cheroots, and phet kyan which, together, account for nearly all of tobacco use in Myanmar. This study uses a price measure that is derived from self-reported expenditures and consumption quantities, treating this price variable as exogenous after having conducted a Hausman test for endogeneity of price. The estimated price elasticities are substantial—a prevalence elasticity of −1.28 and an intensity elasticity of −0.34. In addition, he finds that price elasticity of demand (in absolute values) falls with age, although demand remains elastic even among the oldest age groups, and that price elasticity rises and then falls with income. In the subsequent study (Kyaing *et al.*, 2005), separately examining the effect of price on consumption of cigarettes and cheroots among low-income consuming households, only tobacco-consuming households were considered in the analysis. The price variables that were derived from self-reported prices were determined to be endogenous in some specifications and exogenous in others, based on Hausman tests. When the price variable was endogenous, a two-stage least squares model was estimated using taxes as instruments for price. The resulting estimated intensity elasticities were −0.25 for cigarettes and −0.36 for cheroots.

Karki and colleagues (2003) used Nepalese household consumption expenditure data to estimate the price elasticity of combined cigarette and bidi demand after having concluded that price can be treated as exogenous based on a Hausman test. They obtained an overall price elasticity of −0.88, with the impact of price on combined demand about evenly divided between its impact on prevalence (−0.46) and use in consuming households (−0.42). Adioetomo and colleagues (2005) used data from the 1999 National Socioeconomic Survey to analyse cigarette demand in Indonesia. To account for the potential endogeneity of price, they conducted a two-stage least squares model, finding little impact of price on smoking prevalence, while estimating that the overall price elasticity of consumption among smokers is −0.61, with demand less inelastic among those smokers on lower incomes. Arunatilake and Opatha (2003) performed a similar analysis, using household consumption expenditure and consumption quantities taken from the 1999–2000 Sri Lanka Integrated Survey database. They also find that smoking prevalence is unaffected by price, that higher prices reduce consumption in smoking households (intensity elasticity of −0.60), and that demand in lower-income households is most responsive to price. Sarntisart (2003) takes a somewhat different approach, applying a linear expenditure system model to data from the 2000 Thailand Household Socioeconomic Survey that were augmented with local price data on many goods and services collected as part of the survey. He obtains an overall price elasticity of −0.39, with demand increasingly inelastic among higher-income households and relatively less inelastic among urban households.

Europe. Several studies of the impact of taxes and prices on adult tobacco use based on individual or household survey data have been conducted for a few former Soviet Republics (the Russian Federation, Ukraine, and Estonia) and other central and eastern European countries (Bulgaria and Poland). In general, these studies find that higher taxes and prices reduce tobacco use, with widely varying estimates of price elasticity across countries.

Two peer-reviewed studies used data from the Russian Longitudinal Monitoring Survey, a nationally representative household survey that collects data on household members' tobacco use and includes a community module that collects information on retail prices for the highest and lowest domestic and imported cigarette brands (Ogloblin and Brock, 2003; Lance *et al.*, 2004). Ogloblin and Brock (2003) used data from the 1996 and 1998–99 waves of the survey to investigate the impact of price on smoking prevalence among men and women. They concluded that smoking prevalence among men was relatively unresponsive to price (elasticity of −0.085), while smoking prevalence among women was significantly affected by price (elasticity of −0.63). In addition, they found that smoking prevalence was becoming less inelastic over time, as cigarette prices nearly doubled between the two waves of the survey they analysed. In their subsequent analysis, Lance and colleagues (2004) added the 2000 wave of the survey to assess the impact of price on both prevalence and intensity among men. They similarly found little impact of price on prevalence (prevalence elasticities ranging from −0.05 to −0.1) and almost no impact of price on consumption among male smokers (intensity elasticities ranging from 0 to −0.03). Ogloblin and Brock (2003) attributed the low intensity elasticities obtained for male smokers to the fact that they mostly consume low-quality, very inexpensive cigarettes (in contrast, many female smokers use the higher-price, higher-quality cigarette brands).

Krasovsky and his colleagues (2002) used data on over 2700 individuals they surveyed throughout Ukraine to explore differences in the price elasticity of cigarette demand by age and income. Their measure of price was based on a self-reported price in response to a survey question that asked respondent smokers “What is the price for a pack of the cigarettes you usually smoke?” This measure of price is likely to be endogenous, reflecting a variety of factors including brand choice, quantity purchased and location of purchase. That is, heavier consumers will likely choose less-expensive brands, buy in greater quantities, and obtain these products from lower-priced locations. Their overall intensity elasticity was −0.4, while their other price elasticity estimates indicated that younger or lower-income Ukrainian smokers were generally more responsive to price.

Taal and colleagues (2004) used monthly household survey data on cigarette consumption and household composition from 1992 through 1999 to construct a measure of average adult cigarette consumption for use in their estimation of the price elasticity of cigarette demand in Estonia. The price was the real tobacco product price index reported by the Statistical Office of Estonia. Using ordinary least squares methods applied to a myopic addiction model, they obtained an overall price elasticity of cigarette demand of −0.34.

Sayginsoy and colleagues (2002) used data from the 1995 Living Standards Measurement Survey for Bulgaria, a nationally representative household expenditures survey, to estimate the impact of price on cigarette demand in Bulgaria. To estimate price elasticities, they used a multistep process. First, prices were derived from self-reported expenditures and consumption quantities for smoking households. Second, for non-smoking households, the average of the derived prices from smoking households in the same income quintile was used. Finally, price was modelled as a function of taxes and cigarette characteristics. Using a two-stage least squares model, they estimated an overall price elasticity of cigarette demand of −0.80, with price elasticity in absolute value being greatest among lower-income households and becoming more inelastic as household income rises.

Gardes and Starzec (2004) applied a variety of methods to estimate the price elasticity of cigarette demand in Poland. They used data from the 1987 through 1990 Polish Consumption Panel database—a database that contains information on household consumption expenditures and price indices for various goods including tobacco products. Specifically, they estimated an Almost Ideal Demand System (cited and explained in Gardes and Starzec, 2004) using the consumption expenditure data, a Rotterdam system using a Frisch scheme, and a rational addiction model (Becker and Murphy, 1988). The alternative approaches produced comparable elasticity estimates, with a short-run price elasticity of overall cigarette demand of −0.4 and a long-run elasticity of −0.7.

Onder (2002) applied a two-part model to examine whether price affects smoking prevalence among households and intensity among smoking households, using 1994 expenditure survey data for Turkey. Using two-stage least squares methods to account for the endogeneity of the price measure that is derived from the self-report data on consumption expenses and consumption quantities, Onder (2002) obtained an overall price elasticity of −0.41, but finds little impact of price on households' smoking prevalence (elasticity of −0.03). In general, she found that overall demand is less inelastic among lower-income households.

Africa. Few price elasticity estimates based on survey data exist for African countries. To date, such studies have been conducted in South Africa (Berg and Kaempfer, 2001; Van Walbeek, 2002 and 2005) and Egypt (Nassar, 2003).

Berg and Kaempfer (2001) used the 1991 Living Standards Measurement Survey to estimate the price elasticity of cigarette demand for black and white households in South Africa. Prices appear to be derived from the self-reported expenditures and consumption quantities, while the potential endogeneity of price does not appear to be addressed in the estimation. Using censored maximum likelihood and censored least absolute deviations methods Berg and Kaempfer (2001) found that cigarette consumption was more than twice as responsive to price among whites (total price elasticity of −1.79) than among blacks (total price elasticity of −0.80). When limiting the analysis to only consuming households, however, they found little impact of price on consumption for either group. This finding suggests that the impact of higher prices in reducing smoking in South Africa is limited to reducing prevalence. However, the estimates they obtained may be biased due to the likely endogeneity of price in their models.

Van Walbeek (2002) considered smoking prevalence and the percentage of total income spent on cigarettes by income quartile for two periods, 1990 and 1995. The data were obtained from Income and Expenditure Surveys that are used to determine the weightings of the CPI (consumer price index) basket. Van Walbeek (2002) considered the expenditure patterns of approximately 15 000 urban households. In a subsequent study, he expanded the period to include the year 2000. He found that the percentage of households that bought cigarettes decreased from 49% in 1990 to 30% in 2000 (Van Walbeek, 2005). This was a period in which the real price of cigarettes increased by more than 100%. He found that the percentage of households in the poorest income quartile that bought cigarettes decreased from 46% to 22% while among the richest income quartile that percentage decreased from 43% to 34%. He concludes that the poor are significantly more price sensitive than the rich in consuming cigarettes.

Nassar (2003) estimated the price elasticity of tobacco use in Egypt, using data from 1995–96 and 1999–2000 household expenditure surveys. In addition to overall price elasticity estimates, she produced similar estimates for a variety of population subgroups based on urban/rural location, income and education, using average unit values that were derived from the self-reported price data. She estimated an overall price elasticity of −0.40 for tobacco use in Egyptian households, finding little difference in price elasticity for urban and rural households (elasticities of −0.41 and −0.39, respectively), while generally finding that tobacco use is less price inelastic among lower-income, less-educated households than higher-income, more educated households.

The Americas. For low- or middle-income counties in the Americas, only one study on the effects of price on adult tobacco use based on survey data was identified. Jiménez-Ruiz and colleagues (2008) examined cigarette demand in Mexico, using data from multiple waves of the National Household Expenditure Survey conducted from 1994 through 2005 and applying two-part models for demand. To account for the potential endogeneity of price, they used average prices derived from self-reported information on consumption expenditures and consumption quantities, stratified by household location (state and rural/non-rural) and income quintile. Jiménez-Ruiz and colleagues (2008) found little impact of price on households' smoking prevalence (elasticity of −0.06), with a much greater impact on consumption in smoking households (elasticity of −0.45).

Summary

Over the past decade, at least 28 studies have used individual or household survey data to assess the impact of prices on adult tobacco use in low- and middle-income countries. Given the limited geographic differences in prices and the considerable variability in the availability and prices of different tobacco products and brands in these countries, as well as the reliance on self-reported information on expenditures or/and prices in many of these studies, researchers conducting these demand analyses have faced several challenges in estimating price elasticities. As a result, they have applied a variety of different approaches in their modelling, overcoming to the extent possible the potential measurement errors and endogeneity biases they faced.

Despite these challenges and the problems that are likely to remain in many of the studies, this growing body of research consistently demonstrates that higher taxes and prices lead to reductions in tobacco use. There are considerable differences across countries in terms of the estimated price elasticities. Some studies indicate that price has limited impact on prevalence of tobacco use, while significantly reducing tobacco consumption among users. Others find price to have large effects on prevalence but more limited impact on amount used, and still others discover that both prevalence and intensity of tobacco use are reduced by higher tobacco prices. While the point estimates vary considerably, they generally imply that adult demand for tobacco products in low- and middle-income countries is at least as sensitive to price, and often more sensitive to price, than it is in high-income countries. Studies that produce price elasticity estimates that are less elastic tend to come from countries where cigarettes are very inexpensive or affordability has increased significantly over time (most notably recent studies for China and the Russian Federation).

Systematic review of the scientific literature: Impact of price on adult cessation

A growing number of studies consider the impact of higher tobacco taxes and prices on cessation of tobacco use among adults. Given the variety of available data and the extensive cross-sectional and intertemporal variation in taxes and prices, much of the work on cessation also uses data from the USA. A few studies use data from other high-income countries, such as Canada, the United Kingdom, France and Spain. Only one study to date uses data from a low- or middle-income country, Viet Nam. These studies are summarized in Table 5.2 and are described below (see Chapter 6 for studies that focus on cessation among young people).

Most of these studies use one of three basic designs: analysis of cross-sectional data with retrospective information on when an individual quit; analysis of cross-sectional data with information on recent quit attempts or interests in quitting; or analysis of longitudinal data with information on tobacco use behaviours over time. Two potential problems arise in the analysis of retrospective data on cessation: first, there may be measurement error in the cessation measure due to imperfect recall of the age at which an individual quits; second, there may be measurement error in prices that were matched to the survey data, given the problems with the timing of quitting as well as the possibility that a survey respondent has moved since quitting. In general, these problems will be less significant than when using retrospective data on initiation, as described more fully in the next chapter, given that quitting will be much more recent than initiation.

Table 5.2. Summary of studies on the effect of cigarette price on smoking cessation

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Endpoint – (definition of price)	Main results (elasticity)	Sub-populations (which subpopulations are considered)	Comment
USA						
Douglas (1998) USA	Longitudinal analysis (retrospective) from reconstructed tobacco histories from the 1987 cross-sectional survey (NHIS) N=22 080 Analysis sample: 8754 (≥25yrs)	An ordered aprobit split-sample duration model Taken into account lagged duration dependence and time-varying covariates With and without a state-level regulation	Weighted average real prices per pack (including taxes) for each state from 1954 to 1991	**Price elasticity** -1.05 -0.98 (after being controlled for regulation)	**Price elasticity** 1.31 (for future price) 1.07 (after being controlled for regulation)	“Quitting hazard” increases substantially with future cigarette price; a result that is robust across alternative specifications
Franz (2008) USA	Cross-sectional (8 surveys from BRFSS (1993–2000) Analysis sample: N=1 000 013 (≥18 yrs)	Two models were considered: i) A simple OLS ii) A two-part model: 1) OLS; 2)OLS Adjusted for sex, health status, age, race, education, marital status, income, region and year effects Price: state-level average real price of a pack of cigarettes	Dependent variable: quitting decision	**Overall** +0.375	**By age (in years)** ***18–29*** +0.493 ***30–39*** +0.424 ***40–64*** +0.398 ***≥65*** +0.202	
Ross *et al.* (2011) USA and Canada	Longitudinal data (three waves of International Tobacco Control Policy Evaluation Survey (ITC) 2002, 2003 and 2004) Cohorts were based on the national representative samples of adult smokers annually interviewed in the three waves (N=4352 at wave 1) Study sample: N=5304–5973 depending on models Longitudinal sample: ca. N=2000	(1) OLS for change in cessation stage over time (2) Generalized Estimating Equations (GEE) models for smoking cessation Different OLS and GEE models were considered according to the number of covariates included in the models. The first, simplest model only included demographic and socioeconomic variables. The second model further adjusted for knowledge of the health risk of smoking. The third model furthermore accounted for nicotine addiction	Cessation stage of an individual (collapsed into three stages) Price: (i) Change in self reported price (ii) Change in external price (iii) Change in tax	Coefficient estimates from the OLS models Overall: 0.0009 to 0.0015 Coefficient estimates from the GEE models Overall: 0.0007 and 0.0044		Cigarette prices increased the likelihood of actual quitting Only the coefficient estimates of the external price obtained from the GEE models were statistically significant The results lends support to that higher cigarette prices can be used to increase cessation and to motivate smokers to quit

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Endpoint – (definition of price)	Main results (elasticity)	Sub-populations (which subpopulations are considered)	Comment
Other high-income countries						
Canada						
Hamilton *et al.* (1997) Canada	Longitudinal (retrospective) Survey on Smoking in Canada (1994) Follow-up one year 11 119 respondents (≥15 yrs) Telephone survey	No multivariate regression analysis Simple descriptive analysis	No computation of elasticities	Higher cessation rates (10.7% vs. 10.3%) in provinces where taxes were not cut vs. provinces without taxes cut		Quit rate by different time of interview in provinces: With tax cut: +2.5 to +10.3 Without tax cut: +5.7 to +10.7 Changes in taxes across years not analyzed
France						
Peretti-Watel (2004) France	Life-course perspective of retrospective data extracted from the 1999 cross-sectional survey French Health Barometer (FHB) (A telephone survey representative of the French population 12–75 yrs) n=13 685	Time hazard model of smoking cessation: logistic regression Adjusted for time-constant variables (gender, education and age of smoking initiation), and for time-varying variables (age, age2, parenthood, and price) Cessation was assessed separately for men and women aged 21–50	Odds ratio (OR) of cessation given an increase in price by 1%	**For subsample of individuals aged 21–50, by sex** ***Men*** OR=1.007 ***Women*** OR=1.009	**Full sample** ***Cessation by age range*** *Age 20 or younger* OR=1.005 *Age 21–30:* OR=1.017 *Age older than 30* OR=1.011	Risk estimates were statistically significant for both subsamples (p<0.001)
Spain						
López Nicolás (2002) Spain	Longitudinal analysis (retrospective) from reconstructed tobacco histories from cross-sectional surveys National Health Interview Surveys (ENSE) 1993, 1995 and 1995 Face-to-face interview Analysis sample (≥16 yrs): Starting: Men: N=7092 Women: N=9913 Quitting: Men: N=2305 Women: N=1817	A log-logistic split population model with the Weibull distribution Adjusted for education, dummies for tobacco policies, time trend and birth cohort	Real price of 20 cigarettes	**Elasticity of quitting with respect to the price of black tobacco** ***By sex*** *Men* -1.32 *Women* -1.50		Different price series for black cigarettes and blond cigarettes, and a weighted average of both were used Different model specifications were also tested **Elasticity of starting** ***Men*** +0.07 ***Women*** +0.08

Table 5.2. Summary of studies on the effect of cigarette price on smoking cessation

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Endpoint – (definition of price)	Main results (elasticity)	Sub-populations (which subpopulations are considered)	Comment
United Kingdom						
Forster & Jones (2001) United Kingdom	Cross-sectional survey (1984) British Health and Lifestyle Survey (HALS) Sample of adults (≥18 yrs) representative of the population living in households in England, Scotland and Wales N=9003 Retrospective smoking data by using individuals' self-reporting information Analysis sample: N=9003	Split-population log-logistic probit duration model for smoking initiation Generalized gamma and Weibull models for smoking quitting Adjusted for social class, education, ethnicity, parental smoking, and a time trend	Tobacco tax: proxy for the real price of cigarettes Tax elasticity of quitting smoking	**Full sample** -0.41 to -0.69	**By sex** Men -0.41 to -0.63 Women -0.41 to -0.69	**Tax elasticities of starting smoking** ***By sex*** *Men* +0.16 *Women* +0.08
Low- and middle-income countries						
Viet Nam						
Laxminarayan & Deolalikar (2004) Viet Nam	Viet Nam Living Standards Survey, waves 1992/93 and 1997/98 6110 males (≥16 years) Two forms of tobacco: cigarettes and rustic tobacco	Three multinomial logit regressions for change of tobacco use status from 1993 to 1998 for three samples: 1) all smokers in 1993 2) all cigarette smokers in 1993 3) all rustic tobacco users Explanatory variables: real per capita expenditure in 1993, age in 1993, education, price of cigarettes in 1993, price of rustic tobacco in 1993; changes between 1993 and 1998 in real per capita expenditure, in price of cigarettes and in price of rustic tobacco Price data: collected from separate, commune-level surveys. Tobacco prices for year 1997/98 were imputed from household rustic tobacco expenditures and price of tobacco sold obtained from households producing tobacco		Given a change in price of cigarettes, price elasticities of decisions to quit cigarette smoking: -0.242 Given a change in price of rustic tobacco, price elasticities of decisions to quit rustic tobacco: +0.735		Cigarette smokers appear to be more price-sensitive than rustic tobacco users

BRFSS, behavioral risk factor surveillance system; NHIS, national health interview survey; OLS, ordinary least squares

Similarly, the analysis of cross-sectional data with information on recent quit attempts or interest in quitting will be useful in understanding how tax and price increases motivate cessation, but will be of limited utility in understanding their impact on successful, long-term cessation. Multiple waves of longitudinal data are most useful for addressing this, but few such data are available to researchers.

Given the available data, the most commonly employed design has been the use of retrospective information on smoking behaviour and cessation constructed from cross-sectional survey data. Douglas (1998) was the first to use this approach, constructing smoking histories from the retrospective data collected in the 1987 US National Health Interview Survey, with historical cigarette prices matched to the survey on the basis of each respondent's current state of residence. Using ordered probit, split-sample duration methods, Douglas (1998) modelled cessation using the rational addiction framework. He found that higher prices significantly increased the probability of cessation, with the duration of smoking approximately unitarily elastic (e.g. a 10% increase in prices would reduce the duration of smoking by 10%). In addition, he found that the probability of quitting rose with the duration of smoking, consistent with the predictions of the rational addiction model.

Forster and Jones (2001) applied a similar approach to estimating the impact of cigarette tax on smoking cessation in the United Kingdom, using retrospective information from the 1984 British Health and Lifestyle Survey. They studied men and women separately, obtaining tax elasticities for the number of years of smoking before quitting of −0.60 for men and −0.46 for women in their baseline models. A variety of sensitivity analyses produce similar elasticity ranges: −0.41 to −0.63 for men and −0.41 to −0.69 for women. Similar methods were employed by López Nicolás (2002) for Spain and by Peretti-Watel (2004) for France. Both studies similarly concluded that higher cigarette prices increased the probability of cessation.

Franz (2008) applied a related approach to look at the impact of cigarette prices on quitting in the past year, using cross-sectional data for the USA from the 1993 through 2000 Behavioural Risk Factor Surveillance System surveys. He found that cigarette prices were positively associated with this measure of cessation, with an estimated elasticity of cessation of 0.375 (the higher the price, the higher the probability of having quit the previous year). In addition, the elasticity estimate of cessation fell with increasing age, although it remained statistically significant (the elasticity estimate for the youngest group was more than twice that of the oldest group; Franz, 2008).

Two studies have employed longitudinal data taken from the International Tobacco Control (ITC) Policy Evaluation Project's nationally representative surveys of adult smokers to examine the impact of tax and price on cessation related outcomes. Hyland and colleagues (2006) used the first (late 2002) and second (mid-2003) waves of the US, United Kingdom, Canadian, and Australian ITC surveys to look at the effects of cigarette purchase behaviours in wave one on the likelihood of making a quit attempt and the likelihood of having quit by wave two. They found that smokers who purchased cigarettes from a low or untaxed source (e.g. from duty-free shops, online vendors and various other sources) were less likely to have made a quit attempt or to quit successfully between waves than those who did not purchase from these sources. This finding suggests that the availability of opportunities for tax avoidance and evasion reduces cessation.

More recently, Ross and colleagues (2011) used the first three waves of the US and Canadian ITC surveys to further explore the role of price and related factors on cessation outcomes. Using a five-level "stages of change" measure of quit intentions (pre-contemplation, contemplation, preparation, action and maintenance), they found that smokers living in areas with higher taxes and higher prices were significantly more interested in quitting. Similarly, they found some evidence that increases in prices resulted in increased motivation to quit and higher prices increased the likelihood of successful quitting. In contrast to Hyland and colleagues (2006), they found that the availability of cheaper cigarettes did not deter cessation, although smokers would respond more aggressively in their cessation efforts if lower priced cigarettes were not as readily available.

In the only cessation study conducted in a low- or middle-income country, Laxminarayan and Deolalikar (2004) used data for the subset of households participating in both the 1992–93 and 1997–98 waves of the Viet Nam Living Standards Survey[3]. They considered two forms of tobacco—cigarettes and rustic tobacco—and used price data collected from separate, commune-level surveys,

[3] Laxminarayan and Deolalikar (2004) also assess initiation with these data, as discussed in Chapter 6.

with rustic tobacco prices in the latter wave imputed because only cigarette prices were collected at that wave. They found little evidence that higher cigarette prices lead to cessation of cigarette smoking or that higher prices of rustic tobacco increase the probability of quitting among rustic tobacco users. Their findings indicated the occurrence of product substitution in response to increases in price; in this particular instance, smokers switching from manufactured cigarettes to the use of rustic tobacco. However, this finding may be the result of several factors. The sample sizes used in their models are relatively small. Correlations in price changes over time may reduce the precision of their estimates. The use of imputed rustic tobacco prices for one of the two waves included in the analysis can also bring about measurement errors to the estimates.

Summary

Studies on the impact of tobacco product taxes and prices on cessation are relatively scarce. The majority of these rely on retrospective data on smoking histories collected in cross-sectional surveys that are subject to various sources of measurement errors. Nevertheless, the findings from the small but growing body of research from high-income countries are consistent with the findings described above for the impact of price on smoking prevalence. Specifically, these studies consistently find that higher cigarette prices are associated with increased motivation to quit and with successful cessation. The only study from a low- or middle-income country, using Vietnamese data, does not reach similar conclusions, which may be accounted for by data limitations.

Systematic review of the scientific literature: Impact of relative prices on substitution among tobacco product by adult tobacco users

Even fewer studies have used survey data to examine the effects of changes in the price of one tobacco product relative to other tobacco products on substitution between these products by adult tobacco users. This is likely due to the very low prevalence of non-cigarette tobacco product use in many countries, to the lack of detailed data on use of multiple tobacco products in the same survey, and to the correlations that exist between taxes and prices for various tobacco products which make it difficult to empirically sort out the differential impact of each on use. Most of the studies that have examined the impact of changes in relative prices on substitution have been discussed above where findings regarding the effects of own-price on use were reviewed. This section briefly reviews the limited existing evidence on cross-price effects, with Table 5.3 providing a summary of the relevant studies.

Most of the evidence on cross-price effects also comes from the USA, with Ohsfeldt and colleagues responsible for most of those studies (Ohsfeldt and Boyle, 1994; Ohsfeldt *et al.*, 1997; Ohsfeldt *et al.*; 1999). In their various papers, Ohsfeldt and colleagues used data from different waves of the Tobacco Use Supplement to the Current Population Survey augmented with data on state-level cigarette and smokeless tobacco taxes. As described above, they consistently obtained negative own-tax effects, with higher cigarette taxes associated with reduced cigarette use and higher smokeless tobacco product taxes associated with reduced use of snuff and chewing tobacco. In their demand models for cigarettes and smokeless tobacco use, they included state-level taxes on both cigarettes and smokeless products to examine cross-price effects on tobacco use. While the point estimates vary from study to study, they find consistent evidence that higher cigarette taxes encourage some substitution to smokeless tobacco products, with positive cross-tax elasticities for smokeless tobacco use with respect to cigarette taxes. In contrast, they find little evidence in the opposite direction: estimates for smokeless tobacco taxes were generally insignificant in models of cigarette smoking.

Delnevo and colleagues (2004) find similar evidence of substitution between cigarettes and cigars based on data from the 2001 and 2002 New Jersey Adult Tobacco Use Surveys. Their analysis takes advantage of a significant increase in the New Jersey cigarette excise tax (from $0.80 per pack to $1.50 per pack) between the two waves of the survey, while the tax on other tobacco products in New Jersey was unchanged. They found that the prevalence of cigar use increased significantly from 2001 to 2002 among current cigarette smokers, and even more so among those who had recently quit smoking cigarettes. Delnevo and colleagues (2004) concluded that the changes in cigar smoking were the result of some cigarette smokers who had switched to cigar use following the significant increase in the relative price of cigarettes in New Jersey.

To date, only three survey-based studies of cross-price effects for adult tobacco use exist for low- and middle-income countries. In addition to estimating the own-price effects for cigarettes, bidis and leaf tobacco, John’s (2008) analysis of tobacco demand in India estimated cross-price effects.

Table 5.3. Summary of studies on the effect of cigarette price on substitution among tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Endpoint	Main results	Sub-populations	Comment
USA						
Ohsfeldt & Boyle (1994) USA	Cross-sectional CPS (1985) n=100 000 in file Analysis sample: only men (≥16 yrs) (N not reported)	Multivariate regression (snuff use, chewing tobacco use, and any smokeless tobacco use) Adjusted for per capita income, education, state population characteristics (residence, race, religious denomination, and divorce rate), men aged 16–17, and existing state tobacco regulation	Prevalence of use of smokeless tobacco Price of smokeless tobacco products: border-adjusted state smokeless tobacco average excise tax	**Cross-(tax) elasticities of demand for smokeless with respect to the cigarette tax** ***Snuff use*** +0.3 and +0.62 ***Chewing tobacco use*** +0.49 and +0.39 ***Any smokeless tobacco use*** +0.44 and +0.41		Ranges of elasticity estimates were obtained according to two models See also Table 5.1 for price elasticities of demand for smokeless tobacco use
Ohsfeldt *et al.* (1997) USA	Cross-sectional CPS (1985) n=100 000 in file Analysis sample: only men (≥16 yrs) (N not reported)	Multivariate Logit regression (for (i) cigarette use, (ii) snuff use, (iii) chewing tobacco use, and (iv) any smokeless tobacco use) Adjusted for total real family income, age, marital status, race, ethnicity, employment status, education, and occupation, metropolitan, religion, and tobacco control policy	Prevalence Price of smokeless tobacco products: border-adjusted state average smokeless tobacco excise tax	Cross-tax-elasticities of demand (prevalence) for smokeless tobacco with respect to the cigarette tax	**Cross-tax-elasticities of demand (prevalence) for smokeless tobacco with respect to the cigarette tax** ***By age (in years)*** *Snuff use* >15: +0.13 16–24: +0.71 ≥25: +0.04 *Chewing tobacco use* >15: +0.09 16–24: +0.19 ≥25: +0.08 *Any smokeless tobacco use* >15: +0.10 16–24: +0.23 ≥25: +0.09	See also Table 5.1 for price elasticities of demand for smokeless tobacco use
Ohsfeldt *et al.* (1999) USA	Cross sectional (pooled surveys) CPS (1992–1993) Analysis sample: 165 653 males either white or black (≥16 yrs) Nationally representative samples	Multivariate regression Adjusted for price (tax) of snuff, index of smoking regulation, family income, age, occupation and education, ethnicity (black/white), marital status, per capital income, poverty, unemployment rate and religion	Prevalence Price: real federal excise tax rate	**Overall cross-tax elasticity of demand for** ***Cigarette use*** +0.001 (given a 1-percent change in snuff tax rate) ***Snuff use*** +0.98 (given a 1-percent change in cigarette tax rate)	**Cross-tax elasticity of demand for** ***Cigarettes (given a 1-percent change in snuff tax rate)*** *By age (in years)* 16–24: +0.002 25–44: +0.001 ≥45: -0.002 ***Snuff (given a 1-percent change in***	Tobacco models were estimated with the cigarette tax and smoking regulation variables treated as exogenous and endogenous variables Higher cigarette tax rates are associated with greater snuff use, but higher snuff tax rates

Table 5.3. Summary of studies on the effect of cigarette price on substitution among tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Endpoint	Main results	Sub-populations	Comment
Ohsfeldt *et al.* (1999) (contd) USA					***cigarette tax rate)*** *By age (in years)* 16–24: +1.15 25–44: +0.04 ≥45: +0.54	are not associated with greater cigarette use
Delnevo *et al.* (2004) USA	Cross-sectional New Jersey Adult Tobacco Survey (NJATS) (2001–2002) RDD Analysis sample: N=7934 (≥18 yrs) 2001 data: N=3090 2002 data: N=4004	A logistic regression for (i) ever cigar use and (ii) current cigar use Adjusted for sex, race, age, education, and cigarette smoking status No price elasticities nor association of consumption (OR) with price are reported	Comparison between the odds of being an ever and current cigar user before (2001) and after (2002) a new cigarette excise tax	The odds of being an ever and current cigar smoker substantially increased among recent cigarette quitters after the new tax were taken into account	**The adjusted odd ratio for current cigar use of other tobacco products** ***Men*** *2001* +13.7 *2002* +6.2 ***By smoking history*** *Former smoker* 2001: +1.40 2002: +2.68 *Recent quitter* 2001: +0.52 2002: +4.73 *Current smoker* 2001: +2.82 2002: +4.51	Substitution of cigarettes by cigars after increases in excise tax for cigarettes were controlled for (and reducing that for cigars)
Low- and middle-income countries						
China						
Tsai *et al.* (2005) China (Taiwan)	Two-year follow-up cohort (face-to-face survey) Analysis sample: N=501 male smokers (≥16 yrs)	Logistic regressions (for behavioural change (i) reduction of smoking, and (ii) brand switching). Odds ratios were obtained Adjusted for demographic factors, individual income, smoking behaviour, living area, expense on smoking, addiction level, advertisement, and favourite cigarette brand	Change in smoking behaviour before (year 2001) and after the introduction of a new cigarette tax scheme (year 2002)	OR for reduced smoking with respect to increased retailed cigarette price by 1 NT$=1.03 OR for switching brand with respect to increased retailed cigarette price by 1 NT$=1.07		Overall, 17.4% switched brand, 18.8% reduced smoking, 8.4% both

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Endpoint	Main results	Sub-populations	Comment
India						
John (2008) India	Cross-sectional survey (1999–2000) N=120 309 households Household with zero consumption of tobacco (37% from rural and 60% from urban) were excluded from the analyses Unit of analysis: household	OLS regression Price of each tobacco product: average unit values (self-reported expenditure divided by quantity)	Substitution among tobacco products	**Cross-elasticities (consumption)** ***Rural*** *Demand for cigarettes given a 1% change in the price of* Bidis: -0.24 Leaf tobacco: +0.010 *Demand for bidis given a 1% change in the price of* Cigarettes: -0.117 Leaf tobacco: -0.010 *Demand for leaf tobacco given a 1% change in the price of* Cigarettes: +0.15 Bidis: -0.067 ***Urban*** *Demand for cigarettes given a 1% change in the price of* Bidis: -0.122 Leaf tobacco: +0.002 *Demand for bidis given a 1% change in the price of* Cigarettes: +0.011 Leaf tobacco: +0.011 *Demand for leaf tobacco given a 1% change in the price of* Cigarettes: -0.221 Bidis: +0.252		A demand system model Spatial variation in prices of tobacco products were used to estimate own and cross-price elasticities. When symmetry restrictions were imposed, price elasticity estimates did not considerably change Authors concluded that there are no substitution effects due to price change Cross-price elasticities reported here were symmetric-constrained estimates See also Table 5.1
South Africa						
Van Walbeek (2005) South Africa	Income and Expenditure surveys (IES), 1990, 1995 and 2000 Analysis unit: household Analysis sample: 1990: N=14 332 (urban households) 1995: N=16 903 (urban and rural households) 2000: N=26 263 (urban and rural households)		Two research questions: (1) the relative importance of tobacco in South African households' expenditure patterns; and (2) changes in the regressivity of cigarette taxes between 1990 and 2000	**Percentages of urban households spending money on tobacco products in 1990, 1995 and 2000 by income quintile (lowest to highest)** **Q1**: 46; 42; 22 **Q2**: 54; 46; 31 **Q3**: 51; 45; 34 **Q4**: 43; 44; 34 Between 1990 and 2000 the percentage of		The poor are significantly more price sensitive than the rich in consuming cigarettes. The decrease in aggregate cigarette consumption was driven largely by poorer households quitting (or not starting) cigarette smoking

Table 5.3. Summary of studies on the effect of cigarette price on substitution among tobacco products

Publication (author, yr, country)	Methods (time period, study design and sample size)	Model	Endpoint	Main results	Sub-populations	Comment
Van Walbeek (2005) (contd) South Africa				households consuming tobacco decreased by 14, 19, 16, and 8 percentage points for income quintiles Q1 to Q4.		
Viet Nam						
Laxminarayan & Deolalikar (2004) Viet Nam	Viet Nam Living Standards Survey, waves 1992/93 and 1997/98 6110 males (≥ 16 years) Two forms of tobacco: cigarettes and rustic tobacco	Three multinomial logit regressions for change of tobacco use status from 1993 to 1998 for three samples: 1) all smokers in 1993 2) all cigarette smokers in 1993 3) all rustic tobacco users Explanatory variables: real per capita expenditure in 1993, age in 1993, education, price of cigarettes in 1993, price of rustic tobacco in 1993; changes between 1993 and 1998 in real per capita expenditure, in price of cigarettes and in price of rustic tobacco Price data: collected from separate, commune- level surveys. Tobacco prices for year 1997/98 were imputed from household rustic tobacco expenditures and price of tobacco sold obtained from households producing tobacco		**Given a change in price of cigarettes, price elasticities of decisions to** ***(1) initiate into*** *cigarettes*: -1.175 *rustic tobacco:* +1.375 ***(2) switching from*** *cigarettes to rustic tobacco* +1.395 *rustic tobacco to cigarettes* +0.004 **(3) quitting** *cigarettes* -0.242 *rustic tobacco* +0.243 **Given a change in price of rustic tobacco, price elasticities of decisions to** ***(1) initiate into*** *cigarettes*: 0.477 *rustic tobacco*: 1.558 ***(2) switching from*** *cigarettes to rustic tobacco* -3.240 *rustic tobacco to cigarettes* -1.601 ***(3) quitting*** *cigarettes*: -1.411 *rustic tobacco*: +0.735		Although higher cigarette prices discourage initiation of cigarette smoking, they may encourage the use of rustic tobacco

CPS, current population survey; OLS, ordinary least squares; RDD, random digit dialing

In contrast to the evidence from high-income countries, John (2008) found no evidence that changes in the relative prices of tobacco products would result in substitution from higher-priced to lower-priced tobacco products. Instead, most of his cross-price elasticity estimates were negative, although few of them were statistically significant, suggesting complementarity among these tobacco products in India.

In contrast, Laxminarayan and Deolalikar (2004) found some evidence of substitution between cigarettes and rustic tobacco use in their analysis of adult tobacco use in Viet Nam. Specifically, they found that higher cigarette prices resulted in some substitution from cigarette use to rustic tobacco use, but found little impact of higher rustic tobacco price on cigarette use. Similarly, in his analysis of South African tobacco prices and tobacco use, Van Walbeek (2005) found evidence of substitution in response to relative price changes, at least in some populations. Specifically, he found strong evidence that the poor were switching to pipe and other tobacco (presumably to make roll-your-own (RYO) cigarettes) much more often than the rich as the price of cigarettes went up relative to these products. In 1990, the poorest quarter of the population spent about 5% of their tobacco purchases on pipe and other tobacco; in 2000, this had increased to 18%. Among the second-poorest quarter of the population, there was also an increase in the relative consumption share of pipe and other tobacco (from 2.4% to 7.1% of total tobacco expenditure). However, among the richer half of the population, the consumption share of pipe and other tobacco remained unchanged over this period.

Summary

The limited survey-based research on cross-price effects in adult tobacco use suggests that, at least in high-income countries, tobacco products are generally substitutes for one another. An increase in the price of one product relative to the price of another product will lead some users of products whose relative prices increase to switch to products whose relative prices fall. The even scarcer research on this issue from low- and middle-income countries suggests that cultural differences may be important in reducing cross-price effects.

Systematic review of the scientific literature: Attitudes, perceptions and behaviours towards increases of cigarette prices

Tables 5.4 and 5.5 summarize findings on attitudes and perceptions towards increases of cigarette prices and willingness of smokers to quit in response to increments of cigarette prices, respectively. In these tables, papers are sorted by country (USA, other high-income countries, and low- and medium-income countries) and year of publication.

Attitudes and perceptions towards increasing of cigarette prices

Table 5.4 gives a summary tabulation of studies providing evidence on the attitudes and perceptions of adults towards increasing cigarette prices. Studies were available from the USA (Torabi *et al.*, 1994; King *et al.*, 2003; Hamilton *et al.*, 2005; Shelley *et al.*, 2007), Taiwan, China (Tsai *et al.*, 2003), Italy (Gallus *et al.*, 2005; Gallus *et al.*, 2006), Germany (Hanewinkel & Isensee, 2008), and New Zealand (Wilson *et al.*, 2010). These studies were based on samples ranging between 800 and 27 000 subjects that in most cases were representative of the corresponding target (state or national) populations.

The key messages are that a substantial proportion (i.e. generally between a third and a half) of the population would support tax increases, and that such a support becomes appreciably greater (i.e. 60–80% or more) whenever such tax increases are devoted to measures for tobacco control. A study from New York City (Shelley *et al.*, 2007), based on focus groups and qualitative information on economically disadvantaged population's smoking and purchasing responses to increases on tobacco taxes, reported that a substantial tax rise (e.g. US$5) increased intention to quit but also increased smuggling.

In several studies, the support for increased taxation was greater in nonsmokers and in smokers who were more educated, elderly or less young. However, a study that concerned African Americans' attitudes did not consider a rise in taxation unfair for African Americans (King *et al.*, 2003). At each level of education, responders agreeing with a tax increase represented the most numerous group. A study from Germany (Hanewinkel & Isensee, 2008) also showed growing support for increasing taxation over the most recent calendar periods (35% in 2002 to 42% in 2005).

Willingness of smokers to quit according to increases in cigarette prices

Table 5.5 gives summary findings from studies on the willingness of smokers to quit according to increases in cigarette prices and taxation.

Table 5.4. Summary of studies providing data on the attitudes and perceptions of adults towards increasing cigarette prices

Reference, year, country	Methods	Main results	Comments
USA			
Torabi *et al.* (1994) Indiana, USA	Random sample of 800 adults	About 85% in favour of tax rise for health education and tobacco research	Representative state sample
King *et al.* (2003) USA	1000 African American adults from 10 districts	47% of the sample supported increase in taxation. Positive relation with education	Rise in taxation not considered unfair for African Americans
Hamilton *et al.* (2005) Massachusetts, USA	14 000 adults from 351 Massachusetts towns	Over 80% of support for tax increase if used for tobacco control only, 74% for health or tobacco control, 31% for any government purpose	Greater support by non smokers, more educated, less young individuals and women
Shelley *et al.* (2007) New York City, USA	104 subjects in 14 focus groups	The US$5 price increase in New York City increased interest in quitting, but also smuggling	Qualitative data
Other high-income countries			
Germany			
Hanewinkel & Isensee (2008) Germany	Ten representative samples of the general population, 27 608 persons aged ≥14	Greater support to tax increase over time, from 35% in 2002 to 42% in 2005. General support among elderly, more educated subjects	The amount of price increase did not affect this support
Italy			
Gallus *et al.* (2005) Italy	3114 Italians aged ≥15	54% of the sample confident that an increase of price is effective. 21% of smokers stated there they would reduce, and 10% stop smoking following an 1€ increase in price	Representative sample of the Italian population
Gallus *et al.* (2006) Italy	3050 Italians aged ≥15 interviewed in 2006	36% of ever smokers reported that a tax increase would have a high (10.5%) or intermediate (25.4%) impact on cigarette consumption in the young	Representative sample of the Italian population
Gallus *et al.* (2008) Italy	Adults ≥15 years, interviewed in 2006–07 partly overlapping with Gallus *et al.*2006	25% of 1456 smokers strongly in favour, and 37% moderately favour of an increased of 10 € cents devoted to supporting another association 39% of smokers indicate that a minimum price of 5 € per pack, would decrease smoking	Greater support in middle-aged moderate smokers
New Zealand			
Wilson *et al.* (2010) New Zealand	1376 smokers	59% would support a tax increase if the revenue if used to promote healthy lifestyle and quitting	Greater support for smokers with intention to quit

Reference, year, country	Methods	Main results	Comments
Low- and middle-income countries			
China			
Tsai *et al.* (2003) China (Taiwan)	National sample. Face-to-face interviews of 3279 adults aged 18 to 64 years in 2000	Lower support towards cigarette tax increase among current (OR=0.34) and former smokers, and among lower social classes	Survey conducted before the introduction of a national tax
South Africa			
Martin *et al.* (1992; 1993)	Household survey representative of the South African population Sample size: 2006 adults	56% of adults believed that taxes on tobacco products should be increased. Supporters for tax increases were more frequently whites (60%) and Asians (62%), females (58%), subjects aged ≥ 45 years (59%) and more educated subjects (63%). Greater support was evident in non smokers (59%) and particularly ex-smokers (70%) compared with current smokers (45%)	

Table 5.5. Summary of studies providing data on the willingness of smokers to quit according to increases of cigarette prices

Reference, year, country	Methods	Main results	Comments
USA			
Biener *et al.* (1998)	Ad hoc survey (1993-1994) 1783 adult smokers 216 teenager smokers Telephone survey Representative sample of Massachusetts	Changes in smoking behaviour in front of an hypothetical increase in price: Low income associated to cut cost (switch to cheaper tax or reduce number of cigarettes; OR=3.30; 95% CI 1.79–6.36) and consider quitting (OR=1.98; 95% CI 1.17–3.34) vs. no response Heavy smoking associated to cut cost (OR=2.08; 95% CI 1.10–3.93) vs. no response Teenagers: Low income associated to cut cost (OR=7.64; 95% CI 1.37–42.56) vs. no response and cut cost (OR=13.26; 95% CI 1.93–91.57) vs. consider quitting	Survey after increase of 25¢ and prior to a statewide tobacco control programme Estimates adjusted for age, sex, income, and amount smoked
Other high-income countries			
Republic of Korea			
Chung *et al.* (2007)	3000 men aged ≥20 Telephone interview	Overall price elasticity -0.66	Key impact on amount of cigarette smoked (-0.64), but very limited on smoking cessation (-0.02)
Chung *et al.* (2008)	702 subjects	Mean of the willingness to quit for an increase in price of about 40%	Greater willingness with larger increases
Low- and middle- income countries			
China			
Lee (2008) (Taiwan)	483 questionnaires from a population survey	Elasticity -0.29 for a 44% increase in price	Greater elasticity for women, low income smokers, moderately addicted and smokers who purchase low-price cigarettes

Studies were available from the USA (Biener *et al.*, 1998), the Republic of Korea (Chung *et al.*, 2007, 2008) and Taiwan, China (Lee, 2008) and based on samples from 500 to 3000 subjects.

A study conducted in the USA on 1783 adult smokers analysed changes in smoking behaviour in front of a hypothetical increase of price. Lower-income smokers were significantly more likely to cut smoking costs (by switching to cheaper brands or smoking less cigarettes) or seriously consider quitting than to not adjusting their smoking behaviour in the face of a tax increase ("no response") as compared to higher-income smokers (Biener *et al.*, 1998). Heavy smoking was significantly and positively associated with the probability of cutting costs (OR = 2.08; 95% CI: 1.10–3.93) compared to no response.

Overall summary

A large and growing number of studies have used individual-level or household-level survey data to assess the impact of tobacco product taxes and prices on use of tobacco products among adults. Studies have used survey data to examine the differential impact of tax and price on tobacco use among population subgroups defined by gender, age, socioeconomic status and/or other characteristics, as well as to assess the separate effects of price on different aspects of tobacco use, such as prevalence, frequency, intensity, initiation, uptake and cessation. The relatively large literature from the USA and other high-income countries shows that adult smoking prevalence and intensity are negatively related to cigarette taxes and prices, with most total elasticity estimates falling in the range from −0.2 to −0.6. While the quality of data and methods varies more, estimates obtained in studies from several low- and middle-income countries generally confirm that various aspects of adult tobacco use are responsive to price, with higher prices reducing both prevalence and intensity of use. Several studies from high-income countries have examined adult smoking cessation, generally finding that higher taxes and higher prices reduce the duration of smoking, raise interest in quitting, boost quit attempts and increase the number of smokers who successfully quit smoking. Finally, a few US studies found similar effects of tax and price on the use of other tobacco products, such as smokeless tobacco and cigars, and produced some evidence of substitution among tobacco products in response to changes in the relative prices of these products. In contrast, no clear patterns emerge from the small number of studies from countries other than the US that consider substitution among tobacco products in response to changes in the relative prices of these products.

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Chapter 6
Tax, price and tobacco use among young people

Introduction

An overwhelming majority of adult smokers initiate smoking while they are adolescents or young adults. The World Bank estimates that in high-income countries, approximately eight out of 10 smokers start to smoke in their teens, while in low- and middle-income countries, most smokers start to smoke by their early twenties (Jha and Chaloupka, 1999)

According to the 1999–2007 Global Youth Tobacco Survey (GYTS), approximately 9.5% of students worldwide aged 13–15 currently smoke cigarettes (Centers for Disease Control and Prevention, 2008). The smoking prevalence rate of these students varies considerably by region, with the European Region having the highest prevalence rate at 19.2% and the Eastern Mediterranean region having the lowest smoking prevalence rate at 4.9%. Moreover, estimates from the GYTS suggest that 10.1% of students worldwide aged 13–15 use tobacco products other than cigarettes, such as smokeless tobacco, pipes, water pipes and bidis. Again, other tobacco prevalence rates by students vary considerably by region, with the Eastern Mediterranean region having the highest rate at 12.0% and the Western Pacific region having the lowest prevalence rate at 6.6%.

Youth responsiveness to prices and taxes – Theoretical foundations

Consistent with economic theory, adolescents and young adults are expected to have a larger response to price changes than older adults (see Chapter 5 for discussion of price and tax effects on adult demand for tobacco). That is, the demand for tobacco by adolescents and young adults is expected to be more price-elastic than the demand by older adults. There are several reasons for this prediction. First, as Grossman and Chaloupka (1997) point out, the fraction of disposable income spent on cigarettes by young smokers is likely to be greater than that of adult smokers. Economic theory predicts that the greater the share of disposable income a good takes up, the more responsive individuals will be to price changes. Grossman and Chaloupka (1997) also highlight the point that adolescents typically have a greater propensity to discount the future (i.e. have higher discount rates) than adults. The higher discount rates suggest that youth place a relatively greater importance on the short-term costs of smoking, such as the monetary price of cigarettes, than on the long-term costs of smoking, such as the future health consequences of smoking. Lewit *et al.* (1981) offer two additional reasons why youth are expected to be more price-elastic than adults. First, established adolescent smokers are likely to have shorter smoking histories than adults and therefore would likely respond more to price changes than long-time smokers who are more addicted. Second, adolescents are likely to be more easily influenced by their peers (i.e. friends and siblings) than are adults. That is, relative to older adults, young people are more likely to smoke if their peers also smoke. This implies that an increase in cigarette price would not only directly reduce youth smoking, but would also indirectly reduce youth smoking by decreasing peer smoking. In addition, young people's demand for tobacco can also be indirectly influenced, either positively or negatively, through observance of parental smoking. Finally, young people's responsiveness to tobacco price increases is also indirectly influenced through access to cheap or free tobacco from social sources, such as peers and parents.

The 1989 U.S. Surgeon General's report suggests that smoking behaviour occurs on a continuum, from initiation to experimentation to regular smoking followed by dependence or addiction (U.S. Department of Health and Human Services, 1989). Cigarette prices are also likely to have a differential effect on smoking depending on where on the smoking uptake continuum the individual is. For example, individuals in the experimentation stage of smoking initiation will likely be less affected by cigarette price changes than those who are farther along the uptake continuum because those individuals in the experimentation stage typically do not yet purchase their own cigarettes and are not directly exposed to price. On the other hand, individuals who purchase their own cigarettes are likely to have a larger response to price changes than experimenters.

As described below, the empirical evidence on the demand for tobacco products among young people is consistent with economic theory. That is, youth and young adult tobacco demand has been found to be inversely related to cigarette prices, and with few exceptions, the absolute value of the price elasticity of demand is found to be larger for young people than for adults.

Youth responsiveness to prices and taxes – Review of evidence from demand studies

For the purpose of this review, generally young people refers to individuals under 30 years of age (13–18 youth; 19–30 young adults); however, some studies may provide price elasticity estimates for age groups that extend above this upper age limit.

Smoking prevalence and intensity among young smokers – United States

Numerous studies examining the determinants of youth tobacco use have been conducted over the past three decades. With few exceptions, these studies have taken advantage of natural experiments that result from government changes in tobacco product taxes and/or prices. Given the significant spatial (i.e. state and local) and temporal (i.e. over time) changes in tobacco taxes that have occurred in the United States over the past several decades, a preponderance of these studies have examined youth tobacco use in the United States. However, a growing number of studies have focused on youth tobacco use in other high-income countries, and more recently several studies have focused on low- and middle-income countries. Table 6.1 summarizes the published literature providing evidence on the effects of cigarette prices and taxes on smoking prevalence and smoking intensity among young people.

Lewit and colleagues (1981) were the first to examine the effect of cigarette prices on adolescent smoking. They employed data on 6768 youth aged 12 to 17 taken from Cycle III of the nationally representative Health Examination Survey, conducted from March 1966 through March 1970. They used a two-part model of cigarette demand in which smoking prevalence and intensity of cigarette use among smokers were estimated separately. In addition to price, they controlled for anti-smoking publicity, cigarette advertising and a variety of socioeconomic and demographic factors in their equations. Lewit and colleagues estimated that the total price elasticity of youth smoking was −1.44, an estimate that was considerably larger than the consensus estimate for adults. They found that most of the impact of price on youth smoking came through its impact on smoking prevalence, with an estimated price elasticity of smoking prevalence equal to −1.20. Price played a smaller role in altering average smoking by young smokers, with an estimated price elasticity of cigarette consumption among smokers equal to −0.25. These estimates imply that a 10% increase in the price of cigarettes would reduce youth smoking prevalence by 12% and reduce the average number of cigarettes consumed by young smokers by 2.5%.

A follow-up study by Lewit and Coate (1982) used the 1976 National Health Interview Survey to estimate smoking prevalence and intensity of smoking equations for different subpopulations, including individuals of different ages (20–25 years, 26–35 years, and 36–74 years) and genders. They found that young adults (aged 20–25 years) were the most responsive to changes in price, with an estimated total price elasticity of demand equal to −0.89. The authors estimated total price elasticities of demand for adults aged 26–35 and adults aged 36–74 to be −0.47 and −0.45, respectively. The absolute values of the price elasticities of demand for the adolescents included in this study are generally smaller than those found in Lewit *et al.* (1981), most likely because individuals in this study are older than those in Lewit *et al.* (1981). With respect to the youngest sample, those aged 20–25, males were found to significantly respond to price changes with an estimated total price elasticity of demand equal to −1.40, and females were found not to respond to prices.

Table 6.1. Summary of studies on the effects of cigarette price on young people's demand for tobacco products

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
High-income countries					
USA (Lewit *et al.*, 1981)	Methods 1966–1970; Cycle III of the nationally representative Health Examination Survey of youth aged 12–17 (n = 6768) Model Ordinary least squares multivariate regression controlling for socioeconomic and demographic factors and antismoking and tobacco advertising	−1.44	–1.20	−0.25 Omitting price differential	
USA (Lewit and Coate, 1982)	Methods 1976; National Health Interview Survey, nationally representative sample of 19 266 individuals aged 20–74 from 416 survey sites. Model Ordinary least squares regression and variance components GLS procedure; adjusted for socioeconomic and demographic factors and region and city size characteristics. Subgroup analysis of demand by age is estimated by a FIML logit procedure	**Overall** *20–74 years* −0.221 (SE 0.126) **Restricted sample** 20–74 years −0.416 (SE 0.158) **By age** *20–25 years* −0.89 (SE 0.40) *26–35 years* −0.47 (SE 0.27) *36–74 years* −0.45 (SE 0.20) **By age and sex** *Females* *20–25 years* −0.302 (SE 0.595) *26–35 years* −0.577 (SE 0.424) *36–74 years* −0.118 (SE 0.310) **By age and sex** *Males* *20–25 years* −1.401 (SE 0.563) *26–35 years* −0.320 (SE 0.363) *36–74 years* −0.658 (SE 0.276)	**Overall** *20–74 years* −0.135 (SE 0.086) **Restricted sample** 20–74 years −0.264 (SE 0.122) **By age** *20–25 years* −0.74 (SE 0.35) *26–35 years* −0.44 (SE 0.25) *36–74 years* −0.15 (SE 0.19) **By age and sex** *Females* *20–25 years* −0.136 (SE 0.497) *26–35 years* −0.388 (SE 0.362) *36–74 years* −0.066 (SE 0.274) **By age and sex** *Males* *20–25 years* −1.276 (SE 0.476) *26–35 years* −0.292 (SE 0.318) *36–74 years* −0.246 (SE 0.235)	**Overall** *20–74 years* −0.037 (SE 0.077) **Restricted sample** 20–74 years −0.103 (SE 0.087) **By age** *20–25 years* −0.20 (SE 0.25) *26–35 years* −0.04 (SE 0.16) *36–74 years* −0.15 (SE 0.11) **By age and sex** *Females* *20–25 years* −0.025 (SE 0.395) *26–35 years* −0.134 (SE 0.250) *36–74 years* −0.077 (SE 0.170) **By age and sex** *Males* *20–25 years* −0.171 (SE 0.313) *26–35 years* −0.029 (SE 0.214) *36–74 years* −0.204 (SE 0.152)	Restricted sample: individuals whose own average price was greater than the price within the 20-mile band were removed

Table 6.1. Summary of studies on the effects of cigarette price on young people's demand for tobacco products

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
USA (Chaloupka, 1991)	Method 1976–1980; National Health and Nutrition Examination Survey, nationally representative sample of 28 000 individuals aged 6 mos to 74 years. Model Becker-Murphy model of rational addiction; two stage, least squares regression controlling for socioeconomic and demographic factors	**By age** *17–24 years* −0.103 to 0.05 *25–64 years* −0.454 to −0.315			Long-run price elasticities
USA (Wasserman *et al.*, 1991)	Method 1970–1985; National Health Interview Survey data on 207 647 individuals from 7 of the 9 supplementary smoking questionnaires implemented between 1970 and 1985. Data on smoking among 12–1 7-year-olds from the National Health and Nutrition Examination Survey (*n* = 1891) for 1976−1980. Price data from Tobacco Institute's 1986 report The Tax Burden on Tobacco weighted average price by state. Model Estimated a generalized linear model using an iterative weighted least squares technique, adjusted for socioeconomic and demographic factors and other anti-smoking regulations	**Adults** 1970: 0.059 (SE 0.076) 1974: −0.017 (SE 0.062) 1985: −0.226 (SE 0.118)			No statistically significant difference between youth and adult smoking over time Adjustment for state policy restricting smoking
USA (Chaloupka and Grossman, 1996)	Method 1992, 1993, 1994; Data from 8th-, 10th- and 12th-grade students (ages 13–18) from the Monitoring the Future Survey (*n* = 110 717). Price data from the Tobacco Institute's report The Tax Burden on Tobacco	**Overall** −1.313 **Full Sample** *Price only model* −1.450 *Full model* −0.846	**Overall** −0.675 **Full Sample** *Price only model* –0.799 *Full model* –0.376	**Overall** –0.638 **Full Sample** *Price only model* –0.651 *Full model* –0.470	Estimates are average of the different models/samples. Price only model excludes other policy related variables, subject to omitted variables bias. Full model includes other policy variables, but likely subject to collinearity.

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
USA (Chaloupka and Grossman, 1996) (contd)	Model Two-part model of demand: probit methods to estimate a smoking prevalence equation and least squares methods to estimate consumption by smokers, adjusted for socioeconomic and demographic factors and other anti-smoking regulations	**Restricted sample** *Price only model* −1.702 *Full model* −1.254	**Restricted sample** *Price only model* –0.923 *Full model* –0.602	**Restricted sample** *Price only model* –0.779 *Full model* –0.652	Restricted sample excludes individuals living within 25 miles of a state with lower cigarette prices
USA (Chaloupka and Wechsler, 1997)	Method 1993; Nationally representative sample of 16 570 students from 140 US Colleges and Universities from the Harvard College Alcohol Study. Site-specific cigarette price from the 1993 American Chamber of Commerce Researchers Association Quarterly Inter-City Cost of Living Index Model Ordered level consumption: Ordered probit specification. For 'categorically continuous' consumption: two-part model of demand – probit methods to estimate smoking prevalence and least squares method for the smoking intensity equation. Adjusted for socioeconomic and demographic factors, regional and institutional characteristics	**Overall** −1.11 **Full sample** −1.249 **Restricted sample** −1.009 Estimates are averages of the different models/samples	**Overall** −0.520 **Full sample** −0.536	**Overall** −0.729 **Full sample** −0.472	Two measures of consumption: ordered level consumption (0 = non-smoker, 1 = light smoker etc) and a 'categorically continuous' measure 0, 0.5, 5, 10, 15, 20, 30). Restricted sample excludes all students attending a college/university within 20 miles of a state with lower cigarette excise taxes/price
USA and Canada (Lewit *et al.*, 1997)	Method 1990 and 1992; two cross-sectional school-based surveys of 9th-grade students (aged 13–16) from 21 North American communities representing 15 432 individuals as part of the COMMIT Project Model Mutivariate logistic		**Price elasticity of smoking prevalence** *Full sample* −0.87 *By gender* Boys −1.51 Girls −0.32 **Price elasticity of intention to smoke**		

Table 6.1. Summary of studies on the effects of cigarette price on young people's demand for tobacco products

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
USA and Canada (Lewit *et al.*, 1997) (contd)	regression models including cigarette price, exposure to COMMIT interventions, age, race, gender, year and state level policy interventions as independent variables		*Full sample* −0.95 *By gender* Boys – 0.92 Girls −0.99		
USA (Centers for Disease Control and Prevention, 1998)	Method Pooled data from 1976–1980, 1983, 1985, 1987–1993 National Health Interview Surveys (*n* = 355 246). Price data from the Tobacco Institute. Model Two-part model of demand: probit model to estimate smoking prevalence and Ordinary Least Squares to estimate smoking intensity, controlled for year, region, socioeconomic and demographic factors	**Overall** −0.25 **By gender** *Males* −0.26 *Females* –0.19 **By age** *18–24 years* –0.58 *25–39 years* –0.42 *40+ years* –0.10	**Overall** −0.15 **By gender** *Males* −0.18 *Females* −0.09 **By age** *18–24 years* −0.37 *25–39 years* −0.25 *40+ years* −0.06	**Overall** −0.10 **By gender** *Males* −0.08 *Females* −0.10 **By age** *18–24 years* −0.21 *25–39 years* −0.17 *40+ years* −0.04	
USA (Evans and Farrelly, 1998)	Method 1979, 1987; nationally representative cross-sectional (pooled surveys) data on adults 18 years and over from the National Health Interview Survey supplements 1979 (Smoking) and 1987 (Cancer Control) (*n* = 48 314). Model Two-part model: 1) probit (smoking prevalence); 2) simple linear regression OLS (smoking intensity). Analyses adjusted for socioedemographic variables.	**Tax** *18–24 years* −0.798 *25–39 years* −0.759	**Tax** *18–24 years* −0.575 *25–39 years* −0.434	**Tax** *18–24 years* −0.223 *25–39 years* −0.325	
USA (Chaloupka and Pacula, 1999)	Method 1992, 1993, 1994; Data from 8th-, 10th- and 12th-grade students (ages 13–18) from		**Males** – 0.928*** *White* – 0.861***		Statistically significant at ***1%, **5%, and *10%

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
USA (Chaloupka and Pacula, 1999) (contd)	the Monitoring the Future Survey (n = 110 717). Price data from the Tobacco Institute's report The Tax Burden on Tobacco Model Probit maximum likelihood specification		*Black* – 1.646*** **Females** – 0.595** *White* – 0.451** *Black* – 0.453 **Whites** – 0.639*** **Blacks** – 1.108*		
USA (Dee, 1999)	Method 1977–1992 pooled representative data on high school seniors from 44 US states from the Monitoring the Future Surveys (n = 255 560) Model Weighted least squares estimates of reduced form equations for smoking prevalence. Analyses control for demographic variables, year and state fixed effects, socioeconomics and macroeconomic covariates, race and gender-specific year fixed effects and state-specific time trends.		**Estimates based on pooled data from 1977–1992** 0.0592 to −0.0644 **Estimates based on data from 1985–1992** −0.098 to −0.112		Estimates using pooled data from 1977–1992 suggest that cigarette taxes appear to have implausibly signed or statistically imprecise effects on teen smoking prevalence; richer specifications using data from 1985–1992 provide relatively weak statistical significance in some models
USA (Harris & Chan, 1999)	Method 1992–1993; Tobacco Use Supplements to the Current Population Survey. Model Two-stage model of demand: probit specification for the prevalence equation and OLS equation for the smoking intensity equation. Probit equations and conditional regressions with two price variables: average price of premium and average price of discount brands. Model 1 enters each price variable separately and	**By age** *15–17 years* −0.996 (SE 0.487) *18–20 years* −0.779 (SE 0.306) *21–23 years* −0.644 (SE 0.263) *24–26 years* −0.657 (SE 0.212) *27–29 years* −0.329 (SE 0.190)	**By age** *15–17 years* −0.831 (SE 0.402) *18–20 years* −0.524 (SE 0.258) *21–23 years* −0.370 (SE 0.188) *24–26 years* −0.202 (SE 0.175) *27–29 years* −0.095 (SE 0.157) **Separate equations** *Premium* 15–17 years −1.023 (SE 0.517) 18–20 years −0.735 (SE 0.328)	**By age** *15–17 years* −0.165 (SE 0.276) *18–20 years* −0.255 (SE 0.165) *21–23 years* −0.274 (SE 0.184) *24–26 years* −0.455 (SE 0.120) *27–29 years* −0.234 (SE 0.107) **Separate equations** *Premium Brands* 15–17 years −0.237 (SE 0.371) 18–20 years −0.410 (SE 0.217)	

Table 6.1. Summary of studies on the effects of cigarette price on young people's demand for tobacco products

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
USA (Harris & Chan, 1999) (contd)	Model 2 includes both in a single equation		21–23 years −0.529 (SE 0.236) 24–26 years −0.297 (SE 0.222) 27–29 years −0.123 (SE 0.199) *Discount brands* 15–17 years −0.533 (SE 0.366) 18–20 years −0.091 (SE 0.236) 21–23 years −0.059 (SE 0.175) 24–26 years −0.069 (SE 0.162) 27–29 years −0.178 (SE 0.146) **Single equation** *Premium* 15–17 years −1.069 (SE 0.836) 18–20 years −1.601 (SE 0.526) 21–23 years −1.106 (0.364) 24–26 years −0.911 (SE 0.350) 27–29 years −0.716 (SE 0.305) *Discount brands* 15–17 years 0.041 (SE 0.591) 18–20 years 0.799 (SE 0.376) 21–23 years 0.563 (SE 0.270) 24–26 years 0.577 (SE 0.254) 27–29 years 0.575 (SE 0.224	21–23 years −0.492 (SE 0.176) 24–26 years −0.550 (SE 0.156) 27–29 years −0.427 (SE 0.138) *Discount Brands* 15–17 years −0.152 (SE0.247) 18–20 years −0.057 (SE 0.153) 21–23 years −0.104 (SE 0.129) 24–26 years −0.320 (SE 0.110) 27–29 years −0.114 (SE 0.099) **Single equation** *Premium Brands* 15–17 years −0.151 (SE 0.668) 18–20 years −0.987 (SE 0.366) 21–23 years −1.070 (SE 0.295) 24–26 years −0.524 (SE 0.267) 27–29 years −0.808 (SE 0.225) *Discount Brands* 15–17 years −0.069 (SE0.445) 18–20 years 0.504 (SE 0.258) 21–23 years 0.525 (SE 0.216) 24–26 years −0.023 (SE 0.187) 27–29 years 0.346 (SE 0.162)	
USA (Tauras and Chaloupka, 1999)	Method 1976–1993; Panel data nationally representative cross-sectional surveys of 8th-, 9th- and 10th-grade	−0.711	−0.104	−0.607	Consumption is 'categorically continuous' assuming the following values: 0, 15, 90, 300, 600, 900 and 1200

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
USA (Tauras and Chaloupka, 1999) (contd)	students (ages 13–18) from the Monitoring the Future Survey (approximately 50 000 persons). Price data from the Tobacco Institute's report The Tax Burden on Tobacco Model Two-part, individual fixed effects model of cigarette demand: linear probability model used to estimate smoking prevalence equations and least squares techniques to estimate smoking intensity				
USA (Emery *et al.*, 2001)	Method 1993; Nationally representative data for youths aged 10–22 from the second wave of the longitudinal teenage attitudes and practices survey (*n* = 12 952). Price data from the Tobacco Institute. Model Two-part model of cigarette demand. Smoking intensity modelled separately for current smokers (smoked in last 30 days) and established smokers (smoked in last 30 days and at least 100 cigarettes in lifetime) separately	**Current smokers 14+ years** −1.70 **Established smokers 14+ years** −2.24	**Current smokers 14+ years** −0.83 **Established smokers 14+ years** −1.56 **Experimenters 10+ years** non-significant	**Current smokers 14+ years** −0.87 *Established smokers 14+ years* −0.68	
USA (Farrelly *et al.*, 2001)	Method Pooled data from 1976–1980, 1983, 1985, 1987–1993 National Health Interview Surveys (*n* = 354 228). Price data from the Tobacco Institute. Model Two-part model of demand: probit model to estimate smoking prevalence and Ordinary Least Squares to estimate smoking intensity, controlled for year, region, socioeconomic and demographic factors, and state-specific effects	**Total sample** –0.28 **By gender** *Males* −0.18 *Females* –0.32 **By age** *18–24 years* –0.55 *25–39 years* –0.53 *40+ years* –0.00	**Total Sample** –0.13 **By gender** *Males* –0.03 *Females* –0.19 **By age** *18–24 years* –0.30 *25–39 years* –0.25 *40+ years* –0.02	**Total sample** –0.15 **By gender** *Males* –0.18 *Females* −0.13 **By age** *18–24 years* –0.25 *25–39 years* –0.28 *40+ years* –0.06	Only significant estimates of price elasticity of smoking prevalence and intensity are included in the total price elasticity estimates

Table 6.1. Summary of studies on the effects of cigarette price on young people's demand for tobacco products

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
USA (Gruber and Zinman 2001)	Method 1991–1997; 3 data sets: Monitoring the Future Surveys of 8th-, 10th-, and 12th-grade students (*n* = 336 665), Youth Risk Behavior Surveys of 9th–12th grade students (*n* = 53 278) and Vital Statistic Natality data on teenage mothers during pregnancy (*n* = 1985). State-level price and tax from the Tobacco Institute Model Regression, controlled for demographic factors, state clean air laws and youth access restrictions		**MTF data** −0.66 **YRBS data** −1.5 **Natality data** −0.38		
USA (Ross and Chaloupka, 2003)	Method 1996; Cross-sectional data for 17 287 high school students from 202 schools. Three measures of price: perceived price from smokers and non-smokers, Tobacco Institute price data and ACCRA cost-of-living index price data. Model Two-part model of cigarette demand: probit specification for smoking prevalence equation, ordinary least squares for smoking intensity, controlling for state-level smoke-free air laws and youth access laws and the possibility of smuggling	**Using average state prices** −0.67 **Using perceived prices** −1.02	**Using average state prices** −0.351 **Using average perceived prices** −0.492	**Using average state prices** −0.138 **Using perceived prices** −0.521	
USA (Farrelly *et al.*, 2004)	Method 1988 and 1993; Longitudinal data for 3675 smokers aged 25–64 from the 1988 Community Intervention Trial (COMMIT). Model			**Smokers' ages** *25–34 years* −0.235 *35–44 years* −0.115 *45–64 years* −0.110	Smokers respond to higher cigarette prices by reducing aintensity, but also by switching to cigarettes with higher levels of tar and nicotine

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
USA (Farrelly *et al.*, 2004) (contd)	Linear regression of average daily cigarette consumption adjusted for age, race, sex, marital status education income clean air laws index, nicotine and tar. State average cigarette price				
USA (Ross and Chaloupka, 2004)	Method 1996; Cross-sectional data for 17 287 high school students from 202 schools. Two measures of price: perceived price from both smokers and non-smokers, and Tobacco Institute price data Model Two-part model of cigarette demand: probit specification for smoking prevalence equation, generalized linear model for smoking intensity, controlling socioeconomic and demographic factors as well as for state-level smoke-free air laws and youth access laws and the possibility of smuggling	**Using average state price** −0.722 to −0.763 **Using perceived price** −0.997 to −1.003	**Using average state price** –0.393* **Using perceived price** −0.414**	**Using average state price** –0.052 **Using perceived price** −0.543*	**, * Significant at 5% and 10% level based on two-tailed test after its standard error was adjusted for clustering
USA (Sloan and Trogdon, 2004)	Method 1990–2002; repeated cross-sectional data on a nationally representative sample of adults (n = 1 762 686) from the Behavioural Risk Factor Surveillance System survey. Model Probit specification to estimate smoking prevalence elasticity controlling for socioeconomic and demographic factors		**18–20 years** −0.27 (0.14) **21–24 years** −0.12 (0.08) **25–44 years** −0.10 (0.05) **45–64 years** −0.10 (0.07) **65+ years** −0.25 (0.08)		
USA (DeCicca *et al.*, 2005)	Method 1988–2000; nationally representative panel micro data from the National Education Longitudinal Survey of 8th graders followed up 2, 4 and 12 years		**Model 1** *2000 tax rate* −0.610 **Model 2** *1992 tax rate* −1.137		

Table 6.1. Summary of studies on the effects of cigarette price on young people's demand for tobacco products

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
USA (DeCicca *et al.*, 2005) (contd)	later. (*n* = 11 326) Model Probit model of smoking prevalence. Model 1 uses contemporaneous smoking and tax data; Model 2 incorporates past tax data. Model 3 compares those who move states and those who stay in the same state. All three models are estimated with and without correcting for attrition.		*2000 tax rate* −0.119 *Full sample* −0.610 *Movers* −0.214 *Stayers* −0.692 Corrected for attrition **Model 1** *2000 tax rate* −0.678 **Model 2** *1992 tax rate* −1.126 *2000 tax rate* −0.183 **Model 3** *Full sample* −0.678 *Non-switchers* −0.369 *Switchers* −0.739		
USA (Tauras *et al.*, 2005)	Method 1997–2001; National Longitudinal Survey of Youth 1997 Cohort. Nationally representative sample of 9022 youths aged 12–16, first wave in 1997, annual follow-up for 4 years. Price data from Tobacco Institute. Model Two-part model of cigarette demand using a fixed effects approach that controls for unobserved individual level heterogeneity and individual invariant year-specific unobserved heterogeneity	−0.827	−0.311	−0.516	
USA (Carpenter and Cook, 2008)	Method 1991–2005; National representative data from the Youth Risk Behavior Survey		**National** −0.56 (−0.106) **State/local** −0.25 (−0.047)		State and local versions of YRBS only sources of youth smoking information designed to be representative

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
USA (Carpenter and Cook, 2008) (contd)	(*n* = 101 633) and aggregate data from independent state and local versions of the YRBS representative at the state/local level (*n* = 278, representing over 750 000 youths) Model 1) For national data: Two-way fixed effects model, controlling for demographics and area and year fixed effects, using standard logit regression 2) For state and local data: separate weighted Ordinary Least Squares regressions 3) Model including a direct measure of anti-smoking sentiment using national data				of the sampled state or locality
USA (DeCicca *et al.*, 2008a)	Method 1992 and 2000; National Education Longitudinal Study, two waves as cross-sections: 1992 (*n* = 16 730) and 2000 (*n* = 11 490). State cigarette data from Tax Burden on Tobacco Model Two part model of cigarette demand: probit model of smoking prevalence and ordinary least squares model of smoking intensity, controlling for state anti-smoking sentiment, youth access restrictions, socioeconomic and demographic variables	**1992 to 2000 data** −1.065 to −1.244* **Including direct measure of anti-smoking sentiment** +0.104 to −0.629	**1992 to 2000 data** −0.763 to −0.586 **Including direct measure of anti-smoking sentiment** +0.082 to −0.111	**1992 to 2000 data** −0.302 to −0.658	* Statistically significant at 1%. Price elasticities estimated including anti-smoking sentiment not statistically significant. 'Categorical continuous' variable constructed for consumption based on conditional categorical means
USA (DeCicca *et al.*, 2008b)	Method 1988–2000; 1988, 1992 and 2000 waves of the National Education Longitudinal Study (*n* = 10 336) including youths aged 18–26 years. Model Myopic addiction model using probit specifications,		**Model 1** −0.49* **Model 2** 0.13		* Statistically significant

Table 6.1. Summary of studies on the effects of cigarette price on young people's demand for tobacco products

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
USA (DeCicca *et al.*, 2008b) (contd)	controlling for socioeconomic and demographic factors and anti-tobacco sentiment. Three models estimated: 1) using intrastate variation in cigarette excise taxes, 2) including a direct measure of anti-tobacco sentiment 3) using variation in state excise taxes faced by youths who moved state between study waves				
USA (Franz, 2008)	Method 1993–2000; Nationally representative cross-sectional data for adults 18+ years from the Behaviour Risk Factor Surveillance System Survey (n = 1 million) Method Two models were considered: 1) a simple OLS and 2) a two-part model. Analyses controlled for socioeconomic and demographic factors. Price was the state average real cigarette price	**Overall** −0.374 *18–29 years* −0.518 *30–39 years* −0.360 *40–64 years* −0.327 *65+ years* −0.458	**Overall** −0.193 *18–29 years* −0.289 *30–39 years* −0.176 *40–64 years* −0.201 *65+ years* −0.331	**Overall** −0.191 *18–29 years* −0.184 *30–39 years* −0.192 *40–64 years* −0.158 *65+ years* −0.154	
USA (Fletcher *et al.*, 2009)	Method 1994–2002; data from the first wave of the national Longitudinal Study of Adolescent Health; nationally representative sample of 7th- to 12th-grade students in 1994 followed up one and six years later (about 90 000). State level excise tax used. Model OLS, Poisson, and negative binomial regression used to estimate tax response. Finite mixture models used to estimate differential response by 'type' (light and heavy smokers). Analyses	**Baseline estimates** *OLS* −0.189** *Poisson* −0.090** *Negative binomial* −0.111** **Finite Mixture Models** *Poisson* Light smokers −0.128* Heavy smokers −0.055 *Negative binomial* Light smokers −0.185** Heavy smokers −0.057			Tax elasticities. Study suggests two attributes are associated with adolescent types: self-control and future discount rates. Adolescents with lower self-control and higher future discount rates are less responsive to tax than counterparts with higher self-control and lower discount rates

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
USA (Fletcher *et al.*, 2009) (contd)	controlled for race, gender, age, family income, parental education and employment, family structure, religiosity and rural/urban				
United Kingdom (Townsend *et al.*, 1994)	Method 1972–1990; nationally representative random sample of British adults from the Biennial General Household Survey. Model Multiple regression analysis		**By gender** *Men* (95% CI) −0.47 (−0.83 to −0.10) *Women* −0.61 (−0.89 to −0.33) **By age and gender** *Men* 16–19 years 0.06 (SE 0.32) 20–24 years 0.16 (SE 0.26) 25–34 years −0.73 (SE 0.16)** 35–49 years −0.35 (SE 0.17) 50–59 years −0.66 (SE 0.37) 60+ years −0.29 (SE 0.13) *Women* 16–19 years −0.86 (SE 0.22)** 20–24 years −0.96 (SE 0.20)*** 25–34 years −0.85 (SE 0.09)*** 35–49 years −0.93 (SE 0.13)*** 50–59 years −0.92 (SE0.16)*** 60+ years −0.59 (SE 0.26)*		* *P < 0.05* ** *P < 0.01* *** *P < 0.001*
Canada (Dupont and Ward, 2002)	Method 1994–1998; National Population Health Data, nationally representative longitudinal data for individuals aged 14–18 during cycle 1. Price data from Statistics Canada Model Two-part model of cigarette demand: smoking propensity	**In 1994** −0.919 In 1998 −0.121	**In 1994** −0.914 In 1998 0.434	**In 1994** −0.005 In 1998 −0.555	

Table 6.1. Summary of studies on the effects of cigarette price on young people's demand for tobacco products

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
Canada (Dupont and Ward, 2002) (contd)	estimated using a probit function and smoking intensity estimated using linear regression				
Canada (Sen and Wirjanto, 2010)	1992 to 1999; pooled data from 1992–1996 Waterloo Smoking Prevention Programme; 1991 General Social Survey; 1994 Youth Smoking Survey; 1996/97 and 1998/99 National Population Health Surveys, 1999 Canadian Tobacco Use Monitoring Survey Model Probit and OLS estimation controlling for gender and employing province and year effects		Price elasticity of smoking participation −0.10	Price elasticity of daily smoking −0.14	
27 European countries (Schnohr *et al.*, 2008)	Method 2001/02; Health Behaviour in School Aged Children: pooled, cross-sectional data from 92 217 youths aged 13 and 15 years from 27 countries. Price and policy data from 2003 the WHO Regional Office for European Tobacco Control Database Model Regression analysis with daily smoking as the outcome and the stepwise inclusion of national tobacco policy, adult tobacco epidemiology and macro-economic variables. Multilevel modeling to determine the effects of each group of variables. Analyses adjusted for age and stratified by gender		**Univariate** 0.91 (0.83–1.00) **Model 1** 0.86 (0.78–0.95) **Model 2** 0.91 (0.80–1.04) **Model 3** 0.94 (0.81–1.10)		Odds ratio of daily smoking (95% confidence interval). No significant relationships between price and youth smoking prevalence, possibly as a result of inability to adequately control for intercountry factors correlated with price

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
Low- and middle-income countries					
South Africa (van Walbeek, 2002)	Method 1993–2000; All Media and Products survey—national repeated cross-sectional surveys of between 14 000–30 000 individuals 16 years and over. Model Regression	Not estimated	**Percentage change in estimated smoking prevalence** *Total sample* −16.9% *By age* 16–24 years −22.0% 25–34 years −17.6%	**Percentage change in aggregate cigarette consumption** −26.0% *Percentage change in average consumption* *Total sample* −24.2%	Percentage change in real price of cigarettes 92.7% No estimation of price elasticity by age in models controlling for other determinants of demand
Ukraine (Krasovsky et al, 2002)	Method National survey data on individuals 14 years and over (n = 2700) Model Ordinary least squares regression, adjusted for socioeconomic and demographic factors			**Total sample** −0.4 *4–17 years* Low income −0.65 Medium income −0.7 High income −0.52 *18–28 years* Low income −0.37 Medium income −0.42 High income −0.24 *29+ years* Low income −0.28 Medium income −0.33 High income −0.15	Self-reported price, endogenous Cigarette consumption derived from reported monthly cigarette expenditure divided by reported pack price. No information on statistical significance of estimates
Myanmar (Kyaing, 2003)	Method 1980–2001; Survey data from 75 townships Model Two part demand model: Logit model to estimate smoking probability and OLS regression to estimate consumption equation	**Total sample** −1.619 **By age** *15–24 years* –2.41 *25–34 years* –1.596 *35–44 years* –1.398 *45–54 years* –1.263 *55–64 years* –1.253 *65+ years* – 1.167	**Total sample** −1.277 **By age** *15–24 years* –1.992 *25–34 years* –1.231 *35–44 years* –1.08 *45–54 years* –0.943 *55–64 years* –0.856 *65+ years* –0.887	**Total sample** −0.342** **By age** *15–24 years* –0.418** *25–34 years* –0.365** *35–44 years* –0.318** *45–54 years* –0.32** *55–64 years* –0.397** *65+ years* –0.28**	Prices for smoking households based on expenditures and cigarette/cheroots, home rolled tobacco consumption and used to predict prices for non-smoking households – endogenous **: $P < 0.01$

Table 6.1 Summary of studies on the effects of cigarette price on young people's demand for tobacco products

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
Nepal (Karki *et al.*, 2003)	Method 2000; Smoking Behaviour Survey, nationally representative data on 1438 households and 5957 individuals Model Two part demand model: Logit model to estimate smoking probability and OLS regression to estimate consumption equation	**Total sample** −0.882 **By age** *15–24 years* –1.879 *25–34 years* –0.945 *35–44 years* –0.686 *45–54 years* –0.605 *55–64 years* –0.682 *65+ years* –1.1	**Total sample** −0.459 **By age** *15–24 years* –1.32 *25–34 years* –0.449 *35–44 years* –0.306 *45–54 years* –0.263 *55–64 years* –0.355 *65+ years* –0.459	**Total sample** −0.423** **By age** *15–24 years* –0.599* *25–34 years* –0.496** *35–44 years* –0.38** *45–54 years* –0.342** *55–64 years* –0.327** *65+ years* –0.641**	Prices for smoking households based on expenditures and cigarette/bidi consumption and used to predict prices for non-smoking households—endogenous *: $P < 0.10$ **: $P < 0.01$
Thailand (Sarntisart, 2003)	Method 2000 Household Socioeconomic Survey data for 11 968 households from 9 regions and 4 rural areas Model Linear expenditure system model using pooled estimation			**Total sample** −0.3925 **By age** *8–17 years* –0.3075 *18–29 years* −0.3880 *30–39 years* –0.4616 *40–49 years* –0.2447 *50–59 years* –0.2875 *60 and older* −0.0000	Individual smoking consumption estimated based on consumption of smoking households with individuals of different ages and data on age of initiation
China and the Russian Federation (Lance *et al.*, 2004)	Method 1993–1997; longitudinal data for respondents over 13 years of age from nine Chinese provinces from the Chinese Health and Nutrition Survey (*n* = 8557). Russian data from the 1996, 1998 and 2000 waves of the Russian Longitudinal Monitoring Survey of adults over 13 (*n* = 10 638 men) Model Two-part demand model: logit	**China** *Pooled* −0.082 *Community fixed effects* −0.007 *Pooled cross-section* < 20 years −0.257 21–24 years –0.053 25–54 years −0.025 55+ years −0.199	**China** *Pooled* −0.019 *Fixed effects A* −0.045 *Fixed effects B* −0.034 *Pooled cross-section* 21–24 years 0.141 25–54 years 0.093 55+ years −0.044	**China** *Pooled* −0.063 *Fixed effects A* −0.056 *Fixed effects B* −0.027 *Pooled cross-section* 21–24 years 0.564 25–54 years 0.389 55+ years 0.180	*$P < 0.1$; **$P < 0.05$

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
China and the Russian Federation (Lance *et al.*, 2004) (contd)	specification for prevalence equation and linear regression for the smoking intensity equation. Pooled cross-sectional specifications and including community fixed-effects	*Community fixed effects* < 20 years 0.077 21–24 years 0.122 25–54 years −0.004 55+ years −0.149	*Fixed effects A* 21–24 years 0.141 25–54 years 0.092 55 +years −0.061 *Fixed effects B* 21–24 years 0.070 25–54 years 0.030 55+ years −0.130	*Fixed effects A* 21–24 years 0.571 25–54 years 0.404 55+ years 0.187 *Fixed effects B* 21–24 years −0.041 25–54 years −0.578 55+ years −0.573	
		The Russian Federation *Pooled* −0.132 *Community fixed effects* −0.050 < 20 years −0.345 21–24 years −0.237 25–54 years −0.072 55+ years −0.111 *Community fixed effects* < 20 years −0.199 21–24 years −0.142 25–54 years −0.003 55+ years −0.042	**The Russian Federation** *Pooled* −0.106 *Fixed effects A* −0.101 *Fixed effects B* −0.050 21–24 years −0.003 25–54 years 0.005* 55+ years 0.004 *Fixed effects A* 21–24 years −0.002 25–54 years 0.005* 55+ years 0.004 *Fixed effects B* 21–24 years −0.002 25–54 years 0.005 55+ years 0.002	**The Russian Federation** *Pooled* −0.026 *Fixed effects A* −0.026 *Fixed effects B* −0.000 21–24 years −0.002 25–54 years 0.025* 55+ years 0.035* *Fixed effects A* 21–24 years −0.003 25–54 years 0.024* 55+ years 0.032* *Fixed effects B* 21–24 years −0.002 25–54 years 0.025* 55 + years 0.029*	
Russian Federation, Moscow (Ross, 2004b)	Method 1999; data from the Global Youth Tobacco Survey on 7th-, 8th-, 9th-and 10th-grade students (aged 11–17) (*n* = 4074). School-level measure of average cigarette price.	−1.15 to −1.16	−0.47 to −0.51	−0.64 to −0.69	

Table 6.1. Summary of studies on the effects of cigarette price on young people's demand for tobacco products

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
Russian Federation, Moscow (Ross, 2004b) (contd)	Model Two-part model of cigarette demand: probit model to estimate smoking prevalence equation and Ordinary Least Squares to estimate smoking intensity equation, controlling for socioeconomic factors and school anti-smoking policies				
Ukraine (Kiev), (Ross, 2004a)	Method 1999; Global Youth Tobacco Survey data for 4156 individuals from 100 schools in Kiev city Model Probit model used to estimate smoking prevalence equation		−0.29 to −0.51	−1.43 to −1.83	Average school price calculated based on reported price from smoking students
India (Joseph, 2010)	Method 2000–2004; Global Youth Tobacco Survey data from 26 of 28 states and two of the seven Union Territories on youth aged 13–15 years. Average price data from users and non-users to construct school/state/territory level prices Model Two-part model of cigarette demand; probit model to estimate smoking prevalence equation and Ordinary Least Squares to estimate smoking intensity equation	−0.4	**Total sample** −0.4053 **By gender** *Women* −0.6081 *Men* −0.2852	**Total sample** Insignificant **By gender** *Women* −0.4072 *Men* −0.2408	
20 LMICs (Kostova *et al.*, 2010	Method 1999–2006; Data from the Global Youth Tobacco Survey, average age 14 years (n = 349 930). Price data from the Economist Intelligence Unit World Cost of Living Survey. Model	−1.8	**Local brand prices** −0.56** to −0.96*** **Foreign Brand Prices** −1.540***to −0.904** **By smoking intensity** *Very light smokers* *(1–15 cigs/mo)* 0.396*** to 0.528***	**Local brand prices** −1.13***to −1.21*** **Foreign brand prices** −1.22***to −1.22	**P < 0.05 ***P < 0.01

Publication (location, author, year)	Methods and Model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comments
20 LMICs (Kostova *et al.*, 2010 (contd)	Two-part model of cigarette demand: smoking prevalence estimated using a logit model, smoking intensity estimated with a generalized linear model with a normal distribution and a log link. Analyses include country fixed effects, a measure of local anti-smoking sentiment and control for the prevalence of cigarette advertising, anti-tobacco media outreach, and compliance with youth access restrictions.		*Light to medium smokers* *(15 –100 cigs/mo)* −0.437 ***to −0.339*** *Medium smokers* *(100–300 cigs/mo)* −0.900***to −0.687*** *Heavy smokers* *(300+ cigs/mo)* −1.144***to −0.868***		

In the early 1990s, two studies were published in the US (Chaloupka, 1991 and Wasserman *et al.*, 1991) and one in the United Kingdom (Townsend *et al.*, 1994) that cast doubt on the early studies by Lewit and colleagues by finding that young people were not more price-elastic than adults. Chaloupka (1991) used data from the National Health and Nutrition Examination Survey conducted from 1976 to 1980 to estimate the cigarette demand equations. Applying Becker and Murphy's theoretical model of rational addiction (discussed in Chapter 4), Chaloupka found young adults (aged 17–24) to be insensitive to changes in price, whereas individuals aged 25–64 showed a significant long-run response to a change in price, with an estimated long-run price elasticity of demand in the range of – 0.46 to – 0.32.

Wasserman and his colleagues (1991) used data on 1891 adolescents aged 12–17, taken from the Second National Health and Nutrition Examination Survey conducted between 1976–1980, and data on adults taken from several waves of the National Health Interview Surveys conducted in the 1970s and 1980s to estimate cigarette demand equations. They focused on the effects of cigarette prices while controlling for state policies restricting smoking in public places and a host of other socioeconomic and demographic variables. Consistent with Chaloupka's (1991) results, Wasserman and colleagues found no statistically significant difference in the price elasticity of demand between youth and adult smokers. Moreover, there were no statistically significant effects of price on youth smoking. They attribute much of the difference between their findings and those of previous studies (i.e. Lewit and colleagues) to the inclusion of a measure reflecting the magnitude of restrictions on smoking in public places and its correlation with cigarette prices. When Wasserman *et al.* excluded the smoking restrictions measure from their models, they obtained similar price elasticities to those from the early studies. They argued that the price elasticity estimates were subject to an omitted variables bias when the smoking restrictions measure was not included.

A series of papers starting in the mid-1990s supported the early findings of Lewit and his colleagues that young people are more price-responsive than older people. These studies were based on data covering a period with greater variation in tax and price, which allowed more precise estimates of the impact of price. For example, Chaloupka and Grossman (1996) used data on more than 110 000 8th-, 10th-, and 12th-grade students taken from the 1992, 1993 and 1994 Monitoring the Future Surveys (MTFS) to estimate smoking prevalence and smoking intensity demand equations. They calculated a total price elasticity for youth smoking of −1.31. However, in contrast to Lewit and his colleagues' finding that most of the impact of a price change was on smoking prevalence, Chaloupka and Grossman (1996) found that the effect was about evenly split between prevalence and number of cigarettes consumed by young smokers. This study controlled for other smoking-related interventions, such as restrictions on smoking in public places and schools, as well as youth access restrictions, and refuted the argument by Wasserman *et al.* that previous studies reporting price effects were subject to an omitted variables bias.

Using the same MTFS data as Chaloupka and Grossman (1996), Chaloupka and Pacula (1999) estimated separate demand equations by demographic characteristics including gender and race/ethnicity. While price was found to have a negative and significant impact on both male and female smoking prevalence, the magnitudes of the price effects were very different. Chaloupka and Pacula found that the prevalence price elasticity of demand for young men was nearly twice as large, in absolute value, as that for young women. Specifically, they estimated that the prevalence price elasticity of demand for males was −0.93 and for females was −0.60. Moreover, they found that smoking prevalence for African American adolescents was more price elastic (−1.11) than for white adolescents (−0.64).

Chaloupka and Wechsler (1997) used data extracted from the 1993 Harvard Alcohol Study to estimate the effects of cigarette prices and restrictions on cigarette smoking among college students in the US. The authors estimated a total price elasticity of demand of –1.11 for college students. The authors also concluded that relatively stringent restrictions on smoking in public places reduce smoking prevalence rates among college students, while some restrictions on public smoking reduce the quantity of cigarettes smoked.

A Centers for Disease Control and Prevention (CDC) report authored by Farrelly and Bray (Centers for Disease Control and Prevention, 1998) used data from the 1976–1980, 1983, 1985, and 1987–1993 National Health Interview Surveys to estimate cigarette demand equations in the United States for various subpopulations. In their analyses they estimate separate demand equations for different age groups, including young adults aged 18–24 years, adults aged 25–39 years, and adults aged 40+ years; the total price elasticities of demand obtained were –0.58, –0.42 and −0.10, respectively. Indeed, the estimated total price elasticity of demand for young adults is more than double the −0.25 estimate of the total price elasticity of demand for all respondents.

In a follow-up paper, Farrelly and his colleagues (2001) employed the same data as Farrelly and Bray (Centers for Disease Control and Prevention, 1998), but included state-specific effects in their model to control for state-level, time-invariant heterogeneity, such as sentiment towards tobacco. The findings from these analyses are similar to those of Farrelly and Bray; total price elasticity of demand was estimated to be −0.55 for young adults aged 18–24 and −0.53 for individuals aged 25–39. However, the authors found no significant effects of price on smoking prevalence or smoking intensity among individuals aged 40+.

Lewit and his colleagues (1997) used data from cross-sectional surveys of 9th-grade students in 1990 and 1992 in the 21 US and Canada sites that were a part of the Community Intervention Trial for Smoking Cessation (COMMIT), to examine the impact of cigarette prices on youth smoking prevalence and intentions to smoke. The authors estimated that the prevalence price elasticity of demand for 9th graders was −0.87 and that intentions to smoke in the future among non-smoking 9th graders were somewhat more price elastic, with an estimated elasticity of −0.95. The authors also found strong gender differences, with the estimated prevalence price elasticities of demand for boys and girls estimated at −1.51 and −0.32, respectively. The estimated price coefficients in the girls equations were not significantly different from zero.

Harris and Chan (1999) studied the relationship between cigarette smoking and price among individuals aged 15–29 using data from the 1992–1993 Tobacco Use Supplements to the Current Population Survey. They partitioned their sample into five age groups: 15–17 years, 18–20 years, 21–23 years, 24–26 years and 27–29 years. The authors found that the price elasticity of smoking prevalence declined in absolute value with age: −0.83 for ages 15–17; −0.52 for ages 18–20; −0.37 for ages 21–23; −0.20 for ages 24–26; −0.10 for ages 27–29. However, the price elasticity of smoking intensity rose in absolute value with age (up to age 23): −0.17 for ages 15–17; −0.26 for ages 18–20; −0.27 for ages 21–23; −0.46 for ages 24–26; −0.23 for ages 27–29. This is consistent with the evidence from uptake studies (discussed below), which shows that price has less of an impact on people at the earliest stages of smoking uptake and has a more significant effect on those at later stages who are more established smokers. Nevertheless, the total price elasticity of demand fell in absolute value with age: −1.0 for ages 15–17; −0.78 for ages 18–20; −0.64 for ages 21–23; −0.66 for ages 24–26; −0.33 for ages 27–29. The estimated total price elasticities of demand in Harris and Chan (1999) confirm that an inverse relationship exists between age and the absolute value of the total price elasticity of cigarette demand.

Tauras and Chaloupka (1999) employed data on cigarette use from the 1976 through 1995 longitudinal surveys of high school seniors as part of the Monitoring the Future programme. Individuals from each cohort between 1976 and 1993 were tracked over time, with a maximum number of seven follow-up surveys conducted on individuals. An individual fixed effects model was used to estimate the determinants of smoking prevalence and intensity of cigarette use among smokers. The authors found that increases in cigarette prices lead to significant reductions in both the number of young adults who smoke and the intensity with which they smoke. The estimated total average price elasticity of demand was found to be −0.79, with price having a smaller effect on smoking prevalence than on average consumption by smokers.

Almost all the research conducted over the last decade confirms the early findings of Lewit and colleagues of an inverse relationship between price response and age. For example, using a single cross-section collected in 1996 for The Study of Smoking and Tobacco Use Among Young People, Ross and Chaloupka (2003) examined the effect of cigarette prices on smoking among high-school students in the United States. In their analyses, the authors assessed the use of several alternative measures of cigarette prices, including average state prices and perceived prices among the students, while controlling for both state-level smoke-free air laws and youth-access laws. In their preferred specifications, they estimated total price elasticities of demand of −0.67 when using average state prices and −1.02 when using perceived prices among youth. A subsequent analysis by Ross and Chaloupka (2004) using the same data, but explicitly controlling for the level of compliance with respect to youth-access laws, resulted in similar price elasticity estimates.

Gruber and Zinman (2001) controlled for both state and year fixed effects in their analyses of youth smoking. They employed three separate data sets from the 1990s in their analyses: (1) Monitoring the Future Surveys (MTFS) of 8th-, 10th-, and 12th-grade students; (2) Youth Risk Behavior surveys (YRBS) of 9th- to 12th-grade students; and (3) the Vital Statistics Natality Detail Files (Natality) of mothers during pregnancy. They found consistent evidence that youth smoking responds to changes in cigarette prices, particularly among older adolescents. The prevalence price elasticities ranged from −0.38 in the Natality data to −1.5 in the YRBS data, with the most reliable estimate of −0.66 coming from the 1991–1997 MTFS data. Based on their estimated elasticities, Gruber and Zinman conclude that the “Marlboro Friday” price reductions in 1993 explained 26 percent of the rise in youth smoking observed in the US during the mid-1990s. “Marlboro Friday” refers to Friday, 2 April 1993, when Philip Morris announced a 20% price reduction to their Marlboro cigarette brand to fight off generic competitors.

Tauras and colleagues (2005) investigated the impact of cigarette prices and tobacco control policies on youth and young adult smoking prevalence and intensity of cigarette use among smokers during the late 1990s through early 2000s, which was a period characterized by significant changes in cigarette prices and taxes. They employed the first five waves of data (1997–2001) from the National Longitudinal Survey of Youth 1997 Cohort (NLSY97). Controlling for unobserved year and individual characteristics, they found a strong negative impact of cigarette prices and taxes on young people’s smoking prevalence and intensity of cigarette use among smokers. Specifically, they estimated the total price elasticity of cigarette demand to be −0.83. The estimated smoking prevalence price elasticity of demand and the elasticity of smoking intensity were −0.31 and −0.52, respectively.

Sloan and Trogdon (2004) used data from the Behavioural Risk Factor Surveillance System from the 1990s and early 2000s to estimate smoking prevalence equations among young adults (aged 18–20 years) and older adults (aged 21 years+). Employing both state and year fixed effects, the authors concluded that young adult smoking prevalence was the most price-elastic, with an estimated smoking prevalence elasticity of demand of −0.27. Furthermore, the authors found evidence that the absolute value of the price elasticity of smoking prevalence declined monotonically with age, with the exception of individuals aged 65 years and older.

DeCicca and colleagues (2008a) developed a direct measure of state-specific smoking sentiment using a factor analysis procedure that employed data from the Tobacco Use Supplements to the Current Population Surveys during the 1990s. They merged this tobacco sentiment measure with survey data on youth smoking from the 1992 and 2000 waves of the National Education Longitudinal Study (NELS). The authors found price to have a strong, significant negative impact on smoking prevalence and intensity of cigarette use by young smokers. Between 1992 and 2000, the estimated price elasticities of smoking prevalence and intensity of cigarette use among smokers ranged from −0.76 to −0.59 and from −0.30 to −0.66 respectively. Moreover, even after controlling for the new direct measure of smoking sentiment, price was found to have a strong negative influence on the intensity of cigarette use by young smokers in the 2000 cross-section. However, when the direct measure of smoking sentiment was included in the smoking prevalence equations, the price effects lost statistical significance. Using the 2000 wave of data, they tested models that used this newly developed measure of sentiment and compared it to models using alternative approaches to dealing with antismoking sentiment. The strong negative impact of price on average smoking was robust to all the methods of dealing with unobserved state-level sentiment towards tobacco. Moreover, in all of the models except the model that included the new measure of sentiment, price was found to have a negative and significant impact on smoking prevalence among youth. Given the findings when the direct measure of antismoking sentiment was included in the models, DeCicca and colleagues questioned the adequacy of other proxies to control for antismoking sentiment. However, some caution should be used in interpreting models that include direct measure of antismoking sentiment, as there is likely to be reverse causality in this type of estimation strategy. That is, the amount of smoking within a state is likely to have an impact on the level of antismoking sentiment within a state, resulting in simultaneity bias.

Carpenter and Cook (2008) addressed the concerns of DeCicca and colleagues (2008a) in a recent paper that used national, state, and local Youth Risk Behavior Surveillance System data from 1991 to 2005. The authors tested three alternative methods of dealing with antismoking sentiment. First, they estimated a cross-sectional model that relied on intrastate variation in cigarette taxes to identify the impact of price on youth smoking. Second, they estimated a fixed effects model that controlled for area (i.e. state or local municipality) fixed effects and year fixed effects. Finally, they employed the same direct measure of antismoking sentiment used by DeCicca and colleagues (2008a). They found consistent evidence of a significant negative effect of cigarette taxes on smoking prevalence in the cross-sectional and fixed effects approaches. Importantly, using DeCicca and colleagues' measure of antismoking sentiment, they found a strong negative effect of tax on smoking prevalence among youth, alleviating the concerns raised by DeCicca and colleagues. Using the tax effects from the national and state samples, Carpenter and Cook (2008) estimated price elasticities for youth smoking prevalence of −0.56 in the national sample and −0.25 in the state sample.

To assess the impact of price on youth smoking based on the intensity of smoking, Liang and Chaloupka (2002), used data from the 1992, 1993 and 1994 Monitoring the Future surveys of 8th-, 10th-, and 12th-grade students in a Threshold of Change model. The authors grouped the youth into five categories of smoking intensity including: no consumption; less than daily smoking; light daily smoking (defined as one to five cigarettes per day); moderate daily smoking (defined as one-half pack per day); and heavy daily smoking (defined as one pack or more per day). The authors found that higher prices were associated with lower smoking in all cases, but that the greatest impact of the higher prices was on smoking at the heaviest levels of intensity.

Smoking prevalence and intensity among young smokers – Other high-income countries

An early study from the United Kingdom by Townsend and colleagues (1994) used data on cigarette smoking from the 1972–1990 British General Household Surveys to assess the effects of cigarette prices on smoking prevalence by gender and age and by gender and socioeconomic group in the United Kingdom. They concluded that smoking prevalence among young females (aged 16–19 and aged 20–24) was responsive to changes in cigarette prices, whereas young males' smoking prevalence was not. The estimated price elasticities of smoking prevalence for females aged 16–19 and aged 20–24 were −0.86 and −0.96, respectively. Interestingly, the authors concluded that there were no statistically significant differences in the estimated price elasticities of demand among women in these two age groups and women who were aged 25–59 years.

A Canadian study by Waller and colleagues (2003) used data from the Ontario Student Drug Use Survey to examine the impact of decreases in Canadian cigarette taxes (and consequently prices) in the early 1990s on youth smoking prevalence. They found that youth smoking prevalence had been falling steadily in the years leading up to the tax decrease, despite the increase in cigarette smuggling into Canada in the late 1980s and early 1990s. However, the tax cuts in 1994 led to a significant rise in youth smoking prevalence. Subsequent price increases led to further reductions in prevalence. Dupont and Ward (2002), using the National Population Health Data for the period 1994–1998, reached a similar finding for the effects of Canadian tax increases in the mid-1990s. They estimated that the price elasticity of smoking prevalence for Canadian youth was −0.91.

One recent cross-sectional study by Schnohr and colleagues (2008) pooled data from 27 European countries to examine the effects of prices and tobacco control policies on youth daily smoking prevalence. Data on prices and policies were obtained from the 2003 WHO Regional Office for Europe Tobacco Control Database and were merged with data on smoking prevalence from the 2001/2002 Health Behaviour in School-Aged Children (HBSC) study. In contrast to the US studies, the authors found no significant relationships between price and youth smoking prevalence in their multilevel analyses of these merged data. The researchers suggest that the lack of relationship between price and prevalence may result from their inability to adequately control for inter-country factors correlated with price and youth smoking and their inability to capture the full impact of recent changes in taxes and prices.

Smoking prevalence and intensity among young smokers – Low- and middle-income countries: cross-sectional studies

There are a limited but growing number of studies that investigate the response to price and tax changes among youth in low- and middle-income countries. With few exceptions, the findings from these studies are consistent with those from high-income countries: young people are more price-elastic than the population in general. For example, Krasovsky and colleagues (2002) estimated differences in the price elasticity of cigarette demand by age and income in the Ukraine. The estimated price elasticities of average smoking for younger smokers were found to be larger in absolute value than the estimated elasticities for older smokers at each income level. van Walbeek (2002) used regression techniques on repeated cross-sectional surveys of between 14 000 and 30 000 individuals aged 16 and over to estimate the percentage change in aggregate cigarette consumption and smoking prevalence by age in South Africa. Van Walbeek observed a 26% decrease in aggregate consumption and a 17% decrease in estimated smoking prevalence, with greater reductions in the younger age groups (22%; 16–24 years), largely attributable to a 92.7% increase in the real price of cigarettes. A reduction in smoking prevalence explained 40% of this decrease in consumption, and the greatest reduction in smoking prevalence was observed among the younger cohort (aged 16–34), suggesting that youth are more responsive to price than adults. Karki and colleagues (2003) estimated the joint demand for cigarettes and bidis by age in Nepal. They found that young people (aged 15–24 years) were more than twice as responsive to changes in price than the overall population, and that in general the absolute value of the price elasticity of demand fell with increasing age. Kyaing (2003) estimated price elasticities of smoked tobacco products in Myanmar. The price elasticity estimates for young people were estimated to be approximately 50% greater than the estimated price elasticity for the overall population.

Several studies from low- and middle-income countries have made use of Global Youth Tobacco Survey data, which collects uniform data from school-aged children across several countries. Ross (2004a) estimated cigarette demand equations for students in the Ukraine. Using a two-part model of cigarette demand, Ross estimated the price elasticities for smoking prevalence to be in the range of −0.29 to −0.51, with considerably higher estimates of smoking intensity ranging from −1.42 to −1.83. In addition, Ross (2004b) estimated the price elasticity of demand for students in Moscow, Russian Federation. The average estimated price elasticity of demand for tobacco among Moscow youth in this study was −1.15, an estimate well above those produced in the limited studies of the impact of price on adult smoking in the Russian Federation.

Recent work by Kostova *et al.* (2010) used data on 349 930 youths (average age 14 years) from 20 low- and middle-income countries taken from Global Youth Tobacco Surveys conducted between 1999 and 2006. They estimated a total price elasticity of −1.8 for cigarette and found that price is an important determinant of both smoking prevalence and smoking intensity, with estimated price elasticities of −0.63 and −1.2 respectively. Finally, Joseph (2010) estimated the impact of price on youth tobacco demand using data from 73 356 Indian youths aged 13–15 from the Global Youth Tobacco Survey conducted between 1999 and 2006. This study estimated a total price elasticity of demand for cigarettes of −0.4, with price influencing the decision to smoke more strongly than the intensity of smoking. Similar to studies from the USA, Joseph (2010) found that price had a greater impact on smoking prevalence among girls (−0.61) than among boys (−0.28).

Longitudinal studies

Lance *et al.* (2004) also estimated the price elasticity of demand for cigarettes in the Russian Federation; however, they found elasticity estimates smaller than those of Ross (2004b). They used three waves of longitudinal data on Russian men aged 13 and over from the Russian Longitudinal Monitoring Survey conducted between 1992 and 2000. Among young Russian men aged 13–19, the total price elasticity of demand was in the range of −0.35 and −0.20. In the same study, Lance and colleagues examined three waves of longitudinal household data on Chinese men aged 13 and over from the China Health and Nutrition Survey conducted in 1989, 1993 and 1997. Similarly, they found relatively small price effects for the sample of young Chinese men, with a total price elasticity estimate of −0.26, which becomes insignificant when including community fixed effects. Total elasticity estimates for age interactions show the same pattern across the Chinese and Russian samples: the elasticity falls and then rises with age. The authors suggested that higher elasticity estimates for the younger and older cohorts may reflect the effect of prices on initiation and cessation decisions.

To summarize, the small but growing number of studies from low- and middle-income countries is generally consistent with studies conducted in high-income countries—price has a negative impact on consumption among young people, and the young are more price-elastic than the population in general.

Smoking transitions among young people

Many researchers examining the influence of price on adolescent smoking prevalence believe that much of the effect of price reflects the impact of price on smoking initiation. Similarly, many researchers believe the effects of price on youth and adult smoking is dominated by the effect of price on smoking escalation and cessation. As discussed in the next two sections, several studies have attempted to directly quantify the effect of price on smoking initiation among youth (Table 6.2) and the impact of price on smoking escalation and cessation among young people (Tables 6.3, 6.4). The earliest of these studies on smoking transitions relied on cross-sectional data with retrospective information on smoking. Many of the more recent studies have used longitudinal data that tracks an individual's smoking behaviour and other determinants over time.

Smoking initiation
Cross-sectional studies

Douglas and Hariharan (1994) were among the first to model smoking initiation (see Table 6.2). They employed cross-sectional data from the 1978 and 1979 National Health Interview Survey: Smoking Supplement, and used a split population duration model to estimate the probability that an individual would start smoking. They concluded that increases in cigarette excise taxes had no influence on individuals' decisions to start smoking. In a follow-up paper, Douglas (1998) used one year of cross- sectional data, the 1987 National Health Interview Survey: Cancer Risk Factor Supplement, to investigate the determinants of the decisions to start and quit smoking in the context of an economic model of addiction. He estimated several alternative parametric duration models in his assessment of smoking initiation. Douglas concluded that current, future, and past prices of cigarettes had an insignificant effect on the probability of initiation. The effects of price on smoking cessation are discussed in detail in Chapter 5.

Forster and Jones (2001) used cross-sectional data to investigate the determinants of smoking initiation and cessation in the United Kingdom. In particular, Forster and Jones (2001), using data from the British Health and Lifestyle Survey, relied on retrospective information on cigarette smoking to approximate the length of time each individual smoked and abstained from smoking. They found cigarette taxes to be a statistically significant but relatively weak determinant of youth smoking initiation. The effects of tax on smoking cessation are discussed in detail in Chapter 5.

Table 6.2. Summary of studies on the effect of cigarette price on smoking initiation among young people

Publication (author, year)	Methods (location, time period; study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulation	Comments
High- income countries						
USA (Douglas and Hariharan, 1994)	1978/79; National Health Interview Survey: Smoking Supplement (*n* = 10 219). Price data from the Tobacco Institute (1992)	Split population duration model of the decision to start smoking, with 'failure' defined as the decision of a never smoker to start smoking	Price elasticity of age of smoking initiation (% change in the probability of ever smoking associated with a 1% change in price variable) Price elasticity of age of smoking initiation (% change in the age of starting smoking associated with a 1% change in price variable)	**Price 18** –0.014 (SE 0.229) **Price 15–18** 0.001 (SE 0.312) **Price 18** 0.009 (SE 0.028) **Price 15–18** 0.001 (SE 0.038)		Includes two price variables: 'Price 18' which is the log real cigarette price, when the respondent is age 18 and 'Price 18–15' which is the change in log real cigarette price between ages 15 and 18.
USA Douglas, 1998)	1987; National Health Interview Survey: Cancer Risk Factor Supplement (*n* = 8754)	Ordered probit split-sample duration model with lagged duration dependence and time-varying covariates (cigarette price and regulation)	Smoking initiation hazard elasticity (% change in the probability of starting smoking in a given time period, conditional on being a non-smoker until then, for each % change in price)	**Without controlling for state regulation** *Past price* 0 0.60 (SE 0.53) *Present price* –0.30 (SE 0.70) *Future price* –0.58 (SE 0.53)	**Controlling for state regulation** *Past price* 0.55 (SE 0.51) *Present price* –0.30 (SE 0.75) *Future price* –0.57 (SE 0.54)	Findings for the impact of price on starting hazard using the split population model are statistically insignificant.
USA (DeCicca *et al.*, 2000)	1988–1992; Data from 3 waves (1988, 1990 and 1992) of the National Education Longitudinal Survey (*n* = 10 893). Price data from the Tobacco Institute (1993)	Discrete time hazard model of smoking onset	Price elasticity of smoking initiation	**White Youth** 0.000053 **Hispanic Youth** –0.0086** **African-American Youth** –0.0059		** Statistically significant
USA (Tauras *et al.*, 2001)	1991–1993; Three cohorts of nationally representative longitudinal data on students in 8th, and 10th grades in 1991, 1992, 1993 with 2–3 waves for each cohort from the Monitoring the Future Survey. Price data from the Tobacco Institute	Discrete-time hazard model using weighted dichotomous probit equations to estimate the probability that an individual starts smoking in a given time period, conditional on being a non-smoker at the start of the time period.	Price elasticity of smoking initiation	**No State-fixed effects** *Any smoking* –0.271 *Smoking at least 1–5 cigarettes per day* –0.811* *Smoking at least ½ pack per day* –0.955*	**With State-fixed effects** *Any smoking* –0.111 *Smoking at least 1–5 cigarettes per day* –1.23* *Smoking at least ½ pack per day* –1.43*	* Significant at 1% level

Table 6.2. Summary of studies on the effect of cigarette price on smoking initiation among young people

Publication (author, year)	Methods (location, time period; study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulation	Comments
USA (DeCicca *et al.*, 2002)	1988–1994; panel micro data from the National Education Longitudinal Survey of 1988 which surveys eighth graders with follow-up 2 and 4 years later (*n* = 13 989)	Ordered probit model using cross-sectional data Discrete time hazard model using panel data Analyses controlled for socioeconomic status, school and parent characteristics, as well as three measures of smoking-related state legislation.	Price elasticity of smoking prevalence Price elasticity of smoking onset between 8th and 10th grade or 8th and 12th grade	**Cross-sectional results** *10th grade* –1.31 *12th grade* –0.72 *Onset between 8th and 10th grade* From –1.3 to –0.9 *Onset between 8th and 12th grade* From –0.72 to –0.46 (not statistically significant)		This study finds weak or non-existent tax effects in models of the onset of smoking between 8th and 12th grades, models of onset of heavy smoking between 8th and 12th grades, and discrete time hazard models that include state fixed effects.
USA (Glied, 2002)	1979–1994; representative microdata from the National Longitudinal Survey of Youth. Youth aged 14–23 in 1979 followed up annually (*n* = 2295). Price variable represents the mean price of cigarettes when the respondent was 14	Cross-sectional analysis	Tax elasticity of later smoking initiation	**1984 (age 19–28)** –0.74* **1992 (age 27–35)** 1.10 **1994 (age 29–37)** 1.34	**Women** *1984* –0.87 *1992* 1.55 *1994* 1.03 **Men** *1984* –1.22 *1992* 0.29 *1994* 1.23 **Low income** *1984* –1.35 *1992* 1.05 *1994* 1.75	* $P < 0.10$
USA (Cawley *et al.*, 2004)	1997–2000; four waves of the National Longitudinal Survey of Youth: nationally representative, longitudinal data on youths aged 12–16 as of the first wave (*n* = 9022). Price data from the Tobacco Institute	Discrete time duration method, using a probit specification to estimate the hazard rate	Price elasticity of smoking initiation	**Males** *Less stringent smoking initiation* –0.86 *More stringent smoking initiation* –1.49	Price was found to be an insignificant determinant of smoking initiation among females	Uses two measures of smoking initiation: less stringent, transition from non-smoker to any positive quantity of cigarettes, and more stringent, transition from non-smoker to frequent smoker defined as smoking at least 15 of last 30 days

Publication (author, year)	Methods (location, time period; study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulation	Comments
USA (Cawley *et al.*, 2006)	1988–2000; Children born to female respondents of the National Longitudinal Survey of Youth, 1979 Cohort	Simple latent variable model, controlling for smoke-free air laws, youth access laws, socioeconomic and demographic factors	Price elasticity of smoking initiation	**Males** –1.20	Price was found to be an insignificant determinant of smoking initiation among females	
USA (DeCicca *et al.*, 2008a)	1988–2000; Pooled data from four waves (1988, 1990, 1992 and 2000) of the National Education Longitudinal Survey (*n* = 37 937)	Discrete time hazard model, with a dependent variable representing the conditional probability of starting to smoke in a given period, assuming the individual was a non-smoker at the start of the period	Price elasticity of smoking initiation	**No State-fixed effects** –0.0015*** **State-fixed effects** –0.0005		*** Significant at 1% (two-tailed tests)
USA (DeCicca *et al.*, 2008b)	1988–2000; 1988, 1990, 1992 and 2000 waves of the National Education Longitudinal Study (*n* = 10 336) including youths aged 18–26 years.	Myopic addiction model using probit specifications, controlling for socioeconomic and demographic factors and anti-tobacco sentiment. Three models estimated: 1) using intrastate variation in cigarette excise taxes, 2) including a direct measure of anti-tobacco sentiment, and 3) using variation in state excise taxes faced by youths who moved state between study waves	Price elasticity of smoking initiation	**Model 1** –0.17* **Model 2** 0.08*	**Model 3** *Movers* 1.69 *Stayers* –0.7	* Statistically significant
United Kingdom (Forster and Jones, 2001)	1984; Cross-sectional data from the British Health and Lifestyle Survey; representative sample of adults 18+ years living in England, Scotland and Wales in 1984 with retrospective smoking data. (*n* = 9003)	Split-population duration model, using probit specification yields to model the likelihood of smoking initiation	Tax elasticity of the age of starting smoking	**Men** 0.164 **Women** 0.081		
Spain (López Nicolás, 2002)	1993, 1995, 1997; Pooled, nationally representative cross-sectional data from the Spanish National Health.	Hazard functions for duration to smoking initiation are estimated using a log logistic split population model	Price elasticity of time to smoking initiation (% change in time starting at the mean age of smoking initiation for	**Men** 0.069 (2.68) **Women** 0.076 (2.60)		Survival and hazard functions compared to those from a Kaplan–Meier estimate of the survival function and

Table 6.2. Summary of studies on the effect of cigarette price on smoking initiation among young people

Publication (author, year)	Methods (location, time period; study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulation	Comments
Spain (López Nicolás, 2002) (contd)	Survey with retrospective information on smoking. Price data from National Statistics Office		each% change in price)			a standard log logistic function. Results from preferred specification presented here. t-statistics in parentheses
France (Peretti-Watel, 2005)	1999; Cross-sectional nationally representative data for individuals aged 12–75 from the French Health Barometer Survey with retrospective smoking data (*n* = 13 685)	Using a life course perspective, examined smoking cessation by distinguishing 6 cohorts of individuals: Born 1969–1978, 1959–1968, 1949–1958. Each cohort experienced a different pattern of price changes during the critical period just preceding and proceeding regular smoking initiation.	Life course smoking prevalence and cessation by cohort	Cigarette price has had no or little impact on regular smoking initiation in France.		Life course perspective cannot separate the effects of price from other factors that vary across cohorts (tobacco control policy, cultural trends, etc.)
Canada (Auld, 2005)	1994; nationally representative data from the Youth Smoking Survey on youths aged 15–19 (*n* = 9139). Province-specific tobacco product price indexes deflated by CPI as reported by Statistics Canada were used.	Maximum likelihood estimation controlling for year of birth, self-reported health status, education, employment, social interactions and perceived non-pecuniary costs of smoking	Point elasticity of smoking prevalence with respect to contemporaneous prices changes	**Early initiation** –1.268 (SE 0.633) **Prevalence in late adolescence if early initiator** 0.012 (SE 0.031) **Prevalence in late adolescence if not early initiator** –0.615 (SE 0.100)		Early initiation, defined as respondents who had smoked one whole cigarette every day for seven consecutive days and were 14 or younger when they started such smoking behaviour. The sample includes youths who have dropped out of school
Canada (Zhang *et al.*, 2006)	1994 to 1997; longitudinal data from Statistics Canada's National Population Health Survey for young adults aged 20–24 who were non-smokers at baseline (*n* = 636)	Multivariate logistic regression analysis using bootstrap weights controlling for sociodemographic and tobacco control variables	Price elasticity of smoking initiation	3.36 (95% CI: 0.07 to 6.75)		This study examines the impact of decreasing taxes. Elasticity estimate should be interpreted as the change in the probability of initiating smoking associated with a 1% decrease in cigarette tax
Canada (Sen and Wirjanto, 2010)	1992 to 1996; longitudinal data from the Waterloo Smoking Prevention Project	Probit and OLS estimation controlling for gender and employing province and year effects	Tax elasticity of smoking initiation and persistence	–0.20 to –0.50		

Publication (author, year)	Methods (location, time period; study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulation	Comments
Canada (Sen and Wirjanto, 2010) (contd)	(WSPP) on students in grades 8–12 (n = 591)					
Australia (Kidd and Hopkins, 2004)	1990; Cross-sectional data from the National Health Survey 1990 and 1998 aged 27–37 (n = 9402) with retrospective data on smoking. Price data from the Australian Bureau of Statistics	Split population hazard models	Price elasticity of smoking initiation	**27–37 years** *Men* 0.16** *Women* 0.12*	**18–26 years** *Men* 0.11 *Women* 0.14*	**$P < 0.05$ *$P < 0.10$ Price appears to be a significant determinat of smoking for 27–37 year olds in 1990; however, sensitivity analysis across age groups and data source raise question of the robustness of these findings
Low- and middle-income countries						
Viet Nam (Laxminarayan and Deolalikar, 2004)	1992–93 and 1997–98; data on 4300 households and 17 780 individuals aged 15 and older from two waves of the Viet Nam Living Standards Survey. Price data from commune-level surveys	Multinomial logit model to estimate the effect of both individual attributes and choice attributes (related to cigarettes and rustic tobacco) on the decisions of individuals to initiate use	Price elasticity of smoking initiation	**Cigarettes** –1.175* **Rustic tobacco** –1.558		While the price elasticity of initiation is estimated for the entire population in the survey, much of the initiation is likely to have occurred among relatively young individuals. Estimates suggest tat cigarettes and rustic tobacco are economic substitutes, but estimates are not statistically significant. *$P < 0.05$

Several more recent studies from high-income countries have used retrospective data on smoking collected in nationally representative surveys of adults to look at the impact of prices on smoking initiation. In particular, studies have been conducted in Australia (Kidd & Hopkins, 2004), France (Grignon & Pierrard, 2002; Peretti-Watel, 2005), Spain (López-Nicolás, 2002), and Germany (Göhlmann, 2007). These studies produced mixed findings on the effects of price on initiation, while generally finding that higher taxes and prices significantly increase the likelihood that adult smokers quit (see Chapter 5 for discussion of cessation results). In addition to the aforementioned measurement error problems that are inherent in using retrospective data to look at smoking transitions, the lack of variation in price over time in many of these countries adds an additional challenge to estimating price effects.

Lastly, Madden (2007) used cross-sectional data from the Saffron Survey, with retrospective information on Irish women, to examine the effects of cigarette taxes on smoking initiation and cessation. With regard to smoking initiation, Madden (2007) found that an inverse relationship exists between cigarette taxes and smoking initiation, with the strongest effect of taxation on Irish women with intermediate levels of education, and weaker tax effects for those with the least education.

Previous studies on smoking transitions have made significant contributions to the literature by modelling the decisions to start and quit smoking; however, these cross-sectional studies are subject to at least two potential measurement errors. First, the use of retrospective information on smoking is likely to suffer from errors in recall about the age at which individuals began and quit smoking. Given that it is a more recent outcome, the recall bias should be smaller when looking at cessation than initiation. Indeed, most of the aforementioned studies find evidence that higher cigarette prices significantly increase the probability of smoking cessation (and consequently reduce the duration of smoking). Second, studies that rely on cross-sectional data likely suffer from a price-matching problem. The smoking transition studies discussed above are based on previous prices/taxes that an individual would have paid for cigarettes in the individual's current location of residence. If an individual lived in a different location in the past, that individual would have been matched with the incorrect cigarette price/tax. Moreover, a price-matching problem will exist if there is imperfect recall on the timing of initiation or cessation. That is, the assumed prices at the time of initiation and cessation will be incorrect due to imperfect recall. The measurement errors in both the dependent and independent variables will bias estimates of the effect of prices on the smoking transitions towards zero.

Smoking initiation

Longitudinal studies

Several recent econometric studies have employed longitudinal data to examine the impact of economic factors such as prices and taxes on smoking initiation and uptake. In general, these studies do not suffer from the cross-sectional limitations discussed above.

In a series of papers, DeCicca and colleagues (2000; 2008a; 2008b) investigated the influence of price and tax on smoking initiation among adolescents and young adults. Initially, DeCicca and colleagues (2000) examined the determinants of smoking initiation by individuals of different race and ethnicities using data extracted from the 1988, 1990 and 1992 National Educational Longitudinal Survey (NELS). After controlling for state and year fixed effects, they found price to have a dramatic negative impact on smoking initiation decisions among Hispanics and African Americans, while having no influence on smoking initiation decisions among Whites. The authors estimate that a price increase of $1.50 would decrease smoking initiation rates by Hispanics and African Americans to approximately 1%. However, the authors caution that the African Americans prediction is based on an insignificant price coefficient estimate. These estimates should be viewed with caution because the use of state fixed effects relies on within-state variation in price over time. During the short time period under investigation, there may be insufficient within state variation in the price variable.

DeCicca *et al.* (2008a) used data from the 1988, 1990, 1992 and 2000 waves of the NELS to examine the influence of cigarette prices on smoking initiation decisions among adolescents and young adults. The authors found price to have a strong and significant negative influence on smoking initiation when state fixed effects were omitted from the model. However, when state fixed effects were included in the regressions, the price effects failed to reach significance at conventional levels. They concluded that unobserved state-level heterogeneity (possibly anti-smoking sentiment), not price, was driving young people's smoking initiation decisions. Further, DeCicca *et al.* (2008b) used data from the 1992 and 2000 waves of the NELS to examine the influence of cigarette excise taxes on smoking initiation of young adults (individuals who start smoking between the ages of 18 and 26). They used three identification strategies in their equations. First, they used intra-state variation in cigarette excise taxes to identify the impact of price on smoking initiation. Second, they included the direct measure of anti-smoking sentiment developed by DeCicca *et al.* (2008a) in their smoking initiation equations. Finally, they used variation in cigarette taxes faced by young adults who moved across state lines between 1992 and 2000 versus young adults who remained in the same state in these two years. Cigarette taxes were found to have a significant negative impact on young adult smoking initiation using identification strategy 3 for only those who remained in the same state in both years. Given this, the authors concluded that cigarette prices have little impact on smoking initiation. These results should be viewed with some caution. First, the study was conducted on a sample of individuals who initiate smoking later in life (non-smokers in high school but smokers by modal age 26). In the United States, most adult ever-smokers initiate smoking well before the age range investigated by DeCicca and colleagues (2008b), and the smoking initiation decisions of an older cohort may be quite different than those of younger cohorts. Second, anti-smoking sentiment may be an endogenous variable being simultaneously determined with smoking. Moreover, in the models that rely solely on intrastate variation in taxes, the authors found only weak evidence of a negative effect of taxes on smoking prevalence (i.e. price effect fails to reach 5% significance levels of a two-tailed test).

Among the first studies to examine the impact of price on youth smoking initiation using longitudinal data was that of Tauras and colleagues (2001). They employed data from three cohorts of students enrolled in 8th and 10th grade in 1991, 1992 and 1993 as part of the longitudinal component of the Monitoring the Future project. The authors examined three measures of smoking initiation based on alternative smoking thresholds. The measures of initiation included the transitions from not smoking any cigarettes in the immediate previous wave of data to: smoking any positive amount in the current wave; daily smoking, defined as smoking at least 1–5 cigarettes per day on average in the current wave; and heavy daily smoking, defined as smoking at least a half a pack per day on average in the current wave. After controlling for youth access laws and region fixed effects, the authors found that the average price elasticity of initiation based on any smoking, at least 1–5 cigarettes per day on average, and at least ½ pack per day on average were –0.27, −0.81, and –0.96, respectively. These estimates imply that youth smoking initiation is indeed responsive to changes in cigarette prices, with the price response being positively related to higher thresholds of smoking initiation.

Cawley and colleagues (2004) used more recent data to investigate the determinants of youth smoking initiation in the United States. In particular, they employed the first four waves (1997–2000) of the National Longitudinal Survey of Youth 1997 Cohort (NLSY97). In their analysis, the authors employed two alternative measures of smoking initiation. The first measure indicates a transition from not smoking in the immediate previous wave of data to smoking any positive quantity of cigarettes in the current wave of data (termed “less stringent initiation”). The second measure (termed “more stringent initiation”), reflects the transition from not smoking in the immediate previous wave of data to being a frequent smoker in the current wave of data, as measured by having smoked at least 15 days of the past 30 days. Given the notion that some youth, particularly girls, may use cigarette smoking as a weight suppressant, which might make their smoking behaviour less responsive to prices and tobacco control policies, they estimated separate models for adolescent boys and girls. While controlling for smoke-free air laws, youth access laws, and anti-smoking sentiment by a dichotomous indicator for tobacco-producing state residence, the authors concluded that male adolescent smoking initiation was very responsive to changes in cigarette prices, with the average price elasticity of less stringent smoking initiation estimated to be −0.86 and the average price elasticity of more stringent smoking initiation estimated to be −1.49. Female smoking initiation was found not to be significantly related to cigarette prices, but was found to be very responsive to weight concerns.

A follow-up paper on youth smoking initiation by Cawley and colleagues (2006) found very similar findings to Cawley *et al.* (2004) despite using a longitudinal data set that spans a much larger time period. Specifically, the authors used data from the 1988–2000 Children of the National Longitudinal Survey of Youth, 1979 Cohort (CoNLSY). After controlling for smoke-free air laws and youth access laws, cigarette prices were found to have a negative impact on smoking initiation in all models that were estimated; however, the price coefficients were significantly different from zero in only the male equations. The price elasticity of male smoking initiation based on any cigarettes consumed was estimated to be −1.20. The findings from Cawley and colleagues suggest that the gender-specific differences in the impact of price on initiation may account for the mixed findings in the effects of price on smoking initiation contained in some of the previous studies.

Zhang *et al.* (2006) explored the effect of decreasing prices on young adult smoking initiation. They used longitudinal data from Canada's National Population Health Survey from 1994 to 1997 to examine the impact of decreased cigarette prices, resulting from tobacco tax reductions, on smoking initiation among young adults in Canada. After controlling for smoke-free air laws, tobacco control expenditures, and socioeconomic and demographic factors, the authors found that lower cigarette prices were significantly associated with a higher likelihood of initiating smoking. Specifically, the authors found that the price elasticity of initiation was -3.36, suggesting that a 1% decrease in price, increases smoking initiation among young adults by 3.36% in Canada.

In another study examining the impact of decreasing prices in Canada, Sen and Wirjanto (2010) used longitudinal data from the Waterloo Smoking Presentation Project to explain the impact of a large reduction in cigarette excise taxes in Canada on adolescent smoking initiation decisions. The authors found the tax decrease to have a significant impact on youth smoking initiation in multivariate regression. In particular, the tax elasticity of smoking initiation based on any cigarettes smoked in the 30 days before the survey was −0.5, and the tax elasticity of smoking initiation based on daily smoking in the 30 days before the survey was −0.2. In addition, they estimated the tax elasticity of smoking prevalence using various data sources, and found tax elasticities ranging from −0.10 to −0.14.

Smoking uptake
Cross-sectional studies

Emery *et al.* (2001) used data from the 1993 Teenage Attitudes and Practices Survey to look at the differential impact of price on experimentation with cigarettes (defined as having ever smoked or tried a cigarette, but not having smoked at least 100 cigarettes in their lifetime) and current smoking (defined by smoking in the past 30 days) and established smoking (smoking in the past 30 days and had smoked at least 100 cigarettes in their lifetime) among 10- through 13-year-olds and 14- through 22-year-olds. They found that price did not have a statistically significant impact on experimentation in either age group. Price was found to have a significant effect on the likelihood of being a current smoker, with an elasticity of −0.83, and the likelihood of being an established smoker, with an elasticity −1.56. Also, price was found to have a significant effect on cigarette consumption among current and established smokers, with elasticities of −0.87 and −0.68, respectively (Table 6.3).

Using the survey entitled The Study of Smoking and Tobacco Use Among Young People conducted in 1996, Ross and her colleagues (2006) applied a generalized ordered logit model to examine the differential impact of price and tobacco control policies on the five stages of smoking uptake ranging from a low-risk cognition non-smoker, defined as individuals who have neither experimented with smoking nor smoked a whole cigarette and definitely will not smoke next year and will not smoke a cigarette offered to them by a friend, to an established smoker, defined as individuals who have consumed more than 100 cigarettes in their lifetime. They found price to have a significant impact on progression from each stage to the next, and consistent with Liang and Chaloupka (2002), they found price to have a greater impact on the likelihood of progressing to later stages of uptake. The authors suggest that the greater impact of price on later stages of smoking uptake reflects the changes in young smokers' sources for cigarettes as they progress to higher intensities of smoking. Specifically, smokers at earlier stages of uptake smoke relatively few cigarettes and are more likely to rely on social sources for these cigarettes. As they progress to more regular smoking, they begin to buy their own cigarettes and are more directly influenced by prices.

Finally, Slater *et al.* (2007) combined data on cigarette prices and point-of-sale cigarette marketing collected around schools that participated in the 1999 through 2003 Monitoring the Future surveys to examine the effects of prices, price-related promotions, and advertising on youth smoking uptake. Using a generalized ordered logit equation, Slater and colleagues found that price had its greatest impact on later stages of smoking uptake, a finding consistent with previous studies. In addition, they found that point-of-sale promotions related to price (e.g. multipack discounts and other retail value added promotions) had little effect on early stages of uptake, but were strongly associated with later stages beyond experimentation.

Table 6.3. Summary of studies providing data on the effects of price on youth smoking uptake

Publication (author, year)	Methods (location, time period; study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulations	Comment
High-income countries						
USA (Emery *et al*., 2001)	1993; Nationally representative data for youths aged 10–22 from the second wave of the longitudinal teenage attitudes and practices survey (n = 12 952). Price data from the Tobacco Institute.	Two-part model of cigarette demand. Smoking intensity is modelled separately for current smokers (smoked in last 30 days) and established smokers (smoked in last 30 days and at least 100 cigarettes in lifetime)	Price elasticity of smoking prevalence		**Experimenters 10 – 13 years and 14+ years** non-significant	
USA (Liang and Chaloupka, 2002)	1992–1994; Monitoring the Future Surveys (n = 110 717), nationally representative data on 8th-, 10th- and 12th-grade students (aged 13–18)	Threshold of Change model (generalized version of the ordered logit model), controlled for state level smoke-free air laws, youth access restrictions, price differentials within 25 miles and socioeconomic and demographic variables.	Price elasticity of smoking uptake (the probability of progressing to a higher intensity of smoking based on a % increase in the price of cigarettes (95% CI)	**Equal effect odds ratio** *Medium price* 1.060 (1.017, 1.105)** *High Price* 1.146 (1.091, 1.204)	**Varying effects odds ratio** *Medium Price* Threshold 1 1.057 (1.014, 1.102)** Threshold 2 1.051 (1.001, 1.104)* Threshold 3 1.094 (1.027, 1.165)** Threshold 4 1.128 (1.035, 1.229)** *High Price* Threshold 1 1.132 (1.077, 1.188)*** Threshold 2 1.190 (1.124, 1.260)*** Threshold 3 1.255 (1.169, 1.348)*** Threshold 4 1.307 (1.186, 1.439)***	Categories of smoking intensity: no consumption, less than daily smoking, light daily smoking (1–5 cigarettes/day), moderate daily consumption (10 cigarettes per day), and heavy consumption defined as 20 or more per day). Price categories: high, medium and low. *P < 0.1, **P < 0.01, ***P < 0.001
USA (Tauras, 2005)	1976–1993; Nationally representative data on 8th-, 10th- and 12th-grade students (13–18 years) contained in baseline surveys from the 1976–1993 components of the Monitoring the Future Survey, with follow up through 1995.	Discrete time duration method, using a probit specification to estimate the hazard rate of progressing to a higher smoking intensity. Analyses controlled for socioeconomic and demographic factors as well as anti-smoking sentiment	Price elasticity of smoking uptake	**Daily uptake** –0.646 **Moderate uptake** –0.576 **Heavy uptake** –0.412		Three measures of smoking progression: 1) daily uptake, 2) moderate uptake (transition from light smoking 1–5 cigarettes/day to 10 or more cigarettes/day, 3) Heavy uptake (from moderate smoking to 1+ packs/day.

Table 6.3. Summary of studies providing data on the effects of price on youth smoking uptake

Publication (author, year)	Methods (location, time period; study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulations	Comment
USA (Ross *et al.*, 2006)	1996; Cross-sectional data from students in grades 9–12 attending 202 US high schools in 1996 from 'The Study of Smoking and Tobacco Use Among Young People' (n = 17 287). State cigarette prices from the Tobacco Institute and an average school price calculated using self-reported price were used.	Generalized ordered logit model	Regression coefficients reflecting the effect of price on probability of progressing to higher stages of smoking uptake, corrected for within-cluster dependence (Standard errors)	**State average price** *Stage 2,3,4, or 5* –0.383** (0.143) *Stage 3,4, or 5* –0.387** (0.137) *Stage 4 or 5* –0.400** (0.138) *Stage 5* –0.478** (0.183) **Average perceived price** *Stage 2,3,4, or 5* –0.336** (0.106) *Stage 3,4, or 5* –0.354** (0.100) *Stage 4 or 5* –0.367** (0.107) *Stage 5* –0.457** (0.162)		** $P < 0.05$, based on two-tailed test
USA (Slater *et al.*, 2007)	1999–2003; Annual, nationally representative cross-sectional data on 26 301 8th-, 10th- and 12th-graders, aged 14, 16 and 18 respectively. Price data calculated as the average price of a premium brand collected through a retail audit of community tobacco vendors	Generalized ordered logit analyses with weighted data that controlled for demographic and socioeconomic factors, state level tobacco control policies, and year, and accounted for clustering at the community level	Price elasticity of smoking uptake, reflecting the probability that an adolescent will move on to the next level of smoking for every dollar increase (95% confidence intervals)	**Threshold 1** 0.87 (0.74–1.02) **Threshold 2** 0.76 (0.64–0.89)** **Threshold 3** 0.77 (0.65–0.92)* **Threshold 4** 0.81 (0.67–0.98)* **Threshold 5** 0.79 (0.63–0.98)*		** $P < 0.001$ * $P < 0.05$

Smoking uptake
Longitudinal studies

One study used longitudinal data to examine smoking transitions other than initiation or cessation. Tauras (2005) examined the impact of cigarette prices on smoking uptake transitions among youth and young adults in the United States. He examined the transition from non-daily to daily smoking and the transitions from light smoking intensity (defined as 1–5 cigarettes per day) and moderate smoking intensity (defined as smoking 10 cigarettes per day on average) to higher intensities of smoking. Tauras (2005) employed baseline surveys from the 1976 through 1993 Monitoring the Future Surveys with follow-up surveys on individuals through 1995 in the analyses. He controlled for anti-smoking sentiment using a variety of techniques: including separate indicators for whether or not the individual resided in a tobacco-producing state or resided in Utah, where there is a large Mormon population whose religious beliefs ban tobacco use; including census division fixed effects to capture division differences in smoking sentiment; and estimating the smoking progression equations on a subsample of the respondents who did not reside in either a tobacco-producing state or the state of Utah during the time that the surveys were being conducted. Tauras (2005) found cigarette prices to have a strong negative impact on all the smoking transitions that were estimated. In particular, the estimated mean price elasticities of daily uptake, moderate uptake and heavy uptake were –0.65, –0.58 and –0.41, respectively. These findings indicate that increases in cigarette prices will prevent many young adults from progressing into higher intensities of smoking.

To summarize, studies that rely on cross-sectional data and retrospective information on smoking find mixed results for the effects of price on smoking initiation, likely due to measurement error in the timing of initiation and in the price measure. Studies that rely on longitudinal data and do not suffer from cross-sectional limitations generally find that price has a negative and significant impact on youth smoking initiation. Finally, higher cigarette prices have been found to decrease the probability of transitioning into higher intensities of smoking. Evidence suggests that price has greater impact at later stages of the uptake process than at the experimentation stage.

Smoking cessation
Cross-sectional studies

Using an experimental framework, Ross and colleagues (2005) examined the expected smoking reaction to a future price increase among smokers in high school in the USA. The authors used cross-sectional data collected in 1996 for the project The Study of Smoking and Tobacco Use Among Young People that contained information on individual's current smoking status and expected smoking behaviour after hypothetical changes in cigarette price. Four different price changes were examined including an increase by US$0.50, by US$1, by US$2, and by US$4. After controlling for smoke-free air laws and youth access laws, the authors found hypothetical increases in cigarette prices to have a strong positive impact on youth smoking cessation decisions. In particular, the estimated price elasticity of cessation ranged from 0.895 to 0.930 (Table 6.4).

Tworek and colleagues (2010) used cross-sectional data from the 1991–2006 Monitoring the Future Surveys to examine smoking cessation behaviours among 8th-, 10th- and 12th-grade regular smokers. After controlling for demographic characteristics, smoke-free air laws, and youth access laws, the authors found increases in cigarette price to be positively associated with smoking cessation behaviours. In particular, the authors calculated that a $1 per pack increase in the price of cigarettes increases: the odds of wanting to quit smoking by 30%; the odds of an ever-regular smoker not smoking in the past 30 days by 20%; the odds of a high school ever-regular smoker who has made at least one quit attempt, not smoking in the past 30 days by 30%.

Smoking cessation
Longitudinal studies

A few studies have used longitudinal data to examine the impact of price on adolescent and young adults' decisions to quit smoking. Tauras and Chaloupka (2001) were the first to model smoking cessation decisions using longitudinal data. In particular, the authors used data extracted from the 1976–1993 cohorts of the Monitoring the Future project with follow-up surveys through 1995. The authors used a semi-parametric Cox regression to assess the probability that smokers would make a transition from smoking in the previous wave of data to non-smoking in the current wave. After controlling for smoke-free air laws, region of residence, socioeconomic and demographic characteristics, the authors concluded that the likelihood of making a smoking cessation attempt among both men and women increased significantly as cigarette prices rose.

Table 6.4. Summary of studies on the effect of cigarette price on smoking cessation among young adults

Publication (author, year)	Methods (location, time period, study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulations	Comments
High income countries						
USA (Douglas, 1998)	1987; National Health Interview Survey: Cancer Risk Factor Supplement (n = 8754)	Ordered probit split-sample duration model with lagged duration dependence and time-varying covariates (cigarette price and regulation)	Smoking cessation hazard elasticity (% change in the probability of quitting smoking in a given time period, conditional on being a smoker at the start of the time period, for each% change in price)	**Without controlling for state regulation** *Past price* –0.07 (SE 0.52) *Present price* –1.05 (SE 0.82) *Future price* 1.31 (SE 0.51)**	**Controlling for state regulation** *Past price* 0.08 (SE 0.51) *Present price* –0.98 (SE 0.81) *Future price* 1.07 (SE 0.52)*	* $P < 0.10$ ** $P < 0.01$
USA (Tauras and Chaloupka, 2001)	1975–1995; Panels formed from the nationally representative cross-sectional surveys of 8th-, 10th- and 12th-grade students from the Monitoring the Future Surveys	Semi-parametric Cox duration models to estimate the probability that smokers would make a transition from smoking in the previous wave to non-smoking in the current wave. Analyses controlled for socioeconomic and demographic factors, year effects, clean air laws and youth access restrictions	Price elasticity of smoking cessation	**Females** 0.24* to 1.00* **Males** –0.10 to 1.30	**Females** *Smokers at 18* 0.57* *Smokers at 23* 0.82* *Smoke at least 1 cigarette in 30 days* 0.51* *Smoke at least 1–5 cigarettes/day* 0.88* **Males** *Smokers at 18* Not significant *Smokers at 23* 1.06* *Younger smokers who have smoked any cigarettes in 30 days* Not significant *Younger smokers who smoke 1–5 cigarettes per day* Not significant *Older smokers who have smoked any cigarettes in 30 days* 0.89* *Older smokers who smoke at least 1–5 cigarettes per day* 1.23*	* Statistically significant

Publication (author, year)	Methods (location, time period, study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulations	Comments
USA (Glied, 2002)	1979–1994; representative microdata from the National Longitudinal Survey of Youth. Youth aged 14–23 in 1979 followed up annually (n = 5823). Price variable represents the mean price of cigarettes when the respondent was 14	Cross-sectional analysis controlled for race, sex, age, marital status in year of interview, grade of school completed by interview, AFQT score. Includes only those who reported smoking in 1984 or earlier	Tax elasticity of smoking cessation: effect of taxes at age 14 on quitting by follow up in 1992 or 1994	**1992–94** 0.16	**Women** 0.02 **Men** 0.19 **Low income** –0.04 **Those who moved State since age 14** 0.17	
USA (Tauras, 2004)	1975–1995; Panels formed from the nationally representative cross-sectional surveys of 8th-, 10th- and 12th-grade students from the Monitoring the Future Surveys	Semi-parametric Cox duration models to estimate the probability that smokers would make a transition from smoking in the previous wave to non-smoking in the current wave. Models allow for the possibility of multiple quit attempts. Analyses controlled for socioeconomic and demographic factors, year effects, clean air laws and youth access restrictions	Price elasticity of smoking cessation	Range 0.269 to 0.466 Average 0.350		
USA (Ross *et al.*, 2005)	1996; cross-sectional data collected for The Study of Smoking and Tobacco Use Among Young People containing information on smoking status and expected behaviour after a hypothetical change in cigarette price	Probit regression model to estimate an equation for the probability of future smoking cessation among current smokers as a function of future cigarette prices. Analyses controlled for socioeconomic and demographic factors	Price elasticity of smoking cessation	**Model using average future perceived price** 0.90 **Model using average future state price** 0.93		
USA (DeCicca *et al.*, 2008b)	1988–2000; 1988, 1992 and 2000 waves of the National Education Longitudinal Study (n = 10 706) including youths aged 18–26 years.	Myopic addiction model using probit specifications, controlling for socioeconomic and demographic factors and anti-tobacco sentiment.	Price elasticity of smoking cessation	**Model 1** 0.93* **Model 2** 0.47	**Model 3** *Movers* 1.49 *Stayers* 0.82	* Statistically significant

Table 6.4. Summary of studies on the effect of cigarette price on smoking cessation among young adults

Publication (author, year)	Methods (location, time period, study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulations	Comments
USA (DeCicca *et al.*, 2008b) (contd)		Three models estimated: 1) using intrastate variation in cigarette excise taxes, 2) including a direct measure of anti-tobacco sentiment, and 3) using variation in state excise taxes faced by youths who moved state between study waves				
USA (Franz, 2008)	Method 1993–2000; Nationally representative cross-sectional data for adults 18+ years from the Behaviour Risk Factor Surveillance System Survey (n = 1 million)	Model Two models were considered: 1) a simple OLS and 2) a two-part model. Analyses controlled for socioeconomic and demographic factors. Price was the state average real cigarette price	Price elasticity of smoking cessation	**Overall** 0.375 **18–29 years** 0.493 **30–39 years** 0.424 **40–64 years** –0.398 **65+ years** 0.202		
USA (Tworek *et al.*, 2010)	1991–2006; nationally representative cross-sectional surveys of 8th-, 10th- and 12th-grade students from the Monitoring the Future Surveys (n = 12 073 to 78 584 depending on outcome variable)	Hierarchical generalized linear modeling controlling for student characteristics (age, gender, race/ethnicity, parental education, total income and work status) and state policies and year effects	Price elasticity of wanting to quit Price elasticity of any quit attempt Price elasticity of non-continuation of smoking Price elasticity of discontinuation of smoking	1.003 (CI: 1.001 – 1.005)* 1.001 (CI: 1.000 – 1.003) 1.002 (CI: 1.001 – 1.003)** 1.003 (CI: 1.000 – 1.005)*		* $P < 0.05$ ** $P < 0.01$ Non-continuation of smoking is defined as ever-regular smokers who have not smoked in the past 30 days Discontinuation of smoking was defined as ever-regular smokers who have made at least one quit attempt and who have not smoked in the past 30 days
United Kingdom (Forster and Jones, 2001)	1984; Cross-sectional data from the British Health and Lifestyle Survey; representative sample of adults 18+ years living in England, Scotland and Wales in 1984 with retrospective smoking data (n = 9003)	Split-population duration model, using probit specification yields to model the likelihood of smoking initiation	Tax elasticity of quitting smoking	**Men** –0.60 **Women** –0.46		

Publication (author, year)	Methods (location, time period, study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulations	Comments
Spain (López Nicolás, 2002)	1993, 1995, 1997; Pooled, nationally representative cross-sectional data from the Spanish National Health Survey with retrospective information on smoking. Price data from National Statistics Office	Hazard functions for duration to smoking cessation are estimated using a log logistic split population model	Price elasticity of smoking duration (% change in the duration to smoking cessation for each % change in price)	**Men** –1.32 (t-value –2.23) **Women** –1.50 (t-value –2.11)		Estimates compared with those from the Cox proportional hazard model and the Gamma model; estimates from the preferred specification presented here.
Poland (Ross & Prezwozniak, 2004)	1999; cross-sectional data on school-aged children from the Global Youth Tobacco Survey examining the reported reaction to price increases	Descriptive analysis	Percentage of respondents reporting reaction (95% confidence interval)	**Demand reduced/ altered** 55.8 (± 3.9) **Successfully quit** 26.0 (± 3.8) **Attempted to quit** 10.2 (± 2.2) **Smoked fewer cigarettes** 15.0 (± 2.8) **Smoked cheaper cigarettes** 4.8 (± 1.7) **Consider quitting** 20.4 (± 3.4) **No reaction** 23.6 (± 3.7)	**Demand reduced/ altered** *Urban* 47.9 (± 5.3) *Rural* 66.9 (± 5.1) *Women* 51.6 (± 5.9) *Men* 59.6 (± 5.7) **Successfully quit** *Urban* 16.8 (± 4.5) *Rural* 38.8 (± 5.8) *Women* 27.7 (± 6.3) *Men* 24.6 (± 5.1) **Attempted to quit** *Urban* 9.5 (± 2.9) *Rural* 11.3 (± 3.4) *Women* 8.2 (± 2.7) *Men* 12.0 (± 3.3) **Smoke fewer cigarettes** *Urban* 16.8 (± 3.6) *Rural* 12.4 (± 4.1) *Women* 13.6 (± 3.1) *Men* 16.2 (± 4.1)	

Table 6.4. Summary of studies on the effect of cigarette price on smoking cessation among young adults

Publication (author, year)	Methods (location, time period, study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulations	Comments
Poland (Ross & Prezwozniak, 2004) (contd)					**Smoke cheaper cigarettes** *Urban* 4.6 (± 2.0) *Rural* 5.1 (± 3.1) *Women* 2.2 (± 1.7) *Men* 6.9 (± 2.7) **Consider quitting** *Urban* 21.3 (± 3.4) *Rural* 19.2 (± 5.5) *Women* 20.2 (± 4.7) *Men* 20.6 (± 4.4) **No impact** *Urban* 31.0 (± 5.6) *Rural* 13.2 (± 3.6) *Women* 19.8 (± 4.3) *Men* 28.2 (± 5.3)	
France (Peretti-Watel, 2005)	1999; Cross-sectional data nationally representative data for individuals aged 12–75 from the French Health Barometer Survey with retrospective smoking data (n = 13 685)	Discrete time hazard model of smoking cessation, using logistic regression with time constant variables including gender, education and age of initiation and time variant variables including age, parenthood and price	Price elasticity of smoking cessation (the probability of quitting smoking for each% increase in price)	**Aged 21–50** *Men* 1.007 $P < 0.001$ *Women* 1.009 $P < 0.001$	**Men and Women** *Cessation at age 20 or before* 1.005 $P = 0.174$ *Cessation between 21 and 30 years* 1.017 $P < 0.001$ *Cessation after age 30* 1.011 $P < 0.001$	

The estimated price elasticity of smoking cessation ranged from 0.34 and 1.00 for women and between −0.10 and 1.30 for men, implying that a 10-percent increase in cigarette price raises the probability of making a cessation attempt by up to ten percent.

Tauras (2004) expanded on the original study to look at longer-term cessation effects related to price. Once again using the aforementioned longitudinal component of the Monitoring the Future surveys, he employed a stratified Cox regression to model multiple quit attempts among young adults. After controlling for smoke-free air laws, US Census division indicators (i.e. indicators for the region of the country where the respondent resided), socioeconomic and demographic characteristics, he found a positive and significant effect of cigarette prices on smoking cessation, confirming the earlier findings. He concluded that a 10% increase in the price of cigarettes increases successful cessation by young adults by approximately 3.5%.

DeCicca *et al.* (2008b) used data from the 1992 and 2000 waves of the NELS to examine the influence of cigarette excise taxes on smoking cessation decisions of young adults in the USA. When they used intra-state variation in cigarette excise taxes to identify the impact of tax on smoking cessation, they found young adults to be very responsive to changes in cigarette excise taxes. The estimated price elasticity of cessation in this model was 0.93. In an alternate specification, they included the direct measure of anti-smoking sentiment, discussed above, and estimated the price elasticity of cessation to be 0.47, but this estimate was based on an insignificant parameter estimate for price. Finally, the authors used variation in cigarette taxes faced by young adults who moved across state lines between 1992 and 2000 versus those young adults who remained in the same state in these two years. In this specification, cigarette taxes were found to have a positive impact on young adult smoking cessation for only those who moved to a different state between 1992 and 2000. The price elasticity of cessation among movers was relatively large (1.49), and the authors concluded that despite the lack of significance on price in this specification (due most likely to the small sample size, n = 321), price is likely to play a strong role in the smoking cessation decisions of young adults.

Smoking cessation
Evidence from low- and middle-income countries

Only one study examining the impact of price on smoking cessation in a low- or middle-income country context was identified. While data to calculate direct or indirect price elasticity of demand was unavailable, Ross and Prezwozniak (2004) used data from the first Global Youth Tobacco Surveys on school-aged children in Poland to examine the reported response of youths to a tobacco price increase. They found that 56% of respondents reported changing their smoking behaviour in response to a price change through successfully quitting (26.0%), attempting to quit (10.2%), reducing their consumption (15.0%) or smoking cheaper cigarettes (4.8%). These data clearly indicate that higher real cigarette prices can reduce cigarette demand among teenage students in Poland.

To summarize, higher cigarette prices have been found, using both cross-sectional and longitudinal data, to significantly affect youth and young adult smoking cessation behaviours. In particular, higher prices have been found to increase the probability of quitting, increase the probability of making a cessation attempt, and increase the desire to quit smoking among youth and young adults.

Effect of tax and price on other tobacco product use among young people

While numerous studies on the economic determinants of youth cigarette demand have been published over the past few decades, there have been few econometric studies published on the impact of taxes on other tobacco products (Table 6.5).

High-income countries

Chaloupka and his colleagues (1997) were the first to estimate the effects of taxes on youth smokeless tobacco demand in the United States. They used data on the prevalence and intensity of smokeless tobacco use taken from the 1992, 1993 and 1994 Monitoring the Future surveys described above to examine the impact of smokeless tobacco taxes and other tobacco control policies. They found higher taxes for smokeless tobacco products to be associated with reductions in both the likelihood and intensity of smokeless tobacco use among teenage boys. Using an estimate of the pass-through of tax to price and the share of smokeless tobacco price that is accounted for by tax, the authors estimated a total price elasticity of smokeless tobacco demand in the range from −0.44 to −0.75, with the impact on prevalence accounting for most of the total elasticity.

Tauras and colleagues (2007) used data extracted from the 1995–2001 National Youth Risk Behavior Surveys (YRBS) to examine the impact of smokeless tobacco taxes on smokeless tobacco use among male high school students.

Table 6.5. Summary of the studies providing evidence on the effects of other tobacco product prices on use among young people

Publication (author, year)	Methods (location, time period; study design and sample size (M/F)	Model	End Point	Main results	Subpopulations	Comment
High- income countries						
USA (Chaloupka *et al.*, 1997)	1992–1994; nationally representative data on males in 8th, 10th and 12th grades from the Monitoring the Future Surveys (*n* = 19 581)	Two-part model of smokeless tobacco demand: probit methods to estimate the smoking prevalence equation and ordinary least squares to estimate the smoking intensity for smokeless tobacco. Analyses controlled for socioeconomic and demographic variables, cross-border purchasing effects and youth access restrictions	Price/tax elasticity of smokeless tobacco prevalence Price/tax elasticity of smoking intensity for smokeless tobacco Price/tax elasticity of demand for smokeless tobacco	**Price** *Prevalence* –0.523 to –0.346 *Smoking intensity* –0.233 to –0.092 *Total price elasticity* –0.746 to –0.438	**Tax** *Prevalence* –0.068 to –0.045 *Smoking intensity* –0.029 to –0.012 *Total tax elasticity* –0.097 to –0.057	
USA (Ohsfeldt *et al.*, 1997)	1985; Cross-sectional data on men aged 16 years and over from the Current Population Survey (*n* = 100 000)	Multivariate regression model adjusted for total family income, marital status, race, ethnicity, employment status and occupation	Price elasticity of smoking prevalence	**Cigarettes** *Overall* –0.05 *16–24 years* –0.07 *25+ years* –0.05 **Snuff** *Overall* –0.27 *16–24 years* –0.31 *45+ years* –0.13 **Chewing tobacco** *Overall* –0.13		Cross-elasticities analysed
USA (Ohsfeldt *et al.*, 1999)	1992–1993; nationally representative cross-sectional (pooled surveys) data from the Current Population Survey. Analysis restricted to 165 653 male adults either white or black 16 years and older	Multivariate regression model. Adjusted for index of smoking regulation, age, education, ethnicity and marital status. Prices of cigarettes and snuff were mutually adjusted	Price elasticity of smoking prevalence	**Cigarettes** *Overall* –0.15* *16–24 years* –0.22* *25–44 years* –0.11* **Snuff** *Overall* –0.01*		Cross-price elasticities analysed *: *P* < 0.01

Publication (author, year)	Methods (location, time period; study design and sample size (M/F)	Model	End Point	Main results	Subpopulations	Comment
USA (Ohsfeldt *et al*., 1999) (contd)				*16–24 years* –0.24* *25–44 years* –0.05*		
USA (Ringel *et al*., 2005)	1999–2000; nationally representative data on students in grades 6–12 (age 9–17 years) from the National Youth Tobacco Survey (*n* = 33 632)	Logistic regression models of the probability of current cigar use, defined as having used cigars in the past 30 days. Analyses controlled for socioeconomic and demographic factors as well as smoke-free air laws and youth access restrictions	Prevalence price elasticity for cigars	–0.336*	**Males** –0.349* **Females** –0.240*	* $P < 0.05$
USA (Tauras *et al*., 2007)	1995–2001; data from the National School-based Youth Risk Behavior Surveys on males aged 13–18 years (*n* = 25 155)	Two part model of smokeless tobacco demand: probit methods to examine smokeless tobacco prevalence and generalized linear model with log link and Gamma distribution to examine smoking intensity among smokeless tobacco users	Tax elasticity of smokeless tobacco prevalence Tax elasticity of smokeless tobacco Cigarette cross-price elasticity of prevalence Cigarette cross-price elasticity of smoking intensity	–0.197 to –0.121 –0.085 to –0.044 –0.715 –0.413		
Low- and middle-income countries						
India (Joseph, 2010)	2000–2004; Global Youth Tobacco Survey data from 26 of 28 states and two of the seven Union Territories on youth aged 13–15 years. Average price data from users and non-users to construct school/state/territory level prices	Two-part model of cigarette demand; probit model to estimate smoking prevalence equation and Ordinary Least Squares to estimate smoking intensity equation	Price elasticity of smoking prevalence and smoking intensity	**Overall price elasticity** *Bidis* –1.40 **Smoking prevalence elasticity** *Bidis* –2.70 *Gutka* –0.58	**Prevalence elasticities** *Women* Bidis –2.91 Gutka –1.12 *Men* Bidis –2.475 Gutka –0.270	Smoking prevalence elasticity estimates for gutka use not statistically significant, nor are smoking intensity estimates for both gutka and bidis

The estimates from this study clearly indicate that higher smokeless tobacco taxes would significantly reduce the number of male students who use smokeless tobacco and the number of days those users use smokeless tobacco. The estimated tax elasticities of smokeless tobacco prevalence ranged from −0.20 to −0.12, whereas the estimated tax elasticities with respect to the number of days using smokeless tobacco ranged from −0.09 to −0.04. Moreover, the authors found cigarette prices to have a significant negative impact on both smokeless tobacco prevalence and on the number of days male high school students use smokeless tobacco. The estimated cross-price elasticity of smokeless tobacco prevalence was −0.72, and the cross-price elasticity of the number of days of use of smokeless tobacco was −0.41. These estimates indicate that a 10% increase in the price of cigarettes would decrease smokeless tobacco prevalence by more than 7% and would decrease the number of days using smokeless tobacco by more than 4% among male high school students. Moreover, these estimates indicate that smokeless tobacco products and cigarettes are economic complements in consumption for young males. In contrast, research on adult smokeless tobacco use in the United States has found that smokeless tobacco and cigarettes are substitutes among adults (e.g. Ohsfeldt *et al.*, 1999). Tauras and colleagues (2007) suggested that the complementarity they observed is likely the result of young male tobacco users being at relatively early stages of uptake, where they are still experimenting with different types of tobacco products.

Finally, Ringel and colleagues (2005) used data from the 1999 and 2000 waves of the National Youth Tobacco Survey to estimate the impact of cigar prices on cigar demand among adolescents in grades 6 through 12. After controlling for smoke-free air laws and youth access laws, the researchers found the price of cigars to be inversely related to the prevalence of youth cigar use. In particular, the price elasticity of youth cigar smoking prevalence was estimated to be −0.34.

Low- and middle-income countries

Joseph (2010) estimated the impact of price on youth tobacco demand using data from 73 356 Indian youths aged 13–15 years from the Global Youth Tobacco Survey conducted between 1999 and 2006. This study suggests that price has a stronger effect on the decision to smoke than on the intensity of smoking among Indian youth, and that the effect holds true across three tobacco types: bidis, gutka and cigarettes. In particular, bidis have the highest participation price elasticity (−2.70), followed by gutka (−0.58) and cigarettes have the lowest participation elasticity at −0.40.

To summarize, evidence from the USA finds higher smokeless tobacco taxes to decrease adolescent and young adult smokeless tobacco use. Additional evidence from the USA finds a negative relationship between cigar prices and cigar use among individuals in grades 6 through 12. Finally, recent research from India suggests that youth consumption of bidis and gutka is responsive to changes in the prices of these products.

Indirect effects of tax and price on youth tobacco demand and related outcomes – High-income countries

Some studies have examined the indirect effect of price on tobacco use among young people by accounting for peer, parental or sibling influences or the source of cigarettes (i.e. buying or borrowing) (Table 6.6). Powell *et al.* (2005) used survey data from The Study of Smoking and Tobacco Use Among Young People, conducted in 1996, to quantify the importance of peer effects on smoking among high school students. Specifically, Powell and colleagues (2005) allowed cigarette prices to have both a direct effect and an indirect effect, via a social multiplier, on youth smoking prevalence. The price elasticity of youth smoking prevalence was estimated to be −0.50, with the peer effect playing a significant role in the smoking decision process. That is, the aforementioned price elasticity comprised a direct prevalence price elasticity of −0.32 and an indirect prevalence price elasticity (measuring the social multiplier effect) of −0.18. These estimates suggest there is a rather large social multiplier effect with respect to price changes and youth smoking prevalence.

Extending the work of Powell *et al.* (2005), Harris and González López-Valcárcel (2008) tested for the possibility that peer influences have asymmetric effects. They examined cigarette smoking among individuals aged 15–24 years using the 1992–1999 Current Population Surveys. The authors found that sibling smoking status is a significant determinant of own smoking status, but asymmetries in effect size exist. In particular, they found that each additional smoking sibling raises the probability of smoking by 7.6%, while each non-smoking sibling decreases the probability by 3.5%. Consistent with Powell *et al.* (2005), Harris and González López-Valcárcel (2008) found a strong indirect impact of cigarette price on youth smoking prevalence.

Table 6.6. Summary of studies providing evidence on indirect effects on youth smoking of an increase in cigarette prices

Publication (author, yr, country)	Methods (location, time period; study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulations	Comment
High income countries						
USA (Powell *et al.*, 2005)	1996; Nationally representative, cross-sectional data on high school students from The Study of Smoking and Tobacco Use Among Young People (*n* = 12 705)	Two-stage generalized least squares estimator for a dichotomous dependent variable (youth smoking prevalence), controlled for socioeconomic and demographic factors and state-fixed effects	Total price elasticity of smoking prevalence Direct prevalence price elasticity Indirect (peer effects) prevalence price elasticity measuring the social multiplier effect	–0.4982 –0.3152 –0.1830		
USA (Powell and Chaloupka, 2005)	1996; Nationally representative, cross-sectional data on high school students from The Study of Smoking and Tobacco Use Among Young People (n = 11 237)	Standard model of consumer demand theory using probit specification to estimate parental influences on demand for cigarettes by youth	Price elasticity of smoking prevalence	**Model accounting for parental influences** –0.27 **Sensitivity analysis without accounting for parental influences** –0.34		Price elasticity estimates based on estimation models that do not account for parental influences tend to capture both the direct price effect and the indirect price effect that operates through the effect of price on parental smoking behaviour
USA (Ross *et al.*, 2005)	1996; cross-sectional data collected for The Study of Smoking and Tobacco Use Among Young People containing information on smoking status and expected behaviour after a hypothetical change in cigarette price	Probit regression model to estimate an equation for the probability of future smoking cessation among current smokers as a function of future cigarette prices. Analyses controlled for socioeconomic and demographic factors	Proportion of respondents who plan to engage in compensatory behaviour in response to a hypothetical price rise. Standard deviations are shown in parentheses	**All future smokers** *Switch to a cheaper brand* 0.29 (0.45) *Buy fewer cigarettes* 0.45 (0.50) *Offer less to friends* 0.60 (0.49) *Buy singles instead of packs* 0.15 (0.35) *Buy packs instead of cartons* 0.37 (0.48) *Buy cartons instead of packs* 0.26 (0.44) *Supplement cigarettes with smokeless tobacco* 0.07 (0.25)	**Light future smokers** *Switch to a cheaper brand* 0.25** (0.43) *Buy fewer cigarettes* 0.43* (0.50) *Offer less to friends* 0.49** (0.50) *Buy singles instead of packs* 0.20** (0.40) *Buy packs instead of cartons* 0.34** (0.47) *Buy cartons instead of packs* 0.13** (0.33) *Supplement cigarettes with smokeless tobacco* 0.07 (0.25)	* Difference between light and heavy smokers is significant at the 5% level ** Difference between light and heavy smokers is significant at the 1% level

Table 6.6. Summary of studies providing evidence on indirect effects on youth smoking of an increase in cigarette prices

Publication (author, yr, country)	Methods (location, time period; study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulations	Comment
USA (Ross *et al.*, 2005) (contd)					**Heavy future smokers** *Switch to a cheaper brand* 0.32** (0.47) *Buy fewer cigarettes* 0.47* (0.50) *Offer less to friends* 0.72** (0.45) *Buy singles instead of packs* 0.08** (0.27) *Buy packs instead of cartons* 0.40** (0.49) *Buy cartons instead of packs* 0.39** (0.49) *Supplement cigarettes with smokeless tobacco* 0.06 (0.24)	
USA (Katzman *et al.*, 2007)	1995–2001; nationally representative data on high school students in grades 9–12 from the biennial National Youth Risk Behavior Surveys (*n* = 49 169)	Multinomial logit model to determine the impact of price on the probability of being a non-smoker, a borrower or a buyer of cigarettes. Ordinary least squares used to estimate the smoking intensity and price elasticity of smoking intensity among borrowers and buyers of cigarettes	Regression coefficients and marginal effects of price and tax changes for whether a teen is a non-smoker, borrower or buyer. Price (tax) elasticity of smoking intensity for borrowers and buyers (demand defined as number of cigarettes smoked on days smoking) Price (tax) elasticity of smoking intensity among borrowers and buyers (smoking intensity defined as number of days smoked)	**All respondents** *Price (tax) Coefficient* Borrowers –0.328–(0.419) Buyers –0.494–(–0.632) *Price (tax) Marginal effects* Non-smoker 0.079 (0.101) Borrower –0.020–(0.026) Buyer –0.059 –(0.075) *Price (tax) elasticity of smoking intensity* Borrowers –0.306 –(0.028) Buyers –0.504–(0.108) *Price (tax) elasticity of smoking intensity* Borrowers –0.833 –(0.155) Buyers –0.320 –(0.074)	**Ever smokers** *Price (tax) Coefficient* Borrowers –0.342 –(0.444) Buyers –0.509 –(0.670) *Price (tax) Marginal effects* Non-smoker 0.107 (0.140) Borrower –0.024 –(0.030) Buyer –0.084–(0.110)	

Publication (author, yr, country)	Methods (location, time period; study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulations	Comment
USA (Harris & González López-Valcárcel, 2008)	1992–1999; data on a pooled sample of 49 898 households with 1–4 siblings from the 1992–1999 US Current Population Surveys	Estimates a youth smoking prevalence equation controlling for sibling smoking status	Social multiplier for the deterrent effect of price	1.60		
Low- and middle-income countries						
India (Joseph, 2010)	2000–2004; Global Youth Tobacco Survey data from 26 of 28 states and two of the seven Union Territories on youth aged 13–15 years. Average price data from users and non-users to construct school/state/territory level prices	Amemiya's generalized least squares estimator. Model 1 Probit model with no peer effects, Model 2 assumes that the peer measure is exogenous, and Model 3 has the AGLS estimator that accounts for the endogeniety of the peer measure and helps disaggregate the direct price effect and the indirect price effect	Prevalence price elasticity	**Cigarettes** *Model 1* –0.4056** *Model 2* –0.1779*** *Model 3 (Direct)* –0.3017*** Model 3 (indirect) –0.0564*** **Bidis** *Model 1* –2.727** *Model 2* –0.8679** *Model 3 (Direct)* –1.3460** *Model 3 (indirect)* –0.5513*** **Gutka** *Model 1* –0.6915* *Model 2* 0.0789 *Model 3 (Direct)* 0.0800 *Model 3 (indirect)* –0.1026	**Women** *Cigarettes* Model 1 –0.6019** Model 2 –0.3474** Model 3 (Direct): –0.4027** Model 4 (Indirect): –0.1195** *Bidis* Model 1 –2.9325** Model 2 –0.8480 Model 3 (Direct): –1.3044* Model 3 (Indirect): –0.5306** *Gutka* Model 1 –1.1152** Model 2 –0.3495 Model 3 (Direct) –0.4853* Model 3 (Indirect) 0.0103*** **Men** *Cigarettes* Model 1 –0.2823* Model 2 –0.0939 Model 3 (Direct) –0.2408** Model 3 (Indirect) –0.0271** *Bidis* Model 1 –2.4860*** Model 2 –0.8760**	* $P < 0.10$ ** $P < 0.05$ *** $P < 0.01$

Table 6.6. Summary of studies providing evidence on indirect effects on youth smoking of an increase in cigarette prices

Publication (author, yr, country)	Methods (location, time period; study design and sample size (M/F)	Model	Endpoint	Main results	Subpopulations	Comment
India (Joseph, 2010) (contd)					Model 3 (Direct) –1.4297** Model 3 (Indirect) –0.5037*** *Gutka* Model 1 –0.3118 Model 2 0.2836* Model 3 (Direct) –0.1699 Model 3 (Indirect) –0.1514***	
	2000–2004; Global Youth Tobacco Survey data from 26 of 28 states and two of the seven Union Territories on youth aged 13–15 years. Average price data from users and non-users to construct school/state/territory level prices	Probit specification to model the decision to smoke. Model 1, Basic model; Model 2, includes household influence	Prevalence price elasticity	**Overall** *Cigarettes* Model 1 –0.1397 Model 2 –0.1392 *Bidis* Model 1 –1.2272*** Model 2 –1.2497** Gutka Model 1 –0.3082 Model 2 –0.2867	**Women** *Cigarettes* Model 1 –0.1690 Model 2 –0.1560 *Bidis* Model 1 –0.7631 Model 2 –0.6010 Gutka Model 1 –0.6588 Model 2 –0.3934 **Men** *Cigarettes* Model 1 –0.1341 Model 2 –0.1432 *Bidis* Model 1 –1.5776** Model 2 –1.6999** *Gutka* Model 1 –0.2095 Model 2 –0.2628	* $P < 0.10$ ** $P < 0.05$ *** $P < 0.01$

In particular, the deterrent effect of an increase in cigarette price on youth smoking prevalence was approximately 60% greater than the sum of the deterrent effect of price on each individual separately.
This study yields a social multiplier effect of price on smoking prevalence of 1.60, which is consistent with the implied social multiplier of 1.56 estimated by Powell *et al.* (2005).

Using the same data as Powell *et al.* (2005), Powell and Chaloupka (2005) examined the indirect effects of price on youth smoking that worked through parental smoking. As Chaloupka (2003) discussed, higher cigarette prices may have an indirect influence on youth smoking by both reducing parental modelling of smoking and by reducing availability of cigarettes to youth who might otherwise steal cigarettes from their parents. Powell and Chaloupka's estimates support Chaloupka's (2003) assertion that the indirect influence of price on youth smoking that works through parents accounts for about one fifth of the total impact of price on youth smoking prevalence.

In addition to examining the effect of future cigarette price increases on smoking cessation decisions among high school students, the aforementioned study by Ross and colleagues (2005) also examined expected compensatory behaviour after a future price increase. The authors estimated that 60% of future smokers intend to offer fewer cigarettes to their friends for free if price was increased. This implies that the availability of cigarettes through social sources would be diminished after a price increase, and that the full price of cigarettes would be indirectly increased by reducing the number of distributional channels available to high school students. The results also indicate that 45% of continuing smokers plan to buy fewer cigarettes after a price increase. The analysis further shows that nearly 21% of future smokers who do not expect to change their smoking intensity after the price increase also expect to buy fewer cigarettes. This implies that some future smokers believe that they can obtain cigarettes from alternative sources, although as discussed above, getting them for free from their peers will become more difficult. In addition, the analysis showed that price increases in the future will also result in other compensatory behaviours such as switching to cheaper brands of cigarettes, switching to smokeless tobacco products, supplementing cigarettes with smokeless tobacco products, and finally switching the usual quantity purchased (i.e. singles, packs, or cartons).

Other studies have examined the impact of cigarette prices on other outcomes such as sharing of tobacco products, risk perceptions, compensatory behaviours and attitudes towards tobacco products (Table 6.7). For example, Katzman and colleagues (2007) used data from the National Youth Risk Behavior Surveys (YRBS) conducted from 1995 through 2001 to explore the relationships between cigarette taxes/prices and youth acquisition of cigarettes. The YRBS data contained information on how cigarettes were acquired, including whether young smokers bought their own cigarettes or obtained them from social sources. As expected, Katzman and colleagues found that higher cigarette taxes/prices reduce the prevalence and intensity of smoking. The authors also found that acquisition patterns were significantly affected by higher taxes/prices. In particular, in models based on their full sample, they estimated that a US$1.00 increase in the price of cigarettes raises the probability of being a non-smoker by 7.9 percentage points, reduces the probability of buying cigarettes by 5.9 percentage points, and decreases the probability of borrowing cigarettes by 2.0 percentage points. Their finding that higher taxes and prices significantly reduce smoking among buyers while having less of an impact on borrowers is consistent with studies described in the smoking uptake section indicating that price has a larger impact of price on youth at later stages of the smoking uptake process.

Tauras and Chaloupka (2004) used data from the 1991–2000 nationally representative surveys of 8th-, 10th-, and 12th-grade students as part of the Monitoring the Future Surveys to examine the determinants of youth attitudes and beliefs about smoking. After controlling for smoke-free air laws, youth access laws, state spending on tobacco control efforts, and a host of socioeconomic and demographic characteristics, higher cigarette prices were found to be positively and significantly related to the prevalence of youths who agree that there is a great risk in smoking one or more packs a day, and the prevalence of youths who agree that smoking should be banned in public places. Moreover, Tauras and Chaloupka concluded that higher cigarette prices were found to be negatively and significantly related to the prevalence of youth who think the harm associated with smoking is exaggerated, the prevalence of youth who think they can smoke one or more packs a day and quit smoking, and the prevalence of youth who think that smoking is not dangerous because they can quit.

One Canadian study examined cigarette brand preference as a function of price among youth in Canada. Leatherdale and colleagues (2009) used nationally representative data from youths in 5th through 12th grade in 10 Canadian provinces to identify factors associated with smoking premium brands (any cigarettes sold for the traditional price per carton), newly emerging discount brands (cigarettes sold for CAD$10–$12 less than premium brands), and native brands (tax-exempt cigarettes sold to aboriginals, or counterfeit cigarettes). While almost half of the young people in this study preferred the premium brands, half were accessing cheaper cigarettes. The study suggests that youth with less spending money and those who smoke more were more likely to access these cheaper sources of cigarettes.

Indirect effects of tax and price on youth tobacco demand and related outcomes – Low- and middle-income countries

Similar to the study by Powell *et al.* (2005), Joseph (2010) estimated the direct and indirect effects of price through peers on young adult tobacco use prevalence and intensity. Using data on 73 356 Indian adolescents aged 13–15 years taken from the Global Youth Tobacco Survey, Joseph found a significant impact of price on youth demand for cigarettes, bidis and gutka, as well as a significant indirect effect through peers on demand for all three tobacco products (Table 6.6).

To summarize, higher tobacco product prices have been found to have a direct negative impact on youth tobacco use and to have an indirect negative impact through peer and parental effects. These findings suggest that there is a sizeable social multiplier effect with respect to price changes and youth tobacco use. Moreover, higher tobacco prices have been found to change the attitudes and perceptions about tobacco among youths, alter the availability of tobacco through social sources, and increase the likelihood that young individuals engage in compensatory behaviours.

Table 6.7. Summary of studies providing evidence on other outcomes related to an increase in cigarette prices

Publication (author, year)	Methods (location, time period; study design and sample size (M/F)	Outcomes	Main results	Comments
High-income countries				
USA (Biener *et al.*, 1998)	1993–1994; Reported reactions to a price increase were assessed through telephone interviews with a representative sample of Massachusetts adults and teenagers (aged 12–17). Only smoking respondents included in the analysis (n = 1999). Descriptive statistics indicate response to price increase. Multinomial logistic regression used to test hypothesis that lower-income smokers would be more responsive to price than higher income smokers and that heavier smokers would be more likely to cut costs rather than attempt to quit when compared to lighter smokers	Possible reactions to price were typified as: 1) Cut costs associated with continued smoking (switching to a cheaper brand or reducing number smoked) 2) Quit smoking 3) No response to price increase. Regression coefficients for all possible pairs of above outcomes in a multinomial set	% (95% CI) Adults Cut costs 19.0 (15.1, 23.7) Consider quitting smoking 35.0 (29.6, 39.6) No response 46.0 (40.9, 51.1) Teenagers Cut costs 26.0 (10.4, 42.0) Consider quitting smoking 21.0 (9.3, 31.9) No response 53.0 (36.8, 69.6)	Among young smokers (aged 12–17), those from lower-income groups were significantly more likely than their more affluent counterparts to cut the costs associated with continued smoking in response to a tax/price increase rather than doing nothing or considering quitting smoking
USA (Tauras and Chaloupka, 2004)	Probit methods to estimate attitudes and beliefs equations. Analyses controlled for socioeconomic and demographic factors as well as year effects	Twelve dependent variables on attitudes and beliefs about smoking, 6 expected to be positively affected and 6 negatively affected by tobacco control policies.	Cigarette prices have a positive and significant impact on the 'great risk' and 'public smoking ban' outcomes and a negative and significant impact on the 'harm exaggerated', 'smoke 1+ packs daily and quit', 'smoking is not dangerous – you can quit' and 'don't mind being near smokers' outcomes. Price was found to be an insignificant determinant of 'smoking reflects bad judgement', 'dirty habit', 'disapprove of adults smoking', 'prefer to date non-smoker', 'smokers enjoy life' and 'cigarettes are easily accessible' outcomes	
Canada (Leatherdale *et al.*, 2009)	2006–2007; Nationally representative data for 5th – 12th grade students from the Canadian Youth Smoking Survey. Two logistic regression models were used: Model 1 estimates the odds of smoking discount cigarettes versus premium cigarettes and Model 2	Odds of smoking discount cigarettes versus premium cigarettes (95% CI) Odds of smoking native cigarettes versus premium cigarettes (95% CI)	**Factors associated with smoking discount versus premium cigarettes** *a. Smoking status* Occasional smoker 1.00 Daily smoker 1.55 (1.14 to 2.10)**	* $P < 0.05$ ** $P < 0.01$ *** $P < 0.001$

Table 6.7. Summary of studies providing evidence on other outcomes related to an increase in cigarette prices

Publication (author, year)	Methods (location, time period; study design and sample size (M/F)	Outcomes	Main results	Comments
Canada (Leatherdale *et al.*, 2009) (contd)	estimates the odds of smoking native cigarettes versus premium cigarettes		*b. Aboriginal status* Non-aboriginal 1.00 Aboriginal 0.028 (0.19 to 0.43)*** *c. Weekly spending money* $C0 1.00 $C1 to $C10 0.39 (0.19 to 0.79)** $C11 to more 0.84 (0.48 to 1.48) *d. Average cigarettes/day* Few puffs to 1 cigarette 1.00 2–3 cigs 2.11 (1.01 to 4.00)* 4–10 cigs 4.02 (2.00 to 8.10)*** 11 or more cigs 2.87 (1.34 to 6.12)* **Factors associated with smoking native versus premium brands** *a. Sex* Girl 1.00 Boy 1.72 (1.24 to 2.40)** *b. Smoking Status* Occasional smoker 1.00 Daily smoker 1.45 (1.02 to 2.06)** *c. Aboriginal status* Non-aboriginal 1.00 Aboriginal 0.56 (0.37 to 0.84)** *d. Weekly spending money* $C0 1.00 $C1 – $C10 0.72 (0.39 to 1.32) $C11 or more 0.34 (0.20 to 0.56)***	

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Chapter 7
Tax, price and tobacco use among the poor

In general, the prevalence of tobacco use is higher among the poor.[1] Several reasons are given to explain why the poor smoke more (Bobak *et al.,* 2000). First, people at lower socioeconomic status tend to be less aware of the adverse health consequences of smoking and thus more likely to be smokers. Second, smoking is an outlet for releasing stress resulting from material deprivation of the poor (Graham, 1987). Third, a smoker sees his/her smoking habit as a way of rewarding himself/herself, an attitude more likely to be observed among the poor (Graham, 1994). Fourth, the loss of productivity and income due to ill health caused by smoking-induced diseases is lower for the low-income people. Thus, the poor seem to have more reasons to adopt the practice of smoking as a part of their life.

The high level of smoking prevalence among the poor imposes a heavier disease burden on this disadvantaged group of the population and widens social and economic disparity between the rich and the poor. However, the poor are also generally more responsive to price changes, which makes them more inclined to cut tobacco consumption in response to increased tobacco taxation. Also, by reducing consumption or quitting, the poor benefit most by avoiding the health and economic cost from tobacco use. Thus, increasing taxes on tobacco is considered a win-win situation, not only because it serves the dual goal of curbing the tobacco epidemic and increasing government revenue, but also due to the fact that it works more effectively for the poor than for the rich.

Raising tobacco excise taxes as a tobacco control policy is often criticized because of the regressivity of tobacco taxes. It is argued that the increase in taxes on tobacco may increase the burden on low-income people by reducing the overall ability to purchase and consume other goods and services and thus increasing the inequality in the post-tax distribution of income.

This chapter concentrates on smoking prevalence, price sensitivity and tobacco consumption by socioeconomic status, and their implications on potential regressivity of tobacco taxes. It is organized as follows: First, the patterns of tobacco use within countries with different income levels and socioeconomic status are presented. The opportunity cost of spending on tobacco is discussed in the second section. A third explores the relationship between tobacco use and poverty. The possible regressivity of tobacco taxes is discussed and the existing evidence from several countries is then presented, followed by the existing evidence on price elasticity of tobacco use for different income or socioeconomic status in several counties. The empirical evidence found on price sensitivity of different socioeconomic groups is then explained, and the chapter concludes with a discussion on the implications of the empirical findings.

Patterns of tobacco use within countries by socioeconomic status

The relationship between smoking behaviour and socioeconomic status is well documented in the literature. In general, the studies examining this relationship measure socioeconomic status with respect to a wide range of variables such as income level, education, profession, expenditure levels and other relevant socioeconomic characteristics.

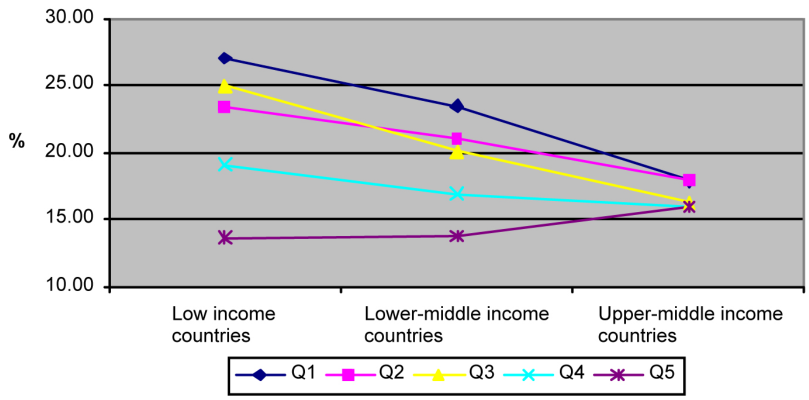
[1] Throughout the chapter, the status of poverty has been identified with low socioeconomic status of individuals or households in terms of household income, expenditure, level of education of individuals. Depending on how different empirical studies conceptualized poverty and defined low socioeconomic status of population, we have used the two concepts (i.e. low socioeconomic status or poverty) interchangeably without further specification of how poverty is measured in general. In most cases, the stratification of the poor and the non-poor is based on the classification of households by total household income or expenditure.

The effect of socioeconomic status or education or income on smoking differs from one country to another and depends on the diffusion of smoking within the country (Graham, 1996). If the country is in the later stage of the tobacco epidemic, when the smoking prevalence rate is declining, smoking is typically observed more in the lower socioeconomic sector of the population (Pierce *et al.* 1989; Lopez *et al.* 1994; Graham, 1996). Bobak *et al.* (2000) reported the ratio of smoking prevalence rate of the lowest socioeconomic groups to the highest socioeconomic groups, calculated from 74 studies which examined this relationship in 41 countries. In many countries this ratio is found to be greater than 1, which indicates that people in the lowest group have a higher smoking prevalence rate than those in the highest socioeconomic group. However, there are huge differences between the countries, even within the same income category. For example, among low-income countries, the ratio of smoking prevalence in the lowest socioeconomic group relative to the highest socioeconomic group varied between 9 in India and 1 in China. Among lower-middle-income countries the ratio varied between 3 in the Russian Federation to less than 1 in Thailand and Bolivia. Thus, in the latter two countries people in the lowest socioeconomic group have lower smoking prevalence than people in the highest socioeconomic group. Among high-income countries the ratio is typically greater than 1, indicating that smoking prevalence is higher among the poor than the rich. An exception is Japan, which has a ratio of less than 1.

The examination of the relationship of smoking prevalence with socioeconomic status of people, using the World Bank's classification of countries, reveals more information about the economic gradient of tobacco use. Evidence from the World Health Survey 2003 showed that tobacco smoking is mostly strongly related to household permanent income or wealth (WHO, 2007). As shown in Figure 7.1 reproduced from WHO (2010), poorer people tend to have greater smoking prevalence than richer people in low-income- and lower-middle-income as well as upper-middle-income countries, and the disparity in terms of smoking prevalence rate is more apparent among the lower-income groups of countries.

The general pattern observed in high-income countries is that as the level of income or education of individuals increases, smoking prevalence rate declines. Those at the lowest income group or those with the lowest level of education have a higher smoking prevalence rate than those at the highest income group or those with highest level of education. However, there are some exceptions as well. For example, among old (aged 50–79) Italian males, smoking prevalence did not change with their education level – it is around 25%, whereas among old Italian women there was a positive relationship between education level and smoking prevalence rates (Federico *et al.,* 2004). Similarly, in Portugal and Greece, women with higher education and in higher income groups are more likely to smoke. The differences among the EU countries were explained by the stage of the country in the tobacco epidemic. If the country is at the earlier stages, then smoking prevalence might be positively associated with education, i.e. more educated men and women were more likely to smoke than less-educated individuals. More recent studies reported that the gaps in the prevalence rates between low-income and high-income groups has widened in recent years because even though the prevalence rates are generally declining, the decrease is greater among those with higher levels of education or those with low income (for example, Townsend *et al.*

Figure 7.1. Prevalence of daily tobacco smoking by income group and income quintile



Notes: 1. Q1 to Q5 indicate income quintiles. Q1 represents the lowest income group and Q5 is the highest income group. 2. The graph was made using average prevalence figures from 44 countries. Prevalence of China and India were removed from these averages to avoid skewed results from their large population weights. 3. High-income countries are not included in the graph.

Source: Adapted from David A, Esson K, Perucic AM, Fitzpatrick C (2010).Tobacco use: equity and social determinants. In: Blas E, Sivasankara Kurup A, editors. Equity, social determinants and public health programmes. Geneva: World Health Organization.

(1994), Federico *et al.* (2004), Franks *et al.* (2007), Khang *et al.* (2009)).

Compared to high-income counties, the evidence on the relationship between income level and prevalence rate is different in upper-middle income countries. According to the results of the limited number of studies, as education level or the income level of household increases, smoking prevalence and tobacco consumption increase as well (Onder (2002) for Turkey, Sayginsoy *et al.* (2002) for Bulgaria and van Walbeek (2002a) for South Africa).

The relationship between prevalence rate and socioeconomic status in lower-middle-income and low-income countries is similar to that observed in high-income countries. In general, those with higher income level or those with more education have lower smoking prevalence rates than those with lower income level or those with less education. Although this is the general trend, there are some differences in rural or urban parts of the country as well as the types of tobacco consumed. Table 7.1 presents the prevalence rates of individuals or households by socioeconomic status in different countries grouped according to World Bank income classification.

Opportunity cost of tobacco use

Opportunity cost is defined as the cost of an alternative that must be foregone to purchase a particular product, in this case tobacco. Spending on tobacco often constitutes a significant part of smoking households' budgets. Its share in smoking households' budgets varies between close to 1 percent in areas such as Mexico and China's Hong Kong Special Administrative Region to around 10 percent in Zimbabwe and China (John, 2008). Since in high-income, lower-middle-income and low-income countries the poor smoke more than the rich and their income level is lower, it means that, on average, they spend a higher share of their income on tobacco than the rich. It is reasonable to expect that tobacco expenditures have a higher opportunity cost among the poor. Spending on tobacco would be expected to reduce the consumption of food and non-food items, thus reducing the quality of life (Wang *et al.,* 2006).[2]

The percentage of income spent on tobacco products is generally found to be higher when the level of household income or expenditure is lower. For example, in Myanmar, in 2000, the share of tobacco expenditures constituted 4.04% of total household expenditures of all households in the lowest income quintile, compared to 1.58% in the highest income quintile (Kyaing, 2003). In Indonesia, cigarette expenditure as a percentage of income was 7.24% for the low-income group and 3.02% for the high-income group (Adioetomo *et al.,* 2005). On average, poor households in Morocco spent the same amount on tobacco products and education, while their cigarette expenditure was half of the average spending on health (Aloui, 2003). Similarly, in Turkey in 1994, the households in the lowest income quintile spent 3.08% of their monthly income on cigarettes, whereas this percentage was only 1.65% for the households in the highest income quintile (Onder, 2002). Siahpush (2003) reported that average tobacco expenditure as a percentage of total household expenditures varied from 7.7% in the lowest income quintile to 2.4% in the highest income quintile in Australia. Using the 1998–99 Household Spending Surveys, Thomson *et al.* (2002) reported that low-income smoking households in New Zealand spent almost 14% of non-housing spending on tobacco. In contrast to other studies, John (2008) reported that in India, the share of tobacco expenditure in poor households' total budget was slightly less than that of richer households even though the poor had a higher prevalence rate of tobacco use in India. These results are summarized in Table 7.2.

Several studies estimated the share of income or expenditures spent on tobacco and what individuals could purchase with that money if they were to divert it away from tobacco. For example, a study conducted by Efroymson *et al.* (2001) in Bangladesh showed that during 1992–1996, the average male smoker spent more than twice as much on cigarettes as he spent on clothing, housing, health, and education combined. Moreover, on average male and female smokers would be able to buy 1402 calories and 770 calories of rice, respectively, with the money saved by quitting.

This study further showed that in Bangladesh in 1995/96, the lowest household expenditure (below $18) group spent almost 10 times as much on tobacco as on education. If the poor had reallocated 69% of their tobacco expenditure to food, which a typical lowest-income household without smokers would do, then over 10.5 million fewer people would have been malnourished and about half of them would be from the hard core poor group (consuming below 1805 calories/day). More strikingly, if parents were to use their tobacco expenditure for feeding their children, it would save 127 750 children under 5 years from death from malnourishment each year in Bangladesh alone.

[2] Only selected papers are reviewed in this section.

Table 7.1. Smoking prevalence rates by socioeconomic status

Publication (location, author, year)	Data sets and year	Prevalence rate (%)
Low-income and lower-middle-income countries		
China (Hu and Tsai, 2000)	Household survey from rural areas in 3 Chinese provinces: Henan, Fujian and Shanxi, conducted during 1996–1998	**By Education** *Illiterate* 24.1 *Primary school* 32.8 *Junior high school* 32.5 *Senior high school or higher* 37.1 **By Occupation** *Farmer* 32.2 *Worker* 34.1 *Other* 26.2 *Student or housekeeper* 12.6
Bangladesh (Efroymson *et al.*, 2001)	The National Health and Demographic Survey, 1995	**By monthly household income (currency: US$)** *<24* 58.2 (M) *24–30* 56.7 (M) *30–35* 54.4 (M) *35–47* 53.7 (M) *47–59* 45.6 (M) *59–71* 46.1 (M) *71–94* 38.4 (M) *94–118* 36.3 (M) *118+* 32.3 (M)
Bangladesh (Ali *et al.*, 2003)	Bangladesh Bureau of Statistics Survey, 1995	**By monthly household income (currency: Taka)** *<1000* 58.2 (M) *1000–1499* 56.7 (M) *1500–1999* 53.7 (M) *2000–2499* 45.6 (M) *2500–2999* 46.1 (M) *3000–3999* 38.4 (M) *4000–4999* 36.3 (M) *5000+* 32.3 (M) **By Education** *No education* 61.4 (M)

Publication (location, author, year)	Data sets and year	Prevalence rate (%)
Bangladesh (Ali *et al.*, 2003) (contd)		*Class I-V* 40.7 (M) *Class VI-IX* 31.3 (M) *At least secondary school* 25.0 (M) **By monthly household income (currency: Taka)** *<1000* 53.0(M) *1000–1499* 48.1 (M) *1500–1999* 47.2 (M) *2000–2499* 44.2 (M) *2500–2999* 42.4 (M) *3000–3999* 38.7 (M) *4000–4999* 34.4 (M) *5000+* 31.7 (M) **By Education** *No education* 59.5 (M) *Class I-V* 34.9 (M) *Class VI-IX* 28.5 (M) *At least secondary school* 31.6 (M)
India (Rani *et al.*, 2003)	National Family Health Survey-2 (1998–1999)	**By residence** *Urban* 21.4 (M); 0.8 (F) *Rural* 32.5 (M); 3.0 (F) **By Household wealth** *Richest 20%:* 16.0 (M); 0.5 (F) *2nd richest* 25.7 (M); 1.3 (F) *Middle* 31.6 (M); 2.4 (F) *2nd poorest* 36.4 (M); 3.3 (F) *Poorest 20%* 39.8 (M); 4.9 (F) **By years of schooling** *11+ years* 12.8 (M); 0.1 (F) *6–10 years* 22.3 (M); 0.3 (F) *1–5 years* 36.9 (M); 0.9 (F) *No education* 45.3 (M); 4.1 (F)
India (John, 2005)	The 50th and 55th Round National Sample Survey, July 1993–June 1994 and July 1999–June 2000	**By household income** *Smoke tobacco* Lowest (<30th percentile) 32.5 (R); 28.7 (U) Middle (30–70) 44.4 (R); 30.5 (U)

Table 7.1. Smoking prevalence rates by socioeconomic status

Publication (location, author, year)	**Data sets and year**	**Prevalence rate (%)**
India (John, 2005) (contd)		Higher (>70th percentile) 45.6 (R); 27.3 (U) *Smokeless tobacco* Lowest (<30th percentile): 32.7 (R); 17.0 (U) Middle (30–70) 29.5 (R); 14.7 (U) Higher (>70th percentile) 24.7 (R); 10.9 (U) *Total* Lowest (<30th percentile) 59.1 (R); 42.6 (U) Middle (30–70) 65.7 (R); 41.5 (U) Higher (>70th percentile) 60.8 (R); 34.5 (U)
Nepal (Karki *et al.*, 2003)	Nepal Smoking Behaviour Survey, November–December 2000	**By illiteracy** *Literate* 31.9 (M); 7.5 (F) *Illiterate* 59.9 (M); 38.6 (F) **By length of education** *Illiterate* 50.6 *<6 years* 45.8 *6–12 years* 32.7 *>12 years* 32.9
Upper-middle-income countries		
Bulgaria (Sayginsoy *et al.*, 2002)	Living Standards Measurement Study Household Survey, 1995	**By household income group** *Lower and lower middle* 32.3 *Upper middle* 43.5 *High* 51.4
South Africa (van Walbeek, 2002a)	All Media and Products Survey, 1993 and 2000	**By education** *Year 1993* No education 26.8 Primary education 33.6 Secondary education 31.4 Tertiary education 29.8 *Year 2000* No education 23.6 Primary education 29.5 Secondary education 27.0 Tertiary education 25.7 ***By household income (currency: Rand (R))*** *Year 1993* R1–R499 29.4

Publication (location, author, year)	Data sets and year	Prevalence rate (%)
South Africa (van Walbeek, 2002a) (contd)		R500–R899 30.6 R900–R1399 31.8 R1400–R2499 31.6 R2500–R3999 34.2 R4000–R6999 35.2 R7000–R11999 33.0 R12000+ 28.1 *Year 2000* R1–R499 23.5 R500–R899 23.2 R900–R1399 25.7 R1400–R2499 29.8 R2500–R3999 29.3 R4000–R6999 30.7 R7000–R11999 35.1 R12000+ 31.0
Turkey (Onder, 2002)	Household Expenditure and Consumption Survey, 1994	**By household income** *Lowest* 52.0 *2nd quintile* 62.6 *3rd quintile* 65.1 *4th quintile* 68.2 *Highest* 70.3
High-income countries		
United Kingdom (Townsend, 1987)	Central Statistical Office, 1982	**By social class** *Professional* 20 (M); 21 (F) *Employers and managers* 29 (F) *Skilled manual* 40 (F) *Semi-skilled manual* 40 (F) *Unskilled working* 49 (M); 40 (F)
USA (Farrelly *et al.*, 2001)	National Health Interview Survey, 1976–1980, 1983, 1985, 1987–1993	**By real family income** ≤ *Median income* 31.7 ≥ *Median income* 27.5

Table 7.1. Smoking prevalence rates by socioeconomic status

Publication (location, author, year)	Data sets and year	Prevalence rate (%)
USA (Barbeau *et al.*, 2004)	National Health Interview Survey, 2000	**By education level** *0–12 grade, no diploma < 24 y* 30.9 *0–12 grade, no diploma > 24 y* 36.7 *12th grade, diploma* 31.9 *GED diploma* 53.1 *Some college/assoc degree* 24.2 *≥ 4-year college degree* 12.5 **By income/poverty** *Poor* 34.7 *Near poor* 34.2 *Middle income* 31.4 *Higher income* 20.7 *Unreported income* 25.5 **By occupational class** *White collar* 20.3 *Service workers* 31.1 *Farm workers* 24.2 *Blue collar* 35.4 *Not in labour force* 27.2
Australia (Siahpush, 2003)	Household Expenditure Survey, 1998–1999	**By household income** *Lowest* 33.0 *2nd quintile* 31.6 *3rd quintile* 33.6 *4th quintile* 35.0 *Highest* 32.8 **By education** *No qualification* 36.3 *Diploma* 34.0 *Degree* 19.8 *Unknown* 46.5 **By occupation** *Blue collar* 44.0 *White collar* 38.4 *Professional* 27.6

Publication (location, author, year)	Data sets and year	Prevalence rate (%)
Australia (White *et al*., 2008)	Triennial cross-sectional national studies of representative random samples of secondary students aged 12–17 years, 1987–2005	**By socioeconomic status, aged 12–15 years** *Lowest* 15 (1987); 8 (2005) *Second* 16 (1987); 7 (2005) *Third* 16 (1987); 6 (2005) *Highest* 16 (1987); 5 (2005) **By socioeconomic status, aged 16–17 years** *Lowest* 25 (1987); 16 (2005) *Second* 25 (1987); 17 (2005) *Third* 30 (1987); 17 (2005) *Highest* 30 (1987); 15 (2005)
Italy (Federico *et al*., 2004)	National Health Interview Surveys, 1980	**By education** *Aged 25–49 years* Elementary 64.7 (M); 17.2 (F) Lower secondary 65.2 (M); 30.9 (F) Upper secondary 61.6 (M); 37.7 (F) Post-secondary 53.6 (M); 40.5 (F) *Aged 50–79 years* Elementary 53.6 (M); 6.2 (F) Lower secondary 48.3 (M); 19.4 (F) Upper secondary 49.8 (M); 22.8 (F) Post-secondary 42.9 (M); 25.3 (F)
	National Health Interview Surveys, 1999–2000	**By Education** *Aged 25–49 years* Elementary 50.2 (M); 24.6 (F) Lower secondary 45.0 (M); 27.1 (F) Upper secondary 34.2 (M); 24.6 (F) Post-secondary 26.9 (M); 21.7 (F) *Aged 50–79 years* Elementary 25.6 (M); 9.2 (F) Lower secondary 26.0 (M); 16.5 (F) Upper secondary 24.4 (M); 19.2 (F) Post-secondary 24.4 (M); 20.0 (F)
EU countries (Austria, Belgium, Denmark, Germany, Greece, Finland, Ireland, Italy, Portugal, Spain, United Kingdom) (Huisman *et al*., 2005)	The fifth wave of the European Community Household Survey, 1998	**By education** *Highest* 22 (M); 19 (F) *Middle* 33 (M); 22 (F) *Lowest* 40 (M); 28 (F)

Table 7.1. Smoking prevalence rates by socioeconomic status

Publication (location, author, year)	Data sets and year	Prevalence rate (%)
EU countries (Austria, Belgium, Denmark, Germany, Greece, Finland, Ireland, Italy, Portugal, Spain, United Kingdom) (Huisman *et al.*, 2005) (contd)		**By household income** *Lowest* 39 (M); 25 (F) *2nd quintile* 34 (M); 22 (F) *3rd quintile* 32 (M); 21 (F) *4th quintile* 30 (M); 20 (F) *Highest* 27 (M); 19 (F)
Japan (Fukuda *et al.*, 2005)	Comprehensive Survey of the Living Conditions of People on Health and Welfare, 2001 (aged 18–54)	**By household income** *Lowest* 58.8 (M); 23.6 (F) *2nd quintile* 61.0 (M); 20.1 (F) *3rd quintile* 57.5 (M); 16.9 (F) *4th quintile* 57.3 (M); 13.7 (F) *Highest* 52.4 (M); 11.6 (F) **By Employment status** *Unemployed* 33.2 (M); 14.6 (F) *Employed* 59.2 (M); 17.5 (F) **By residential area** *Non-urban* 57.8 (M); 15.8 (F) *Urban* 52.6 (M); 21.6 (F)
Republic of Korea (Khang *et al.*, 2009)	Social Statistics Survey, 1999 and 2006	**Year 1999** *By education* College or higher 61.7 (M); 1.9 (F) High school 73.1 (M); 2.8 (F) Middle school or less 74.3 (M); 3.7 (F) *By Income quartile* I Highest 67.1 (M); 2.8 (F) II 70.0 (M); 1.9 (F) III 71.4 (M); 3.1 (F) IV Lowest 72.7 (M); 4.5 (F) *By occupational class* Non-manual 62.3 (M); 2.0 (F) Manual 74.1 (M); 4.1 (F) Others 70.7 (M); 2.6 (F) **Year 2006** *By education* College or higher 49.1 (M); 1.6 (F) High school 62.3 (M); 4.0 (F)

Publication (location, author, year)	Data sets and year	Prevalence rate (%)
Republic of Korea (Khang *et al.*, 2009) (contd)		Middle school or less 64.7 (M); 7.9 (F) *By income quartile* I Highest 51.4 (M); 2.2 (F) II 55.3 (M); 2.4 (F) III 57.7 (M); 3.5 (F) IV Lowest 61.5 (M); 4.8 (F) *By occupational class* Non-manual 48.3 (M); 1.5 (F) Manual 61.6 (M); 4.7 (F) Others 59.1 (M); 2.9 (F)

HH, M and F represent household, male and female prevalence rates respectively. Similarly, R and U stand for rural and urban areas.

Table 7.2. Tobacco expenditure as a percentage of total household expenditure/income by socioeconomic status of households

Publication (location, author, year)	Tobacco expenditure as % of household expenditure/income
Low and middle-income countries	
Turkey (Onder, 2002)	**% of income by income quintile** (1) 4.25 (2) 2.87 (3) 2.52 (4) 2.17 (5) 1.65
Egypt (Nassar, 2003)	**% of household expenditure by expenditure level (Currency: LE)** *−1200 LE* 3.60 (R); 1.11 (U) *3200- LE* 1.69 (R); 1.04 (U) *5600- LE* 0.95 (R); 0.48 (U) *10 000- LE* 0.62 (R); 0.26 (U) *14 000- LE* 0.50 (R); 0.15 (U)
Myanmar (Kyaing, 2003)	**% of household expenditure by income quintile** (1) 3.77 (R); 5.12 (U) (2) 3.31 (R); 4.03 (U) (3) 1.83 (R); 2.52 (U) (4) 1.68 (R); 2.64 (U) (5) 1.35 (R); 2.09 (U)
Nepal (Karki *et al.*, 2003)	**% of household expenditure by income quintile** (1) 4.4 (2) 5.7 (3) 3.5 (4) 3.3 (5) 2.3
Sri Lanka (Arunatilake and Opatha, 2003)	**% of household income by income quintile** Overall: 1.5 (1) 3.2 (2) 3.2 (3) 2.8 (4) 2.2 (5) 0.6
China (Hu *et al.*, 2005)	**% of household expenditure** *Poor* 11.3 (R); 6.6 (U) *Near-poor* 9.9 (R); 6.7 (U) *Non-poor* 8.4 (R); 9.1 (U) **% of household income** *Poor* 7.1 (R); 5.8 (U) *Near-poor* 8.9 (R); 5.9 (U) *Non-poor* 5.7 (R); 4.6 (U)
Indonesia (Adieotomo *et al.*, 2005)	**% of household expenditure** *Low-income* 7.24 *Middle-income* 5.53 *High-income* 3.02

Publication (location, author, year)	Tobacco expenditure as % of household expenditure/income
Indonesia (Barber *et al.*, 2008)	**% of total monthly expenditure by income quintile for households with smokers** (1) 11.9 (2) 12.3 (3) 12.4 (4) 11.7 (5) 9.2
South Africa (van Walbeek, 2005)	**% of household income by income quartile for urban smoking households** *Cigarette* 1990 (1) 1.71 (2) 1.54 (3) 0.96 (4) 0.49 1995 (1) 1.79 (2) 1.29 (3) 1.06 (4) 0.66 2000 (1) 3.17 (2) 2.84 (3) 2.61 (4) 1.53 *All tobacco products* 1990 (1) 1.74 (2) 1.57 (3) 0.99 (4) 0.51 1995 (1) 1.68 (2) 1.29 (3) 1.06 (4) 0.66 2000 (1) 2.87 (2) 2.71 (3) 2.57 (4) 1.55
Viet Nam (Kinh *et al.*, 2006)	**% of household expenditure by income quintile** (1) 5.29 (2) 4.58 (3) 4.30 (4) 4.06 (5) 3.60
Mexico (de Miera Juarez *et al.*, 2007)	**% of total household expenditure by income quintile** (1) 5.5 (2) 4.0 (3) 3.7 (4) 4.7 (5) 2.5
High-income countries	
USA (Gruber and Koszegi, 2002)	**% of income by income quartile** (1) 0.032 (2) 0.014 (3) 0.009 (4) 0.004 **% of expenditure by consumption quartile** (1) 0.015 (2) 0.013 (3) 0.010 (4) 0.004

Table 7.2. Tobacco expenditure as a percentage of total household expenditure/income by socioeconomic status of households

Publication (location, author, year)	Tobacco expenditure as % of household expenditure/income
USA (Gruber and Koszegi, 2002) (contd)	**% of income by education groups** *High school dropouts* 0.014 *High school graduates* 0.013 *Some college education* 0.008 *College graduates* 0.003
USA (Colman and Remler, 2008)	**% of income among smokers by income group** *Low* 7.7% *Medium* 3.1% *High* 1.4%
Canada (Gruber *et al.*, 2003)	**% of income by income quartile** (1) 4.14 (2) 2.16 (3) 1.72 (4) 1.01 **% of expenditure by expenditure quartile** (1) 2.28 (2) 1.82 (3) 1.43 (4) 0.93

(R) and (U) stand for rural and urban respectively

Wang *et al.* (2006) examined the opportunity cost of smoking in China by estimating the impact of tobacco spending on expenditure on other goods, controlling for demographic characteristics of households. They found that tobacco spending was negatively and significantly related to spending on food, education, farming, medical care and durable goods. John (2008) compared the expenditures on several categories of food and non-food items by tobacco-consuming and non-consuming households in India. He found that tobacco-consuming households had a lower share of their income spent on the consumption of milk, education, clean fuels and entertainment, but a higher share devoted to health care, clothing and fuels. He estimated that an increase in tobacco expenditure leads to a fall in the budget share devoted to food, education and entertainment and a rise in the budget share of health care in both rural and urban India. He reported that the change in budget shares was similar in both low-income and high-income households.

Tobacco use and poverty

The poor smoke more than the rich in many countries, and they are observed to have more reasons to adopt the practice of smoking as a part of their life (Bobak *et al.,* 2000). However, smoking can make people poor—it adversely affects the income level of individuals or households in several ways in addition to the decline in the availability of income for other goods and services and its opportunity cost. Evidence shows that increased premature deaths and healthcare cost associated with smoking-related illnesses increase the cost of smoking. Cutler *et al.* (2002) estimated that on average smokers lived six years less than comparable non-smokers because of the increase in heart and lung diseases.

In addition to losses due to premature deaths and increases in healthcare cost, smoking may reduce the earnings and wages of individuals. Smokers may earn less than non-smokers for several reasons: smoking may reduce productivity, and smokers may be costly to their employers with increased absenteeism, higher health and insurance premiums, higher maintenance cost and negative effects on morale. Levine *et al.* (1997) compared the wages of continuous smokers and those of the workers who quit smoking in the USA, and estimated that the former group had about 4–8%

lower wages than the latter group, after controlling for observable and unobservable time-invariant characteristics. Similarly, Heineck and Schwarze (2003) reported that smoking workers have 2–8% lower earnings compared to non-smoking workers aged between 25–55 years in Germany. The evidence from Netherlands and Canada also indicated lower earnings because of smoking. Van Ours (2003) estimated that the wages of male smokers were 10% lower than those of identical non-smokers in the Netherlands. Auld (2005) found that the difference was 24%. Lokshin and Beegle (2006) report that male smokers earn 20% less than similar non-smokers in Albania, after controlling for observed characteristics and unobserved heterogeneity in personal characteristics.

All of these studies indicate that smoking can reduce the income level of individuals. Moreover, smoking-attributable deaths and smoking-related diseases reduce the productivity of individuals as well. Furthermore, smoking-attributable medical expenses reduce the income available for other expenditures. For example, Liu *et al.* (2006) reported that on average, smokers spend 45% and 28% more on medical services than non-smokers in urban and rural China, respectively, in 1998.

Liu *et al.* (2006) further showed that even though high-income people had spent more on smoking-attributable medical expenditures than low-income individuals in absolute terms, the percentage of income spent on these types of expenditures was 6.5% for the lowest-income quintile group and only 1.5% for individuals in the highest-income quintile in urban China. They also estimated that because of medical expenditures attributable to smoking, 12.1 million people (5.8 million from urban areas and 6.3 million from rural areas) fall below the poverty line. Moreover, they predicted that smoking-related expenses pushed 41.8 million low-income people into poverty (24.7 million urban residents and 17.1 million rural residents). All of these findings indicate that a reduction in tobacco use would not only improve public health but also would reduce global poverty.

Regressivity of tobacco taxes

Since those individuals with low income are more likely to smoke and spend a higher share of their income on tobacco compared to individuals with high income, when increasing tobacco taxes are discussed, the dispute focuses on equity. The debate considers whether taxes make the income distribution more or less equal. If the tax is paid only by the wealthy, it will reduce income inequality. On the other hand, if the tax is paid by the poor, the post-tax income disparity widens, increasing the inequality. If a tax raises income inequality, it is regressive, whereas if it reduces inequality, it is progressive. If the taxes paid are an equal share of income for all income groups, tax is said to be neutral and it does not influence income redistribution.

The notion of vertical equity is one approach to measure the regressivity of taxes. The basic tenet of vertical equity is as follows: Individuals with the greater ability to pay taxes should be taxed more. The example is an income tax system which has the characteristic that the tax rate increases with the amount of income earned. However, taxes on tobacco and tobacco products seem to violate this notion, because in many countries the tobacco use prevalence rate and expenditure on tobacco as a percentage of income are higher among low-income individuals.

Another concern for any tax policy is the principle of horizontal equity, i.e. the principle that individuals who have similar ability to pay should pay the same or similar amount of taxes. Tobacco taxation seems to violate this principle as well, since otherwise-identical people who consume different quantities of tobacco products will be taxed differently.

As is observed in high- and low-income countries (but not higher middle-income countries), the prevalence of tobacco use is inversely related to income level. Hence, the regressivity of tobacco taxes is exacerbated. In the few countries where tobacco use increases with income levels, tobacco taxes can be considered to be less regressive, even though tobacco taxes as a share of income declines as income level increases. This definition can be considered as an accounting method to assess the tax burden (Remler, 2004).

As a second definition of tax burden, Fullerton and Rogers (1993) considered the welfare effect. They argued that the utility or the welfare of the individual will decline because of the decline in the consumption of the cigarettes with the increase in price. A third method to assess the tax burden was developed by behavioural economists (Gruber & Koszegi, 2004). According to this definition, smokers do want to quit smoking but have difficulty doing so because they have a conflict between their desire for nicotine and their desire for good health. The model is described in Chapter 4. The tax increase helps them to quit so they are doing what they are willing to do in the long run. This is called time-inconsistent preferences (Gruber and Koszegi, 2004). If the poor are willing to quit but have difficulty, the tax increase will help them to quit, thus reducing the tax burden.

Table 7.3. Effects of higher cigarette taxes on three types of smokers, measured under three alternative methods of assessing tax burden

	Response to tax increase	Accounting (income share) tax burden	Willingness-to-pay welfare-based tax burden	Time-inconsistent welfare-based tax burden
Smoker A	Quits	Better off	Worse off owing to cigarette consumption decrease Better off owing to lower tax bill Overall worse off since not compensated for being forced to quit	Better off owing to commitment device: eventual gains of quitting outweigh costs of quitting
Smoker B	No change in smoking	Worse off	Worse off owing to higher expenditures on cigarette	Worse off owing to higher expenditures on cigarette
Smoker C	Cuts back to keep tax expenditures constant	Same as before	Worse off owing to both higher price paid per cigarette and cutting back cigarette consumption	Somewhat better off owing to commitment device; eventual gains of quitting outweigh cost of quitting

Source: Used with permission of DK Remler, Poor smokers, poor quitters, and cigarette tax regressivity. American Journal of Public Health, 94:225–229, 2004. Copyright American Public Health Association.

Remler (2004) summarized the effects of higher cigarette taxes on three types of smokers using these three methods to assess the tax burden (Table 7.3). The first smoker (Smoker A) responds to the increase in taxes by quitting; the second smoker (Smoker B) does not change his/her consumption of cigarettes after the tax increase; the third smoker (Smoker C) reduces the cigarette consumption to keep his/her tax expenditure the same. Smoker A is better off with quitting because of the decline in the share of tobacco expenditure in total expenditures according to the accounting definition of tax burden, but worse off because the decline in cigarette consumption might reduce the utility according to willingness-to-pay welfare-based tax burden, and better off since s/he accomplishes quitting according to time-inconsistent definition. The smoker who does not change his/her consumption pattern (smoker B) will be worse off under three measures of regressivity. Smoker C, who reduces consumption so that there will be no change in tax share, will be worse off based on willingness-to-pay welfare-based tax burden and better off according to the time-inconsistent welfare-based tax burden measure.

Average versus marginal progressivity/regressivity of increases in tobacco tax

To determine whether a tax is progressive or regressive using the accounting measure, the share of taxes paid from a person's income must be calculated. Let *ut* represent the unit excise tax on tobacco and *Q* and *Y* be the quantity of tobacco consumed and income levels respectively. Then, an individual pays *(ut*Q)/Y* fraction of his/her income as tax. If this ratio does not change with income, then tax is said to be neutral. If it increases as income level declines, then taxes are considered to be regressive, meaning that the poor pay a larger proportion of their income in the form of tobacco taxes. On the other hand, if this ratio increases as the income level increases, taxes are defined as progressive, since the rich pay a greater share of their income as tobacco taxes. This measure of progressivity (or regressivity) is defined as average progressivity (or regressivity) because it examines the fairness of total taxes. Because the poor have lower incomes and consume more tobacco in general, we can say that tobacco taxes are regressive.

Although tobacco taxes may be regressive on average, they may not be marginally regressive, as pointed out by Warner (2000), who used an alternative approach to assess the regressivity of tobacco taxes. He argued that tobacco taxes may not be regressive because if the poor are more sensitive to price increases than the rich, then an increase in cigarette taxes and a resulting increase in cigarette prices make the poor quit smoking or reduce their consumption more than the rich would do. This could shift the burden of tax from the poor to the rich. Hence, an increase in cigarette taxes may turn out to reduce the regressivity of the tax, depending on whether the poor are more sensitive than the rich to the price.

From the policy perspective, the marginal regressivity of tobacco taxes is important. It is calculated as a ratio of the change in tobacco taxes paid because of the change in taxes, or tax rates, to income. It can be explained by using the example specified in Chaloupka *et al.* (2000). Assume that there are two smokers, consuming x units of cigarettes; one has an income of Y (low-income) and the other one earns three times higher income (3Y). Suppose that the low-income smoker has a higher price responsiveness (−0.80) than the high-income smoker has (−0.20), and 50% of price is tobacco tax. If the price of cigarettes (p) increases as result of doubling taxes (assume that it increases from P = 1 to P = 1.5 and all of the increase is transferred to consumers), then total tax paid will rise from 0.5x/Y to 0.6x/Y (=(1–0.80*0.50) x/y) for the low-income smoker and from 0.167x/Y (= 0.5x/3Y) to 0.3x/Y (=(1–0.20*0.50) x/3y) for the high-income smoker at the new consumption levels. The increase will be 0.1x/Y for the low-income smoker and 0.133x/Y for the high-income smoker. Hence, although taxes are regressive at the beginning, the tax increase is less regressive and total regressivity of tobacco taxes is reduced with the increase in tax.

Evidence about regressivity of tobacco taxes

Incidence analyses of tobacco excises have been extensive in high-income countries, notably in the USA and United Kingdom (Browning, 1978; Townsend, 1987; Congress of the United States, Congressional Budget Office, 1990, 2001; Borren and Sutton, 1992; Fullerton and Rogers, 1993; Townsend *et al.,* 1994; Lyon and Schwab, 1995; Evans *et al.,* 1999; Viscusi, 2002; Colman and Remler, 2004). Overall, these studies found that current excises on tobacco are regressive. Viscusi (2002) argued that cigarette taxes in the USA fell predominantly on the very poor, so that in 1990, low-income people who earned less than US$10 000 a year paid almost twice as much in cigarette taxes as higher-income people who earned US$50 000 and more a year. Recently, Colman and Remler (2008) examined the regressivity of increases in excise taxes on cigarette products in the USA using both tax-expenditure based (share of tax paid in income) and welfare (using consumer surplus estimates) measures of regressivity. They claimed that cigarette tax increases are not close to being progressive, regardless of the measures used. Moreover, according to the results of the recent study, Gospodinov and Irvine (2009) concluded that in Canada “there is little reason to overturn the traditional concerns about regressivity.”

Studies from low- and middle-income countries also observed that the burden of current excise taxes falls heavily on poor smokers. In these countries, the share of cigarette expenditure in household income or expenditure varies between 4.25% and 7.2%. The tax burden decreases by income, with the share in rich households ranging from 1.65% to 3% (Onder, 2002; Arunatilake and Opatha, 2003; Karki *et al.,* 2003; Adioetomo *et al.,* 2005). Excise taxes were found to be more regressive mainly due to the high smoking prevalence rate or low income level among the poor. However, results are mixed in terms of the regressivity of excise tax increases.

Studies using a budgetary approach in estimating the progressivity of excise tax increases have supported the claim that an increase in excise taxes may not be regressive. For example, Arunatilake and Opatha (2003) found that current excises are regressive in Sri Lanka. However, this study projected that after a 100% tax increase, the pre-tax regressivity gap (the difference between the share of household income spent on tobacco) would be reduced between the poorest and the richest groups, from a pre-tax level of 3.2% to a post-tax level of 2.3% for the poorest group and from a pre-tax level of 0.6% to a post-tax level of 0.9% for the richest group. Similarly, Sayginsoy *et al.* (2002) found that after a 72% tax increase in Bulgaria, the share of cigarette expenditure in poor households was reduced from a pre-tax level of 4.9% to 3.96%. In fact, the budget burden of cigarette tax was observed to be more equal among groups: 3.96%, 3.45% and 3.43% from the lowest to the highest income group respectively. In another study, Rajemison *et al.,* (2003) showed that excise taxes on cigarettes were progressive, but that this result was driven by the peculiarities of the Madagascar market. Cigarettes, which are taxed, are consumed by the better-off; while another tobacco product (parakay), which is not taxed, is consumed widely by the poor.

Hence, to determine whether tax increases increase the burden on the poor, it is important to know how the poor and the rich will change their consumption because of the increase in prices. In other words, the regressivity of tax increases depends on the price sensitivity of the poor and the rich.

Differences in price sensitivity by socioeconomic status

Studies based on aggregate data are limited by the fact that the estimates are not obtainable by income, education, or any type of indicator of socioeconomic status of individuals who consume tobacco products. Hence, studies estimating price elasticity of tobacco demand by socioeconomic status are based on individual or household-level data.[3] Table 7.4 reports the estimates of price elasticity of cigarette demand by socioeconomic status of smokers in different countries classified according to the World Bank income classification.

Evidence from high-income countries

Chaloupka (1991) was the first to investigate the price responsiveness of different socioeconomic groups' tobacco consumption. Using individual-level data from the Second National Health and Nutrition Examination Survey conducted in the late 1970s, Chaloupka estimated that the price elasticity of cigarette demand was greater for individuals with less than high school education (ranging from −0.57 to −0.62) than those with at least high school education, who were found to be unresponsive to price changes.

Separate estimates of price elasticity of smoking prevalence and smoking intensity were not available until 1998. Pooling data for 14 years (1976–1980, 1983, 1985 and 1987–1993) from the US National Health Interview Survey, CDC (Centers for Disease Control and Prevention, 1998) showed that smoking prevalence among people below the median income level was more price responsive than among people above the median income level. The converse was true for smoking intensity—the number of cigarettes smoked per day by smokers above the median income level was found to be more price elastic than that for smokers below the median income level. However, the overall price elasticity was greater for people in the lower economic class (−0.29) than for people in the upper economic class (−0.17). The greater price responsiveness of low-income people was thus driven by their greater smoking prevalence elasticity.

The CDC (Centers for Disease Control and Prevention, 1998) further observed that Hispanics were more price responsive than were the black and white populations, both with respect to smoking prevalence and smoking intensity. Blacks were more price responsive than whites with respect to smoking prevalence, and less so with respect to smoking intensity. To the extent that race and ethnicity are proxies for socioeconomic status of population groups in the USA, the greater price responsiveness of the minority (Hispanic and Black) is attributable to differences in their socioeconomic status. Subsequent studies by Biener *et al.* (1998), Evans *et al.* (1999), Hersch (2000), Farrelly *et al.* (2001), Gruber and Koszegi (2002; 2004), Stehr (2007), and DeCicca and McLeod (2008) confirm the negative relationship between socioeconomic status and price responsiveness of tobacco demand.

In a recent study using data from the 1984–2004 Behavioural Risk Factor Surveillance System surveys for the US, Franks *et al.* (2007) found that the elasticity of smoking prevalence with respect to cigarette price was larger among the lowest income group (−0.45) compared to the higher income groups (−0.22) in the pre-Master Settlement Agreement (MSA) period (1984–1996), whereas in the post-MSA period (1997–2004), smoking prevalence became price insensitive for all income groups. The study concluded from these results that in the USA, "increasing cigarette prices may no longer be an effective policy tool and may impose a disproportionate burden on poor smokers."

[3] One exception is the study on UK by Townsend et al. (1994) that used aggregate level data to obtain estimates of price elasticity by socioeconomic groups.

Table 7.4. Price elasticity of tobacco use by income/SES/education

Publication (location, author, year)	Methods and model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Low-income countries					
Myanmar (Kyaing, 2003)	Myanmar Study on Tobacco Economics 2001 - OLS estimation of the price equation - Logit model (with independent variables in log) to estimate probability of smoking in the household (extract from their price elasticity of smoking prevalence) - OLS estimation method for the consumption equation. Total price elasticity = (1-probability of smoking)*(price elasticity of smoking prevalence) + price elasticity of smoking intensity	**Overall** −1.62 **By income quintile** (1) −1.06 (2) −1.56 (3) −1.75 (4) −1.73 (5) −1.48	**Overall** −1.28 **By income quintile** (1) −1.09 (2) −1.25 (3) −1.41 (4) −1.38 (5) −1.24	**Overall** −0.34 **By income quintile** (1) −0.42 (2) −0.31 (3) −0.34 (4) −0.36 (5) −0.24	Dependant variable: Monthly consumption of cigarettes, cheroots and phet kyan (per stick) Independent variables: price of cigarettes, cheroots or phet kyan; per capita monthly income; tax on cigarette/cheroots; dummies for age, sex, literacy, marital status, addiction, education level, place of residence
Myanmar (Kyaing *et al.*, 2005)	Survey of low-income consumers Log-log OLS estimation of conditional cigarette demand function	**Price elasticity of demand** *By income (currency unit: Kyat)* Group 1 ≤24 000 Group 2 24 000–45 000 Group 3 45 000 – 75 000 Group 4 ≥75 000 *Cheroots* Overall: −0.36** (1) −0.50** (2) −0.44** (3) −0.22** (4) −0.32* *Cigarettes* Overall: −0.25* (1) −0.15 (2) −0.37* (3) −0.25* (4) −0.14 *Cigarettes and cheroots* Overall: −0.17* (1) −0.29* (2) −0.19 (3) −0.10 (4) −0.27			Dependent variable: consumption of cheroots * $P < 0.05$ ** $P < 0.01$

Table 7.4. Price elasticity of tobacco use by income/SES/education

Publication (location, author, year)	Methods and model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Nepal (Karki *et al.* 2003)	Smoking Behaviour Survey, November–December 2000 - OLS estimation of the price equation - Logit model (with independent variables in log) to estimate the probability of smoking of the household (extract from there price elasticity of smoking prevalence). - OLS estimation method for the consumption equation. Total price elasticity = (1-probability of smoking)*(price elasticity of smoking prevalence) + conditional price elasticity of smokers	**Overall** −0.88 **By income quintile** (1) −0.79 (2) −0.87 (3) −0.83 (4) −0.63 (5) −0.60	**Overall** −0.46 **By income quintile** (1) −0.31 (2) −0.26 (3) −0.35 (4) −0.35 (5) −0.31	**Overall** −0.42 **By income quintile** (1) −0.48 (2) −0.61 (3) −0.48 (4) −0.28 (5) −0.29	Dependant variable - Monthly consumption of cigarettes and bidis (per stick) Independent variables price of cigarettes or bidis, per capita monthly income, cigarette and bidi tax, dummies for: age, sex, occupation, marital status, addiction, education level, place of residence
Viet Nam (Kinh *et al.* 2006)	1997–1998 Household level cross-sectional data from Viet Nam Living Standards Survey -Linear probability model of smoking status -Double log model of cigarette consumption conditional of smoking participation		**Overall** −0.53 **By income** *Two low quintiles* −0.65 *Two high quintiles* −0.42	**Overall** −0.50 **By income** *Two low quintiles* −0.59 *Two high quintiles* −0.40	Dependent variable: dummy variable for smoking status Independent variables: Price of cigarettes, price of piped tobacco, annual per capita income, individual, household, geographic and commune characteristics
Bangladesh (Nargis *et al.* 2010)	International Tobacco Control Policy Evaluation Bangladesh Survey, 2009 Two-step method: (1) Logit estimation of smoking prevalence (2) OLS estimation of cigarette (bidi) consumption of smokers	**Cigarette demand** *Overall* −0.43 *By socioeconomic status* Low −0.43 Medium −0.39 High −0.24 **Bidi demand** *Overall* −0.64 *By socioeconomic status* Low −1.18	**Cigarette demand** *Overall* −0.29*** *By socioeconomic status* Low −0.33*** Medium −0.27** High −0.14*** **Bidi demand** *Overall* −0.46*** *By socioeconomic status* Low −0.90***	**Cigarette demand** *Overall* −0.14*** *By socioeconomic status* Low −0.10 Medium −0.12** High −0.10* **Bidi demand** *Overall* −0.18 *By socioeconomic status* Low −0.28	Dependent variable: Smoking participation, daily cigarette (bidi) consumption Independent variables: Price per pack of cigarette (bidi), level of education, marital status, number of years of smoking since initiation, village dummy, urban/rural residence, socioeconomic status represented by CASHPOR Housing Index * $P < 0.10$ ** $P < 0.05$ *** $P < 0.01$

Publication (location, author, year)	Methods and model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Bangladesh (Nargis *et al.* 2010) (contd)		Medium −0.91 High −0.44	Medium −0.77** High −0.07	Medium: −0.14** High −0.37***	
Lower-middle-income countries					
Sri Lanka (Arunatilake, 2002)	Household level data 1999/2000 First step: logit model estimating the smoking prevalence Second step: OLS estimation of the tobacco consumption Total price elasticity derived from the elasticity estimates of the smoking prevalence and conditional demand equations	**Overall** −0.45 **By expenditure quintiles** (1) −0.74* (2) −0.69* (3) −0.61 (4) 0.03 (5) 0.12			Dependent variable: per capita monthly tobacco consumption Independent variables: tobacco price per unit of tobacco, monthly per capita income, male ratio, occupation, education, age category, and location (equations divided by expenditure groups, quintiles) **P* < 0.05
Sri Lanka (Arunatilake and Opatha, 2003)	Srilanka Integrated Survey data of households, 1999–2000 Two-part model: 1 – logit model of household decision to smoke 2 – OLS estimation of conditional demand equation for participating households	**Overall** −0.53 **By expenditure quintile** (1) −0.64 (2) −0.55 (3) −0.60 (4) −0.68 (5) −0.29	**Overall** −0.10* **By expenditure quintile** (1) −0.17 (2) 0.17 (3) 0.21* (4) 0.01 (5) 0.34**	**Overall** −0.60*** **By expenditure quintile** (1) −0.52*** (2) −0.67*** (3) −0.74*** (4) −0.69*** (5) −0.56***	Dependent variable: -household decision to smoke - per capita monthly consumption of cigarettes Independent variables: real price of cigarettes, real per capita income, ratio of adult males to adult females, occupation, education, age, location **P* < 0.10; ***P* < 0.05; ****P* < 0.01.
Ukraine (Krasovsky *et al.*, 2002)	June 2001 national representative survey 1 – OLS estimation of the demand equation 2 – Binary regression using the ML method to estimate the prevalence equation model	**Overall** −0.40 **1 – For adults aged 18 to 28 by income group** *Low* −0.37 *Medium* −0.42 *High* −0.24 **2 – Aged 29+ years** *Low* −0.28 *Medium* −0.33 *High* −0.15			Dependent variable: number of cigarettes consumed (cigarette expenditure divided by cigarette prices) Independent variables: real price of cigarettes, household income, age, sex, strength of addiction, region dummies, dummy reflecting whether a smoker had underage children

Table 7.4. Price elasticity of tobacco use by income/SES/education

Publication (location, author, year)	Methods and model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
China (Mao *et al*., 2003)	1998 National tobacco survey in 8 cities and 16 counties	**Overall** −0.51 **Low-income** −1.90 **Middle-income** −0.77 **High-income** 0.51			
China (Mao *et al*., 2007)		**Overall** −0.154 **Poor** −0.589 **Low-income** −0.234 **Middle-income** –0.018 **High-income** 0.257			
Taiwan, China (Lee, 2008)	Cross-sectional data from 483 respondents of a telephone survey of current smokers (15+ years) from all 23 major cities and counties, collected in April–July 2004 Tobit regression model	**By education** *College and above* −0.10 *High school* −0.06 *Junior high school* −0.11 **By monthly income (currency unit: NT$)** *≤ 9999* −0.63* *10 000–29 999* −0.38 *30 000–49 999* –0.48* *≥50 000* 0.18			Dependent variable: willingness of current smokers to quit smoking or reduce cigarette consumption when faced with a tax increase of NT$22 per pack, which would raise the price of cigarettes by 44% Independent variables: cigarette prices, monthly income **P* < 0.05
Egypt (Nassar, 2003)	1995/1996 and 1999/2000 Household expenditure surveys Log-log estimation of OLS on the pooled data	**Price elasticity of tobacco** *By expenditure quartiles* 1995/96 Urban Rural (1) −0.30 −0.29 (2) −0.33 −0.32 (3) −0.31 −0.35 (4) −0.26 −0.38 1999/00 Urban Rural (1) −0.39 −0.35 (2) −0.42 −0.37			Dependant variable: - tobacco expenditure Independent variables: aggregate prices on different types of tobacco, total household expenditure, education, work status, occupation, urban/rural regions

Publication (location, author, year)	Methods and model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Egypt (Nassar, 2003) (contd)		(3) −0.42 −0.38 (4) −0.47 −0.47 *By education status* 1995/96 Urban Rural (1) −0.37 −0.37 (2) −0.33 −0.37 (3) −0.27 −0.27 (4) −0.25 −0.24 1999/00 Urban Rural (1) −0.47 −0.41 (2) −0.45 −0.38 (3) −0.42 −0.37 (4) −0.41 −0.36			
Thailand (Isra, 2003)	Household socioeconomic survey 2000 (Consumer price index from the Department of Business Economics, Ministry of Commerce) Linear expenditure system model Estimation by 5 income classes in urban and rural areas separately	**Overall** −0.39 **By income class** *Urban* (1) −1.00 (2) −0.36 (3) −0.13 (4) −0.10 (5) −0.04 *Rural* (1) −0.49 (2) −0.05 (3) −0.03 (4) −0.15 (5) −0.07			Variables included: tobacco consumption, expenditure on cigarettes and other tobacco products, cigarette price, household income, prices of 12 consumer goods, age, education Dummy: urban/ rural
Indonesia (Adioetomo *et al.* 2005)	1999 Social and Economic Survey (SUSENAS) household data First step: logit model estimating the smoking prevalence. Second step: OLS estimation of the tobacco consumption conditional on smoking participation. Total price elasticity derived from the elasticity estimates of the smoking prevalence and conditional demand equations	**Overall** −0.61 **By income** *Low* −0.67 *Medium* −0.33 *High* −0.31	**Overall** −0.02 **By income** *Low* −0.03 *Medium* 0.09 *High* 0.20	**Overall** −0.60* **By income** *Low* −0.66* *Medium* −0.37* *High* −0.41*	Dependant variable: Monthly cigarette consumption divided by the number of household members Independent variables: Cigarette price in rupiah per pack of 16 cigarettes (expenditure on cigarettes divided by the quantity of cigarettes consumed), per capita household income per day in rupiah, dummy for urban/rural location, dummies for education, profession, age and sex *$P < 0.01$

Table 7.4. Price elasticity of tobacco use by income/SES/education

Publication (location, author, year)	Methods and model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Upper-middle-income countries					
Bulgaria (Sayginsoy *et al.*, 2002)	Living Standards Measurement Study Household survey, 1995 2SLS log-log estimation for overall sample and by income group.			**Overall** −0.80 **By income** *Low and low-middle* −1.33 *High-middle* −1.02 *High* −0.52	Dependent variable: Number of packs of 20 smoked by the household per month per capita Independent variables: average price paid for a pack of cigarette, total household income, mean age of all members of household, years of education received by the most educated household member, litres of alcohol consumed per capita in each household, ratio of number of adult males in each household to the size of the household, Dummy = 1 if the household has at least one member who is a widow(er), divorced, living separate from husband/wife or is older than 35 and not married
South Africa (van Walbeek, 2002b)	The Income and Expenditure household surveys of 1990 and 1995 - Log-log estimation of income elasticity for each income quartile for 1990 and 1995 (log of the cigarette expenditure divided by the income and function of the income quartiles). - Calculation of net change of cigarette consumption between 1990 and 1995 (% change in average cigarette consumption minus the effect of income change on consumption) - Estimation of price elasticity (net change of cigarette consumption divided by real price change)	**By income quartile** (1) −1.39 (2) −1.13 (3) −1.08 (4) −0.81			Dependent variable: Household's annual expenditure on cigarettes Independent variables: real household income subdivided into four income quartiles, real price of cigarettes

Publication (location, author, year)	Methods and model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
Turkey (Onder, 2002)	Household Expenditure and Consumption Survey, 1994 First step: Estimation of the smoking participation decision of the households with a logit model for all households and by income quintiles; estimation of the cigarette tax as a function of household income and estimation of the price for non smoker households - Second step: Log-log estimation of the conditional demand for cigarettes by the smoker Two-stage least squares estimation to correct for endogeneity of the price variable	**Overall** −0.41 **By household income** (1) −0.47 (2) −0.90 (3) −0.56 (4) −0.43 (5) −0.16	**Overall** −0.03 **By household income** (1) −0.12 (2) −0.32 (3) −0.11 (4) −0.02 (5) 0.15	**Overall** −0.39 **By household income** (1) −0.35 (2) −0.58 (3) −0.45 (4) −0.41 (5) −0.30	Dependent variables: - number of cigarettes smoked by the smoker households - smoking participation decision (probability of smoking) - cigarette price - cigarette excise tax. Independent variables: cigarette price per package of 20, per capita household income per month, education, gender, age, number of adults in the household, location, region, dummy: employed head, dummy: white collar head
High-income countries					
USA (Chaloupka 1991)	1976–1980 individual-level data from the second National Health and Nutrition Examination Survey Two-stage least-squares estimation	**Long-run price elasticity of cigarette consumption** *Overall* −0.30 to −0.46 *Less than a high school education* −0.57 to−0.62 *At least a high school education* unresponsive			Dependent variable: Average daily cigarette consumption Independent variable: Current price, past price, future price, addictive stock, lagged consumption, future consumption
USA (Centers for Disease Control and Prevention 1998)	Pooled data from 14 years (1976–1980, 1983, 1985, and 1987–1993) from the National Health interview Survey for ≥18 age group -Probit model of smoking prevalence -OLS estimation of conditional demand model of cigarette consumption	**Overall** −0.25 **By income** *≤median* −0.29 *> median* −0.17 **By race** *White* −0.14 *Black* −0.32 *Hispanic* −1.89	**Overall** −0.15 **By income** *≤median* −0.20 *> median* −0.05 **By race** *White* −0.05 *Black* −0.36 *Hispanic* −1.31	**Overall** −0.10 **By income** *≤median* −0.09 *> median* −0.12 **By race** *White* −0.09 *Black* 0.04 *Hispanic* −0.58	-Smoking prevalence Dependent variable: prevalence of smoking -Smoking intensity Dependent variable: cigarettes per day for smokers Independent variables: age, age squared, real family income, family size, state of residence, year, city size, race or ethnicity, educational level, marital status, gender, price of cigarettes

Table 7.4. Price elasticity of tobacco use by income/SES/education

Publication (location, author, year)	Methods and model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
USA (Hersch 2000)	1992/93 Current Population Surveys: Tobacco Use Supplement Participation equation estimated by probit model and smokers' consumption equation by OLS regression for men and women		**Male** *Overall* −0.54** *By income* Low −0.58** Medium −0.40** High −0.25 **Female** *Overall* −0.38** *By income* Low −0.99** Medium −0.06 High 0.58*	**Male** *Overall* −0.43** *By income* Low −0.60** Medium −0.44** High −0.13 **Female** *Overall* −0.57** *By income* Low −0.72** Medium −0.55** High −0.30	Dependent variable: smoking participation, cigarette consumption of smokers Independent variables: price, family earning, education, age, age squared, marital status, race, age of youngest child, occupational status *$P < 0.05$ **$P < 0.01$
USA (Farrelly *et al.* 2001)	Pooled data from 14 years (1976–1980, 1983, 1985, and 1987–1993) from the National Health interview Survey for > = 18 age group -Probit model of smoking prevalence -OLS estimation of conditional demand model of cigarette consumption	**Overall** −0.28 **By income** *≤median* −0.43 *> median* −0.10 **By race** *African-American* −0.35 *Hispanic* −0.93 *White* −0.15	**Overall** −0.13 **By income** *≤median* −0.21 *> median* 0.01 **By race** *African-American* −0.20 *Hispanic* −0.62 *White* −0.08	**Overall** −0.15 **By income** *≤median* −0.22 *> median* −0.11 **By race** *African-American* −0.15 *Hispanic* −0.31 *White* −0.15	-Smoking prevalence Dependent variable: prevalence of smoking -Smoking intensity Dependent variable: cigarettes per day for smokers Independent variables: age, age squared, real family income, family size, state of residence, year, city size, race or ethnicity, educational level, marital status, gender, price of cigarettes
USA (Ringel and Evans, 2001)	Cross-sectional Nataly Detail Files (1989–1995) *n* = 20 025 000 pregnant women (14–21 years) Probit model		**By education** *College* −3.39 *Some college* −0.86 *High school* −0.49 *< High school* −0.30		Dependent variable: smoking participation Independent variables: monthly state excise rates (that near the beginning of the pregnancy) in real 1997 prices, age, race/ethnicity, education, marital status, parity of birth, adequacy prenatal care, sex of child, state and month of conception

Publication (location, author, year)	Methods and model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
USA (Ringel and Evans, 2001) (contd)			**By race** *Black* −0.55 *White* −0.79 *Hispanic* −0.64 *Others* −0.54		
USA (Gruber and Koszegi, 2004)	Consumer Expenditure Survey, 1980–1998 Instrumental variable estimation of cigarette expenditure function			**Price sensitivity of cigarette expenditure** *By income quartile* (1) −1.09 (2) −0.70 (3) −0.53 (4) −0.39 *By consumption quartile* (1) −1.05 (2) −0.77 (3) −0.31 (4) −0.64 *By education groups* High school dropouts −1.08 High school graduates −0.93 Some college education −0.11 College graduates −0.40	Dependent variable: cigarette expenditure Independent variables: price instrumented by excise tax, age, education, sex, race of the household head, dummies for number of persons in the household, state dummies, year dummies, calendar month dummies
USA (Franks *et al.*, 2007)	1984–2004 Behavioral Risk Factor Surveillance System surveys Logistic regression		**1984–1996** *Lowest income quartile* −0.45* *All other income quartiles* −0.22* **1997–2004** *Lowest income quartile* −0.14 *All other income quartiles* −0.07		Dependent variable: Smoking prevalence Independent variables: Cigarette pack price, age, age squared, gender, race/ ethnicity, years of schooling, number of adults in the household, consumer price index, household income, dummy variables for each survey year and each state, Gini coefficient for each year * $P < 0.01$
USA (Stehr, 2007)	Cross sectional (pooled surveys) Behavioral Risk Factor Surveillance System (1985–2000); sample size over 1.3	**Male** *Overall* −0.26 *By income quartile* (1) −0.36	**Male** *Overall* −0.16 *By income quartile* (1) −0.23	**Male** *Overall* −0.09 *By income quartile* (1) −0.13	Dependent variables: smoking participation, cigarette consumption Independent variables: gender, state fixed effects,

Table 7.4. Price elasticity of tobacco use by income/SES/education

Publication (location, author, year)	Methods and model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
USA (Stehr, 2007) (contd)	million (age ≥ 18 years) Two-part model: 1) probit (smoking participation) 2) log-log OLS (conditional demand for cigarettes)	(2) −0.11 (3) −0.21 (4) −0.23 **Female** *Overall* −0.51 *By income quartile* (1) −0.59 (2) −0.30 (3) −0.47 (4) −0.53	(2) −0.07 (3) −0.09 (4) −0.15 **Female** *Overall* −0.40 *By income quartile* (1) −0.43 (2) −0.25 (3) −0.30 (4) −0.43	(2) −0.03 (3) −0.13 (4) −0.07 **Female** *Overall* −0.12 *By income quartile* (1) −0.16 (2) −0.05 (3) −0.16 (4) −0.10	income, education, sex, age, ethnicity, and year of interview
USA (Colman and Remler, 2008)	Current Population Survey (CPS) Tobacco Use Supplements (TUS) and March Income Supplements, six pooled cross-sections—1993, 1996, 1999, 2001, 2002, and 2003 Two-part model: First stage—Linear probability model (OLS) Second stage—OLS regression of cigarette consumption among those who smoke	**Low income** −0.37 **Medium income** −0.35 **High income** −0.20	**Low income** −0.24 **Medium income** −0.20 **High income** −0.12	**Low income** −0.13 **Medium income** −0.11 **High income** −0.08	-Smoking prevalence Dependent variable: prevalence of smoking -Smoking intensity Dependent variable: cigarettes per day for smokers Independent variables: cigarette price, family income, year, state indicators, dummies for the education levels of high school, some college, college graduate, and more than college (high-school dropout is the omitted category); Hispanic, non-Hispanic black, and non-Hispanic other race (non-Hispanic white is the omitted category); female; divorced, separated, widowed, and never-married (married is the omitted category); unemployed and not-in-the-labour-force (employed is the omitted category); the occupational categories blue-collar, service, farm, military, and never-employed (white-collar is the omitted category); and several continuous variables, including age and age squared, thenumber of children under 6 years old

Publication (location, author, year)	Methods and model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
USA (Colman and Remler, 2008) (contd)					in the family, interactions between year and age and age squared to allow time trends to differ by age, and an index measure of legal restrictions ("clean air index") on indoor smoking
USA (DeCicca and McLeod, 2008)	Cross-sectional (5 surveys) Behavioral Risk Factor Surveillance System (2000–2005) 435 973 adults (45–59 years old) Telephone interview Representative sample US population Two-way fixed effects models (multilevel model)		**By education** *Low* −0.43 *High* −0.12 **By income** *Low* −0.39 *High* −0.09		Dependent variable: smoking participation Independent variables: real monthly state-specific cigarette excise tax rates per pack of 20 cig in 2001 dollars, gender, age, race, education, income, marital status, health status, unemployment rate, state ban in workplaces and restaurants
USA (Farrelly and Engelen, 2008)	Pre and post- Master Settlement Agreement (MSA) estimates as reported by Nielsen Co. 1990–2006 Sample size: 1990–1998: 782 403 1998–2006: 1 763 952 Logistic regression		**By income quartile** *1990–1998 (pre-MSA)* Overall −0.22 Lowest −0.16 Middle 2 quartiles −0.34 Highest −0.14 *1998–2006 (post-MSA)* Overall –0.09 Lowest −0.11 Middle 2 quartiles −0.06 Highest −0.02		Dependent variable: Smoking prevalence Independent variables: Cigarette pack price, age, age squared, gender, race/ethnicity, years of schooling, number of adults in the households, consumer price index, household income, dummy variables for each survey year and each state, Gini coefficient for each year
United Kingdom (Townsend *et al.*, 1994)	Biennial data from British general household survey, 1972–90 Model of smoking prevalence and cigarette consumption by socioeconomic groups		**Men** *All* −0.08 *Socioeconomic group (5)* –0.61* **Women** *All* −0.23* *Socioeconomic group (5)* −0.51**	**Men** *All* −0.47 *By socioeconomic group* (1) 0.03 (2) −0.12 (3) Non-manual −0.67* (4) Manual −0.49* (5) −0.47* (6) −1.02*	Dependent variable: prevalence of smoking, defined by the proportion of adults currently smoking one or more cigarettes a day, and numbers of cigarettes smoked per smoker **P* < 0.05 ***P* < 0.01

Table 7.4. Price elasticity of tobacco use by income/SES/education

Publication (location, author, year)	Methods and model	Total price elasticity of demand	Price elasticity of smoking prevalence	Price elasticity of smoking intensity	Comment
United Kingdom (Townsend *et al.*, 1994) (contd)				**Women** *All* −0.61** *By socioeconomic group* (1) 0.50 (2) −0.29 (3) Non-manual−0.75** (4) Manual −0.71* (5) −0.64* (6) −0.88*	
Canada (Gruber *et al.*, 2003)	1982–1998 Canadian Survey of Family Expenditure Instrumental variable estimation of cigarette expenditure function	**By income quartile** (1) −0.99 (2) −0.45 (3) −0.31 (4) −0.36 **By expenditure quartile** (1) −0.92 (2) −0.73 (3) −0.20 (4) −0.37			Dependent variable: cigarette expenditure Independent variables: price of cigarettes, region, year, gender, income, income squared, regional time trends
Canada (Gospodinov and Irvine 2009)	Statistics Canada/Health Canada Canadian Tobacco Use Monitoring Survey (CTUMS), 2000–2005 Two-part model of estimation	**Overall** −0.30 **< High school** −0.23 **High school** −0.33 **College** −0.30			Dependent variable: smoking participation, cigarette consumption Independent variables: price, province of residence, level of education
Australia (Siahpush *et al.*, 2009)	Australian population survey data collected monthly from January 1991 to December 2006 Sample size: 515 866 individuals aged ≥18 years Poisson regression to estimate monthly smoking prevalence as a function of covariates		**By income** *Low-income* −0.32 *Medium-income* −0.04 *High-income* −0.02		Dependent variable: smoking prevalence Independent variables: price, income, interaction of price with income, education, age, gender, time

The above conclusion sparked an empirical debate regarding the role of socioeconomic status in the welfare consequences of tobacco tax increase. Farrelly and Engelen (2008), for example, reanalysed the data used in Franks *et al.* (2007), adding two years of data after the MSA and limiting the pre-MSA period from 1990 to October 1998. They dropped the earlier years because only 15 US states were included in the data for 1984–1989. Then replicating the same model and analytic approach, they found that the size of the price effect did decline in the post-MSA period, but only among the middle- and high-income people. Thus the lowest income group was still found to be price-sensitive, in contrast to what Franks and his colleagues observed. This disagreement reflects that the results of estimation by socioeconomic status were sensitive to the period of the data they used. Franks *et al.* (2008) immediately responded by pointing out several inconsistencies in Farrelly and Engelen's analysis, especially the loss of sample size by over one million persons due to dropping two years of observations. A contemporary study by Colman and Remler (2008) reinforced the greater price elasticity for lower-income groups: −0.37 for the low-income, −0.35 for the medium-income and −0.20 for the high-income group.

An earlier study by Ringel and Evans (2001) found that among pregnant women in the USA, price responsiveness of cigarette demand was highest among the most-educated cohort and was lower the lower the level of education. They also found lower price responsiveness among black and Hispanic pregnant women than among whites. Their findings suggest that the pregnant women among the white population are more conscious of the adverse health consequences of smoking compared to the minorities and are more responsive to price increases. However, this result applies to the pregnant women in the USA, not necessarily to the general population.

Estimates of price elasticity of smoking intensity reported in Gospodinov and Irvine (2009) for Canada show greater price responsiveness among high school graduates (−0.33) than among those with less than a high school education (−0.23) or among college graduates (−0.30), suggesting an inverse-U relationship between price sensitivity and level of education. However, Gruber *et al.* (2003) found a more systematic relationship between income and cigarette expenditure elasticity in Canada—the estimates were considerably greater in the lowest two quartiles than in the upper two quartiles.

In a seminal study in the United Kingdom, using biennial data from British general household survey (1972–90), Townsend *et al.* (1994) found that both smoking prevalence and intensity among men and women in lower socioeconomic groups were more responsive to changes in cigarette prices and less responsive to information about the adverse health consequences of smoking. The uniqueness of this study lies in the fact that it uses aggregated data by socioeconomic group rather than cross-sectional level data, which form the basis for all other studies in this genre. The price elasticity of smoking prevalence of men in the lowest socioeconomic group among five groups was estimated to be −0.61, while it was −0.08 for the overall male population. For women, smoking prevalence elasticity was −0.51 in the lowest socioeconomic group, compared with −0.23 for overall female population. Similarly, the elasticity of smoking intensity was estimated to be at −1.02 and −0.88 for men and women in the bottom socioeconomic group respectively, compared with −0.47 and −0.61 for the total male and female population. The inverse relationship of price responsiveness of tobacco demand to the socioeconomic status of people in the United Kingdom was further confirmed in Townsend (1996).

The relationship between price responsiveness of smoking prevalence and socioeconomic status is, however, not monotonic. Borren and Sutton (1992) found evidence of an 'inverse-U' relationship of price responsiveness with income status in the United Kingdom—middle-income men were found to be more price elastic than lower- and higher-income men. Their evidence for women, however, corresponds to the more common finding that price elasticity declines as income increases.

Schaap *et al.* (2008) studied the effectiveness of comprehensive tobacco control policies including price and taxation in 18 European countries.[4] They found the strongest association of quit ratio with price policy among all the tobacco control policies implemented in these countries, including taxes on tobacco products, bans or restrictions on smoking in public places, advertising bans, public information campaign spending, health warnings, and treatment. However, they observed no significant difference in the impact of an increase in tobacco price on quitting between high and low education groups. Similarly, Lee (2008) found no significant difference in price responsiveness across different education groups in Taiwan,

[4] Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Portugal, Slovakia, Spain, Sweden and United Kingdom.

China. However, this study found the highest price sensitivity among the smokers with the lowest monthly income.

In Australia, on the other hand, Siahpush *et al.* (2009) found consistently greater price sensitivity of smoking prevalence among lower-income respondents. The difference of price elasticity of smoking prevalence estimated for low-income people (−0.32) from those estimated for medium income (−0.04) and high income (−0.02) groups is stark. This study is unique in using monthly data on smoking prevalence, and presents a significant improvement over the previous studies that were limited by their use of annual prevalence data. The authors argue that annual data are likely to provide inaccurate estimates of the effect of price on smoking behaviour, as it may miss any fast-acting change in smoking behaviour in response to a price increase or stabilization within a given year.

Evidence from low- and middle-income countries

The variation of price responsiveness of smoking prevalence and intensity across socioeconomic groups is evident in low and middle income countries as well. The relevant literature proliferated during 2002–2003 and thereafter with the launching of the HNP Discussion Paper series by the Health, Nutrition and Population Family (HNP) of the World Bank's Human Development Network on the Economics of Tobacco Control, in collaboration with the Tobacco Free Initiative of the World Health Organization. These studies are based on relatively recent data sets and are uniform in method of estimation of price elasticities for smoking prevalence and smoking intensity.

Among low-income countries, evidence from Myanmar suggests an inverse-U relationship of price responsiveness of smoking prevalence to income group—the prevalence elasticity for the third quintile (−1.41) was estimated to be greater than those for the bottom (−1.09) and top quintiles (−1.24) (Kyaing, 2003). The price elasticity of smoking intensity was, however, highest for the lowest income quintile, although the price elasticity did not decrease monotonically with higher economic status. A later study by Kyaing *et al.* (2005) found the highest price elasticity among the lowest income group for cheroots and among the second lowest income group for cigarettes in Myanmar. For Nepal, as shown in Karki *et al.* (2003), the price elasticity of smoking intensity was greatest for the second-poorest income quintile, and it decreased with higher income quintiles. This pattern was also reflected in total price elasticity. Smoking prevalence did not show any systematic relationship with income status in Nepal. On the other hand, Kinh *et al.* (2006) estimated larger elasticities of both smoking prevalence and smoking intensity for the lowest two quintiles compared to the top two quintiles for Viet Nam.

The study on Bangladesh conducted by the International Tobacco Control Policy Evaluation Project in 2009 found systematic evidence of greater price elasticity of smoking prevalence among lower income households for both cigarette and bidi smoking, and mixed evidence on the price responsiveness of smoking intensity. The daily consumption of smokers belonging to lower socioeconomic status was found to be insensitive to price changes in both cigarette and bidi consumption. The moderate- and high-income households did not differ much with respect to the price responsiveness of smoking intensity of cigarette consumption, although for bidi consumption it was greater for high-income people. The total price elasticity, however, reflected the inverse relationship found between smoking prevalence elasticity and socioeconomic status. These results indicate that price has strong influence on the decision to smoke in Bangladesh, but that the effect is less obvious on the average consumption of smokers.

Among the lower-middle-income countries, in China, low-income people's tobacco consumption is more price responsive than that of higher-income people (Mao *et al.,* 2003, 2007). The evidence is again mixed for Egypt; using Household Expenditure Survey data for two years (1995–96 and 1999–2000), Nassar (2003) found no systematic relationship between price elasticity and expenditure quartiles in either urban or rural areas in Egypt in 1995–96; whereas the price elasticity was greater for higher expenditure quartiles in 1999–2000 in both urban and rural areas. This finding stands in contrast with the conventional pattern. However, when price elasticity estimates were ranked by educational status of individuals, people with lower levels of education were consistently found to be more responsive to price changes than those with higher levels of education.

A study on Indonesia by Adioetomo *et al.* (2005) found that smoking intensity in lower-income groups was consistently more sensitive to price changes than in higher-income groups. They estimated the elasticity of smoking prevalence at −0.034 for low-income households. For medium- and high-income households, the elasticities were positive. None of these estimates were, however, statistically significant. This study, which factors in the number of cigarettes smoked by the smokers, therefore suggests that in Indonesia price is not a significant factor in people's decision to smoke, particularly for the well-off.

Among other lower-middle-income countries, such as Sri Lanka, Thailand and Ukraine, the findings are not systematic enough to reach a conclusion about the variation in price responsiveness among different socioeconomic groups (Table 7.4). This is also the case for upper-middle-income countries, such as Bulgaria and Turkey. In Bulgaria, for example, the average price elasticity of smoking propensity is highest among the low-income group, but the high-income group showed greater price sensitivity than the middle-income group (Sayginsoy *et al.,* 2002). In Turkey, price elasticity was highest for the second income quintile, in line with an inverse-U relationship (Onder, 2002).

In South Africa, on the other hand, price sensitivity was larger at lower income quartiles (van Walbeek, 2002b, 2005). The percentage of households that bought cigarettes decreased from 49% in 1990 to 30% in 2000, while the real price of cigarettes increased by more than 100%. The percentage of households in the poorest income quartile that bought cigarettes decreased from 46% to 22%, while among the richest income quartile that percentage decreased from 43% to 34%. This implies that the poor are significantly more price-sensitive than the rich (van Walbeek, 2005).

Price responsiveness of smoking initiation, quitting and relapse

The evidence available on the price sensitivity of smoking prevalence by socioeconomic characteristics mostly pertains to smoking prevalence in general. The existing literature rarely differentiates between smoking initiation, quitting or relapse, primarily due to the fact that this type of analysis requires longitudinal or retrospective data on individual smoking behaviour. Madden (2007), for example, used retrospective data on a sample of Irish women aged 48 and under to conduct a duration analysis of the factors influencing smoking initiation and quitting. The study found mixed evidence on the effect of price on smoking initiation and quitting by education status of individuals. For starting smoking, the strongest effect of tax was observed on those with intermediate levels of education, and weaker effects for those with least education or higher levels of education, evidence suggesting an inverse-U effect. The finding that the price sensitivity for intermediate levels of education was greater than for higher levels of education was, however, not statistically significant. On the other hand, tax seemed to be most effective in inducing quitting among those with the least education, and there was little evidence of any significant difference in the effectiveness of taxation between groups with higher levels of education.

Explaining differences in price sensitivity by socioeconomic status

The greater price sensitivity of people belonging to lower socioeconomic status, as observed consistently in higher-income countries, has a clear theoretical basis for explanation. It follows from the theory of rational addiction that the variation in the price sensitivity of smokers across different socioeconomic groups in an economy is attributable to the variation in their rate of time preference, which pertains to the premium a person places on enjoyment in the immediate period over delayed gratification (Becker and Murphy, 1988; Becker *et al.,* 1991). An individual with high time preference is focused more on his well-being in the present, and therefore discounts the payoffs in the future more heavily. Individuals with high time preference not only discounts future payoffs more than an average person would do, but they also tend to discount future loss of health or earnings or any harmful effects of current consumption at a higher rate. Smokers from lower socioeconomic status often fall into this category. Relative to people with higher socioeconomic status, they assign greater value to the current gratification from smoking, so much so that it more than compensates for the future loss of health and productivity they expect to incur for their current smoking habit. In the same vein, a given increase in the price of tobacco in the present period imposes greater cost on the addicts belonging to lower socioeconomic status, and induces them to cut tobacco consumption more than well-off addicts would do.

The share of tobacco expenditure in total household expenditure partly accounts for the greater price responsiveness of lower-income people. It can be shown that a 1% increase in the price of cigarettes translates into equal percentage increase in total expenditure on tobacco, given income and the quantity demanded of tobacco. This is the case when the price elasticity of smoking intensity for continued smokers is zero. Tobacco expenditure can increase in response to a price increase even when the quantity demanded of tobacco decreases, provided that the price elasticity is less than one, which is typically the case for an addictive commodity such as tobacco. When tobacco demand is inelastic, tobacco demand falls less than proportionately in response to a price increase raising the total expenditure on it. Thus as long as demand for tobacco is price-inelastic, a given increase in its price results in greater proportion of household expenditure needed to maintain the habit of tobacco use, other things remaining the same. The lower the level of total household expenditure, the greater is the burden of increased expenditure. Given the scarcity of household resources to meet the basic necessities in low-income households, they incur relatively higher opportunity cost of tobacco use, as discussed above. The greater opportunity cost of an additional unit of money spent on tobacco is greater for lower-income households, which leads the smokers at the lower end of household income distribution to cut down tobacco consumption more in response to price increases than higher-income smokers would do.

The effect of the increase in tobacco price on the share of tobacco expenditure and consequent opportunity cost of tobacco use is accentuated when smokers from lower-income households spend a greater proportion of household expenditure on tobacco to begin with. The relatively greater burden of tobacco expenditure on poorer households is widely evident in the low- and middle-income countries (see Table 7.2 for the evidence on varying expenditure pattern by socioeconomic status of households).

The studies cited above do not take into account the possibility of substitution from higher-priced to lower-priced smoked tobacco products, nor from smoked to smokeless tobacco products, or any other form of compensatory change in tobacco consumption pattern in response to price increases. To the extent that this happens, smokers maintain their habit and the impact of price increases is reduced. The existing literature provides ample evidence in support of the substitution to cheaper or alternative tobacco products in response to cigarette tax and price increase (e.g. Thompson and McLeod, 1976; Pekurinen, 1989; Ohsfeldt and Boyle, 1994; Ohsfeldt *et al.,* 1997, 1999; Evans and Farrelly, 1998; Laxminarayan and Deolalikar, 2004; Young *et al.,* 2006). These studies, however, do not report whether the likelihood of tax avoidance through product substitution varies by socioeconomic status of smokers; the evidence base to address this issue is very limited.

Using the ITC data set for four countries, USA, Canada, the United Kingdom and Australia, Hyland *et al.* (2006) found evidence of tax avoidance, particularly among younger, non-white, male and higher-income smokers who smoke more cigarettes per day than the older, white, female and lower-income smokers respectively. Smokers who tend to purchase more from low-taxed and untaxed sources of cigarettes or switch to roll-your-own cigarettes are expected to be less likely to quit smoking, and their price sensitivity would be lower than the rest of the population.

Lower-income smokers would likely also seek tobacco products made available through illicit trade at prices cheaper than the market rates. To the extent that they succeed in maintaining their consumption level and expenditure on tobacco by using contraband tobacco products, their responsiveness to tobacco tax increases is reduced. In the United Kingdom, for example, smokers from socioeconomically disadvantaged areas of Edinburgh reported purchases of contraband products to compensate for the rising costs of smoking, and expressed the view that smugglers provide a valuable service to society (Wiltshire *et al.,* 2001). Evidence from Taiwan, China also indicated that low-income and poorly educated smokers are more likely to purchase smuggled cigarettes—smokers with personal monthly income lower than NT$10 000 in 2004 and the lowest level of education were 54% more likely to smoke smuggled cigarettes than the smokers who had either of these two characteristics or none (Lee *et al.,* 2009).

These findings imply that in the presence of widespread tax avoidance and evasion behaviour among tobacco users, the price responsiveness would be lower than intended, and it may vary across the socioeconomic strata of the population. Since lower-income people are more prone to tax avoidance and evasion than others, price elasticity estimates for this group are likely biased upward. Thus the greater price sensitivity of people from lower socioeconomic status found in most studies in high-income countries may prove to be illusive if this compensatory behaviour pattern of lower-income people is taken into account for the estimation of price elasticity of tobacco demand.

The mixed evidence of the relationship of price responsiveness to socioeconomic status in low- and middle-income countries, however, cannot be explained adequately with time preference, share of tobacco expenditure or product substitution behaviour, as explained above. The poorest people are not necessarily the most sensitive to tobacco price changes in these countries. Although circumstances can differ between countries, in some countries this can be attributed to the availability of low-cost or cheaper tobacco products that are predominantly consumed by lower-income people and are often untaxed or subject to preferential tax treatment. Examples of such products are as kreteks in Indonesia; bidi and chewing tobacco in Bangladesh, India and other southeast Asian regions; waterpipe tobacco in southeast Asia and the eastern Mediterranean, "Eco cigarillos" and fine-cut tobacco in the EU; and "small cigars" in the USA. (Chapter 2 of this volume describes these tobacco products in detail). van Walbeek (2005) found strong evidence that the poor were switching to pipe and other tobacco (presumably to make roll-your-own cigarettes) much more than the rich. In 1990 the poorest quarter of the population spent about 5% of their tobacco purchases on pipe and other tobacco; in 2000 this had increased to 18.7%. Among the second poorest quarter of the population there was also an increase in the relative share of pipe and other tobacco (from 2.4% to 7.1% of total tobacco expenditure), but the share of pipe and other tobacco among the richer half of the population remained unchanged over this period.

Taxes on this type of product are kept low to make them affordable to lower-income consumers. The differential tax rates applied to a wide range of prices across types of tobacco products or even within the same tobacco product encourage substitution of lower-taxed products when taxes are increased, as opposed to quitting or reduction in consumption. It in turn lowers the effectiveness of increased tax, particularly on the lower-income people who primarily consume lower-taxed tobacco products.

The difference in the tax structure between low- and high-income countries is also likely to contribute to the observed pattern of price responsiveness by socioeconomic status of tobacco users. As discussed in Chapter 2, most low-income countries have *ad valorem* taxes, while high-income countries such as the USA, Canada, Australia, New Zealand, Japan and Singapore rely on a specific tax system, and the European countries mostly rely on a mixed structure with both *ad valorem* and specific taxes. It is well recognized that the burden of increased tax is greater on low-priced products under the specific tax system than under the *ad valorem* system. Thus it is expected that consumers of low-priced tobacco products in countries using specific tax system would be more sensitive to tax increases than in countries using an *ad valorem* system.

However, no study has been undertaken to examine the effect of either the differential tax treatment of tobacco products or of different tobacco tax structure across countries that can potentially explain the variation in the price sensitivity of tobacco users across countries or across socioeconomic groups within countries to a great extent. The dichotomy in the evidence base between high- and lower-income countries clearly calls for more rigorous evaluation of the data and methods used for these analyses that are likely to affect the results of estimation, and of country-specific socioeconomic environments and tobacco tax structures that can potentially influence the mechanisms through which tax increase affects tobacco demand.

Conclusion

The prevalence of tobacco use is in general higher among the poor. The greater prevalence of tobacco use among the poor adds to economic and social disparity, with disproportionately larger share of tobacco expenditure and disease burden borne by the poor. In these circumstances, increasing tobacco taxes can yield greater public health gain to them than to the rich.

The price responsiveness of tobacco demand also varies by the socioeconomic status (such as income, expenditure, education, race or ethnicity) of the population groups of a country. It is consistently higher among the poor than the rich in high-income countries. This finding can be explained by the present-oriented nature of poorer people, who tend to discount at a higher rate the future health cost and loss of earning owing to tobacco use. Poor people also incur increasingly higher opportunity cost of tobacco use when tobacco price increases, and thus tend to reduce tobacco consumption more than the rich would do. As a result, the share of the total quantum of tobacco tax paid by the poor is expected to decrease when tobacco tax and prices are increased.

Evidence on the variation of price responsiveness of tobacco demand by socioeconomic status of population groups is mixed in low- and middle-income countries. The poorest people are not necessarily the most sensitive to tobacco price changes in these countries. Although circumstances can differ between countries, in some countries this can be attributed to the availability of untaxed and cheaper tobacco products, which are consumed more by the poor. This explains why the existing empirical literature is not conclusive about the equity implication of the increase in tobacco taxes in low- and middle-income countries.

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Chapter 8
Tax avoidance and tax evasion

Introduction

Tax avoidance and tax evasion can decrease the economic welfare by making tobacco products more affordable and available, thus exacerbating the negative health consequences associated with tobacco use and secondhand smoking.

Furthermore, tax avoidance and tax evasion can undermine the impact of tobacco control measures, primarily tobacco tax policies. The existence of illicit tobacco trade has been used to increase political pressure on governments and discourage them from adopting and implementing effective tobacco tax strategies. Moreover, illicit tobacco trade can channel sales proceeds to organized crime and lead to a loss in government tax revenues.

This chapter reviews and summarizes the research evidence related to tobacco tax avoidance and tobacco tax evasion from published literature and empirical evidence. This body of information is organized in five sections. The first section explains the difference between tax avoidance and tax evasion, defines the activities that fall into each category, and describes methods used in measuring the extend to which these activities supply tobacco products to the market. The next section explains the motivation for tax avoidance and tax evasion, and categorizes these motives based whether they are related to profit generation, costs of supplying illicit products, deterrence or an overall state of the economy. The third section provides the most recent estimates of the extent of tax evasion globally, regionally and also in some selected countries. The following section reviews the literature on the impact of tax avoidance and tax evasion on public health measures such as smoking rate, smoking intensity and heath disparities. The final section reviews the impact of policies attempting to curb illicit tobacco trade and summarizes the lessons learned from the implementation of those policies.

Defining and measuring tax evasion and avoidance

Among those working on tobacco tax issues, a variety of circumventing activities for not paying all tobacco taxes are often grouped together and referred to as “smuggling” or “illicit trade” in tobacco products. A clarification of the terms used is necessary as those terms cover different activities. Smuggling refers to products illegally traded across borders. Illicit trade is defined in Article 1 of the WHO Framework Convention of Tobacco Control (World Health Organization, 2005) as any practice or conduct prohibited by law and which relates to production, shipment, receipt, possession, distribution, sale or purchase, including any practice or conduct intended to facilitate such activity. Illicit tobacco trade covers more activities than the circumvention of taxes, but includes all illegal activities related to the tobacco trade.

Economists mostly refer to the circumvention of taxes, and prefer to use the terms tax avoidance (legal methods of circumventing tobacco taxes) and tax evasion (illegal methods for circumventing tobacco taxes).

This section defines the activities of tax avoidance and tax evasion that fall into each category and briefly describes approaches to measuring the extent of both, drawing heavily from the classification scheme proposed by Joossens and colleagues (2000) and the methods described in IARC’s Handbooks of Cancer Prevention Volume 12, *Methods for Evaluating Tobacco Control Policies* (IARC, 2008), the World Bank’s tool on tobacco smuggling (Merriman, 2001), and the book chapter by Merriman and colleagues (2000).

Tax avoidance

Tax avoidance includes legal activities and purchases in accordance with customs and tax regulations, most of which include the payment of some tobacco taxes, and are done mostly by individual tobacco users, including cross-border shopping, tourist shopping, duty-free shopping, Internet and other direct purchases, industry reformulation and/or repositioning. These include:

Cross-border shopping. This type of tax avoidance involves individual tobacco users residing in higher tax jurisdictions purchasing tobacco products in nearby lower-tax jurisdictions for their own consumption within the customs constraints. This can involve crossing national borders, particularly where such border crossing is freely or relatively easily done (as between the European Union Member States) or can take place within a given country where there are significant differences in subnational taxes (as in Canada where provincial taxes differ, or in the United States where state and local taxes can vary considerably across jurisdictions). Within some countries, this also involves purchases from shops located in tax-exempt areas, such as Aboriginal reserves in Canada and Native American reservations in the USA. In some cases, there are limits on how much can be purchased outside of the jurisdiction in which the individual resides (e.g. the European Union), while in others the individual is supposed to pay the difference between the tax in their home jurisdiction and the tax they have paid on the products purchased in other jurisdictions (e.g. in various US states). However, enforcement of these provisions is difficult.

Tourist shopping. This type of tax avoidance is similar to the cross-border shopping described above, but involves the purchase of tobacco products in more distant jurisdictions, again subject to the constraints imposed by customs laws and/or other policies (e.g. consumption of tax-paid cigarettes by the large tourist population in Thailand). This is a more limited phenomenon, but can account for a significant share of overall tobacco product sales in popular tourist destinations.

Duty-free shopping. This type of tax avoidance is similar to the others, but in this case involves the purchase of tax-free tobacco products purchased in airports, on airlines, and in other travel-related venues. Again, most governments impose limits on how much an individual can purchase and bring home from duty-free sources.

Internet and other direct purchases. This type of tax avoidance involves individual tobacco users buying tobacco products online, through the mail, or over the phone from establishments based in low-tax jurisdictions for consumption in their own higher tax jurisdiction. This has attracted the most attention in the USA, given relatively widespread access to the Internet and significant differences in subnational taxes. For US consumers, for example, these may include purchasing from vendors based on Native American reservations, in low-tax states or in low-tax countries; as above, however, purchasers are obligated to pay taxes to their home state on these types of purchases. Over the past several years, US states have taken steps to curb direct purchases through a variety of policy and enforcement actions and Internet and few smokers purchase cigarettes through direct channels (Chaloupka *et al.*, in press). Differences in legal obligations for paying taxes in the home jurisdiction can make this type of activity more a form of tax evasion than tax avoidance (e.g. EU countries).

Industry reformulation or repositioning. Tobacco companies can reduce the tax imposed on their products by reformulating or repositioning their products. For example, in countries with multitiered tax structures where higher taxes are levied on higher-priced brands, a company can lower the price of its product so that it moves from a higher tax tier to a lower tax tier. As occurred recently in Germany, where cigarette taxes are based on quantity, companies produced long cigarettes that were readily cut into smaller, standard size cigarettes, effectively reducing the tax per cigarette.

Tax Evasion

The activities included under tax evasion are the illegal methods of circumventing tobacco taxes, such as the purchase of smuggled and illicit manufactured tobacco products. Those activities include both small and large quantities and often, but not always, involve efforts to avoid paying any taxes. Many of these activities are done by larger criminal networks or other large-scale operations.

Small-scale smuggling. This type of tax evasion involves the purchase, by individuals or small groups, of tobacco products in low tax jurisdictions in amounts that exceed the limits set by customs regulations, for smuggling or resale in high-tax jurisdictions.

This type of tax evasion is illegal in that the quantities involved exceed the allowable limits and that the purchase does not include the taxes that are supposed to apply in the jurisdiction where they are used. As with cross-border shopping, this is more likely to occur when tax differentials among nearby jurisdictions are large and where border crossing is relatively easy. For example, small-scale smuggling is one form of tax evasion that occurs between US states, most notably low-tax states with no tax stamps (such as South Carolina) where small-scale smugglers buy tax-paid cigarettes and then resell in high-tax states.

Large-scale smuggling. This type of tax evasion involves the illegal transportation, distribution, and sale of large quantities of tobacco products, conducted by criminal networks, that generally avoid all taxes. As Joossens and colleagues (2000) describe, this typically involves: international brands that are sold by multinational tobacco companies and which are easily sold; transportation over longer distances and often involving "in-transit" regimes and tax-free zones; the passing of tobacco products through a wide range of owners; large organized-crime networks; and a sophisticated system for distributing smuggled cigarettes locally. To avoid detection, counterfeit tax stamps are often applied to smuggled cigarettes that are being sold in jurisdictions that require such stamps. Large-scale smuggling has also been used for large consignments of counterfeit cigarettes or for legally manufactured cigarettes which are targeting the illicit markets in other countries. One example is the cigarette brand Jin Ling, which is legally manufactured in the Russian Federation, but destined for the illegal market in Germany and other European countries and which was one of the most seized cigarette brands in Europe in 2008 (World Customs Organization, 2009).

Illicit manufacturing. This type of tax evasion refers to the production of tobacco products contrary to law. The laws in question may be taxation laws or other laws (such as licensing or monopoly-related laws) that restrict the manufacture of tobacco. This type of tax evasion includes underreporting of actual production quantities with the difference between reported and actual production diverted through illegal channels or, in some cases, complete avoiding of reporting with all production diverted to black markets. This type of illegal manufacturing is more likely to occur in countries without effective tax administration that includes monitoring of actual production, and in regions where distribution of the illegally produced cigarettes is relatively easy. Counterfeit tax stamps are often applied to illegally manufactured products when these products are distributed in countries that require tax stamps. The destination of the illegally manufactured cigarettes can be the domestic or a foreign market. Illicit manufacturing includes counterfeiting.

Counterfeiting. Counterfeiting involves the production and distribution of products bearing a trademark without the approval of the trademark owner. These products are produced illegally, often bear counterfeit tax stamps (depending on where they are being sold), and are distributed through the networks established by large-scale smuggling operations. China has been a major manufacturer of counterfeit cigarettes (Shen *et al.*, 2010)

Measuring tax avoidance and evasion

Given the illicit nature of tax avoidance and evasion, developing accurate measures of the extent of these activities is challenging. Over the past few decades, multiple approaches have been developed and applied, each of which captures some part of the full picture. The various approaches used to estimate the scope of tax avoidance and evasion are briefly described below; estimates based on these methods for various countries are presented later in this chapter. Given the different dimensions of tax avoidance and evasion captured using the different methods and the inherent limitations in each method, a combination of multiple methods will be most likely to produce a good measure of the extent of overall tax avoidance and evasion (IARC, 2008).

Expert opinion. One widely used approach to assess the extent of overall tax avoidance and evasion is to ask "experts" for their estimates of these activities, where the experts may be customs and other law enforcement officials, industry representatives, researchers, tobacco control advocates or others with a particular interest in the issue (Merriman, 2001). Such estimates are subjective and can be biased based on the individual expert's position and interests. Tobacco industry informants, for example, may have an incentive to report high levels of tax avoidance and evasion as a way of averting tax increases, while tobacco control advocates may understate the extent of the problem in their efforts supporting tobacco tax increases. Estimates based on expert opinion are most prominent in trade and government publications. Overall, however, measures based on expert opinion are generally consistent with those derived from other approaches, suggesting that such measures are valid (IARC, 2008).

Comparison of export and import statistics. One approach to estimating the extent of large scale smuggling is to compare export and import statistics. The difference between recorded exports and recorded imports is likely to reflect product diverted to illegal markets while in transit. This approach is likely to produce a valid measure for the global level of large-scale smuggling of legally manufactured cigarettes, but is unlikely to produce the same for small-scale smuggling and illicit manufactured cigarettes or at the country level (IARC, 2008). Merriman and colleagues (2000), for example, used this approach in their efforts to assess the extent of illicit trade in cigarettes, finding that about one third of recorded exported cigarettes in the mid-1990s did not appear in recorded imports, accounting for about 6% of global cigarette consumption.

Comparison of tax-paid sales and individually reported consumption measures. If there are no reporting biases in measures of tax-paid sales and measures of average consumption and prevalence obtained from representative population surveys, then the difference between the two will reflect the extent of overall tax avoidance and evasion (IARC, 2008). However, it is likely that there will be some temporal biases in tax-paid sales measures, as these generally reflect shipments at the factory or wholesale level rather than actual consumption. More importantly, there is likely to be some degree of underreporting of tobacco use in population surveys. To the extent that the bias in each is constant over time, changes in the difference between the two can indicate whether tax avoidance and evasion are increasing or decreasing over time (Merriman, 2001). However, as social norms against tobacco use strengthen over time, the extent of underreporting in population surveys is likely to grow, reducing the validity of a measure based on this approach (IARC, 2008).

Modelling of tobacco product demand. A relatively widely used approach among tobacco control researchers is the econometric modeling of tobacco product demand using data from multiple neighbouring jurisdictions (e.g. US states, European Union Member States). Researchers using this approach have included variables measuring the opportunities for tax avoidance and evasion based on differences in prices across jurisdictions, population distributions near borders, extent of cross-border or tourist traffic, Internet penetration, and other factors reflecting access to lower tax/price jurisdictions. Coefficient estimates from the resulting models can be used to predict what tax-paid sales would have been if the variables reflecting the incentives/opportunities were set to zero, with the difference between predicted sales and actual sales reflecting the extent of tax avoidance and evasion. Depending on what opportunities are being modelled, this approach can be used to assess individual cross-border shopping and direct purchases, as well as small-scale smuggling. This approach has been used widely in the USA (see, for example: Becker *et al.*, 1994; Yurekli and Zhang, 2000; Farrelly *et al.*, 2003) and, to a limited extent, in European countries (Merriman *et al.*, 2000).

Survey of tobacco users' purchase behaviours. Representative surveys of tobacco product users that collect information on various aspects of purchase behaviour, including purchase location and price, can be helpful in assessing the extent of various forms of individual tax avoidance, including cross-border shopping, direct purchases, and duty-free purchases (IARC, 2008). Hyland and colleagues (2006), for example, reported data from the International Tobacco Control Policy Evaluation Study's (ITC) surveys of representative samples of smokers in Australia, Canada, the United Kingdom and the United States which include questions on cross-border, duty-free, native reserve, Internet and other direct purchases, and other options that potentially reflect untaxed or lower taxed purchases. They found relatively low rates of individual tax avoidance in Australia (0.7–1.1%), Canada (3.1–3.7%), and the United States (4.8–6.1%), but high rates in the United Kingdom (15.3–19.7%), with rates increasing in each country over the two waves of their surveys.

Observational data collection. A relatively untested but potentially promising approach to assessing multiple dimensions of tax avoidance and evasion is direct observation of tobacco product vendors or collection of packs/containers from tobacco product users or other sources. Products can be examined for tax stamps, local warning labels, other pack markings, and product constituents to identify products that do not bear the appropriate stamps/labels/markings or that include constituents that differ from those contained in locally produced products. As part of the ITC survey in Poland, for example, interviewers were trained to recognize Polish tax stamps, warning labels and other pack markings, as well as the same for Ukraine, Belarus and the Russian Federation in an effort to assess the extent of tax avoidance/evasion in the Polish cigarette market (IARC, 2008). Merriman (2010) applied a novel twist on this approach by collecting littered cigarette packs around Chicago in an effort to assess the extent of avoidance/evasion of the local Cook County and Chicago cigarette taxes, finding that three fourths of the packs collected in Chicago did not bear the Chicago tax stamp. In an ongoing effort, the ITC project is collecting cigarette packs from survey respondents in a variety of countries that will be examined for relevant pack markings, with sophisticated product testing methods used to test for various product constituents that appear at higher levels in counterfeit cigarettes. These approaches are limited by observers' abilities to distinguish licit and illicit (particularly counterfeit) products and by the ability to differentiate licit and illicit products based on product constituents, but do appear promising for capturing at least some aspects of tax avoidance and evasion.

Determinants of tax avoidance/ evasion

The determinants of tax avoidance/ evasion are related to tax/price differences, tobacco products' affordability, corruption, weak tax administration and/or customs, and informal distribution networks as well as to the involvement of global and new firms. The determinants of the supply of illicit tobacco products are related to the profit from the sale of these illegal products. The greater the reward and the lower the costs of supplying these illicit products, the greater the probability an individual will engage in it. The reward depends on the difference in profits from legally sold versus illegally supplied cigarettes.

The costs are related to the probability of detection, the magnitude of punishment, the opportunity costs like foregone salaries from other employment and the cost of the capital employed in smuggling. Other costs may include the cost of bribery (Merriman *et al.*, 2000).

In a competitive market, profits from illicit tobacco trade will be driven to zero. This implies that, in the long run, the cigarette tax revenue the government loses to smugglers is entirely consumed by excess travel costs and costs to avoid detection. This is a wasteful use of scarce societal resources (Bhagwati and Hansen, 1973).

Price/tax differences and their magnitude as determinants of profit

Cigarette prices are high relative to their production costs, in part due to higher level of taxation. Price of tobacco products and the total tax levied on them are related to the amount of profit for those involved in illicit trade.

The absolute price level and the relative price differences can affect the method of delivery of illicit cigarettes to the market.

Small-scale smuggling and legal cross-border shopping are primarily motivated by the relative price differences between adjacent geographical areas. These price differences may be driven by tobacco taxes or tobacco industry pricing strategy (Baltagi & Levin, 1986, 1992). The difference in price or/and tax rate represents the upper limit on the incentive to bootleg or shop across the border due to transaction costs involved in this form of supply (Licari & Meier, 1997).

Wholesale/large scale smuggling is likely to be correlated with the country's absolute retail price of cigarettes (Merriman *et al.*, 2000), because the larger the retail price, the larger the profit for large-scale smugglers who pay wholesale international price for their supply (FIA International Research Ltd, 1999a).

The motivation for small-scale smuggling and legal cross-border shopping has been studied extensively in the USA and in Europe where sufficient data exist and where a sizable population lives in a close proximity to another state/country (Vedder, 1997; Cnossen, 2005).

Several US studies measured the strength of the relationship between the price/tax differences and cross-border shopping. Baltagi and Levin (1986) studied cigarette small-scale smuggling in the USA using a dynamic demand model and a panel data from 46 states on per-capita sales over the period 1963–1980. They found the cigarette demand to be sensitive to price differences between the state of residence and the neighbouring states: a 10% price increase in a neighbouring state caused a 0.8% increase in taxed sales in the home state in the short run and a 0.21% increase in the long run. Baltagi and Levin (1992) updated their previous study by adding data for 8 additional years extending their panel data to 1963–1988 for these 46 US states. Using various model specifications, they found similar results with respect to the price sensitivity of the cigarette market to the price difference with the neighbouring states.

Goel (2008) used more recent cross-section state-level cigarette sales data from the United States from 2002 to conclude that price differences provide the main motivation for cigarette smuggling as compared to non-price factors related to the probability of apprehension. According to his study, a 10% increase in the lowest cigarette price in adjacent US states increases a state's cigarette sale by about 10%.

DeCicca *et al.* (2010) found relatively larger sensitivity of tax avoidance and tax evasion to the tax/price difference: 1% increase in home-state price increased the likelihood of purchasing cigarettes in a neighbouring state by 3.1%

while controlling for the distance to the border. However, the study used individual-level survey data that do not capture small-scale smuggling, and self-reported prices that can be endogenous. Their result that the probability of cross-border shopping approaches zero at a distance to the border of about 300 miles does not seem realistic and indicates problems with the model specification. The author suggested that there is a surge in cigarette tax avoidance and evasion immediately after a tax increase, which then quickly subsides within several months. A similar observation was made by Farrelly, Nimsch, and James (2003).

As noted above, Merriman (2010) employed a novel empirical approach to estimate tax avoidance/evasion in the city of Chicago and its sensitivity to tax differences in the neighbouring jurisdictions. He collected a random sample of 2391 littered cigarette packs in the city in 2007 and studied their probability of having the correct local tax stamp. The difference between the tax in Chicago and surrounding counties equal to $2.68 decreased the probability that a littered pack has a local stamp by almost 60 percent. On the other hand, increasing the distance to the lower-tax state border by a one mile increased the probability a pack has a local stamp by about one percent. That means that compliance increases rapidly with the distance to lower-taxed border and that the distance provides a significant barrier to tax avoidance. However, the results of Merriman (2010) are not directly comparable to econometric studies that report tax compliance at the national or state level due to the potential selection bias. This bias arises due to the possibility that those who litter are also less law obedient, therefore more likely to engage in tax avoidance/evasion.

A review of 24 peer-reviewed studies and studies by reputable researchers using US data provided evidence that tax avoidance/evasion via Internet was related to the level of cigarette taxes: US smokers living in states and cities with high cigarette excise taxes were more likely to purchase non-taxed cigarettes online than smokers living in low-tax jurisdictions (Ribisl *et al.*, 2006).

In Europe, Merriman *et al.* (2000) used cigarette sales data for 1989–95, cigarette prices and frequency of travel from 18 countries to estimate the incentives for small-scale smuggling and cross-border shopping. Controlling for the level of corruption and income, he found that policies that raise incentives for small-scale smuggling and cross-border shopping, such as a cigarette tax increase, will significantly reduce domestic tax-paid cigarette sales. If these incentives to bring cheaper cigarettes from abroad were reduced to zero, the official domestic sale would increase by 3%. If foreigners would not have incentives to buy cheaper cigarettes in a country, this country's domestic sale would fall by 1%. For example, a unilateral 10% cigarette price increase in Germany would reduce yearly cigarette sale by 6 packs per capita, but would increase yearly cigarette purchases abroad by 3 packs per capita, resulting in a 3-pack per capita reduction in consumption.

Taal *et al.* (2004) analysed sales and survey data from Estonia, a European country with high incentives for small-scale smuggling and cross-border shopping from 1993 to 2000, when cigarette prices there were up to four times lower than in neighbouring Finland and Sweden (but considerably higher than in another neighbour, the Russian Federation). They found that illegal purchases of cigarettes by Estonians represent a fairly small part of the total cigarette market. However, legal cigarette purchases by tourists and foreign visitors (that are not part of local consumption) were significant—up to 50% of legal sales. This has been confirmed by the Finish authorities that reported that legal cross-border cigarette shopping by Finish travellers amounted to 12% of total national sales in 1996 (Lipponen *et al.*, 1998).

Buck, Godfrey and Richardson (1994) showed that in the early to mid-1990s there was little incentive for cigarette cross-border shopping between France and Britain, because the savings on 800 cigarettes bought in France and taken back to Britain would be outweighed by the cost of the trip. Cross-border shopping existed at that time, but only when smokers were already across the border for other reasons. Estimates of United Kingdom Department of HM Customs & Excise confirmed that legitimate cross-border shopping was a minor problem in 1997 when the legitimate personal imports of tobacco products was less than 0.5% of total cigarette sales (HM Customs & Excise, 1998).

The situation changed in the second part of 1990s when cigarette prices in the United Kingdom increased by about 25% from 1997 to 2000. The United Kingdom Treasury estimates that the market share of illicit cigarettes in the United Kingdom rose from about 3% in 1996–97 to about 18% by 1999–2000 (HM Customs & Excise, 2000).

In France, similarly, the substantial tobacco tax increases in 2003 and 2004 that led to higher cigarette prices were blamed for an increase in cross-border purchases of tobacco products (both legal and illegal) from a negligible amount to 14−17% of total sales in 2005 and 2006 (Lakhdar, 2008).

The evidence on tax avoidance/evasion in Asia is scarce. Tsai, Sung, Yang and Shih (2003) used survey data collected in 2000 among 437 smokers of imported cigarettes and found that higher cigarette prices were the primary motivation for purchasing of smuggled cigarettes in Taiwan, China. A 1% increase in cigarette price raised the likelihood of purchasing smuggled cigarettes at least 2.60 times (95% confidence interval: 1.08–6.26). Smokers who spent more money on cigarettes were more likely to purchase smuggled cigarettes, but personal income was not significantly associated with smuggled cigarettes purchases (Tsai *et al.*, 2003).

Nelson (2002) suggested that the size of the potential cross-border market plays an important role in the formulation of tax policy for cigarettes. US states with a large potential cross-border market are more likely to set tobacco tax rates below that of neighbouring states to attract non-residents to purchase cigarettes in their state, therefore exporting their tax burden. This seems to be the case of Luxembourg, a country with a high density of foreign population living near its borders that is setting its cigarette taxes at a level considerably lower compared to its neighbours. Using data from 1993, the estimates indicate that 85% of cigarette sales in Luxembourg were due to cross-border sales (Joossens & Raw, 1995).

There is less evidence to support the theory that wholesale/large-scale smuggling is likely to be correlated with the country's absolute retail price.

Merriman *et al.* (2000) found no significant correlation between experts' estimates of large-scale smuggling from 38 countries and the average legal cigarette price.

Joossens *et al.* (2010) employed a larger data set of low-, middle- and high-income countries (84 in total). They found that the countries with the lowest income had the lowest average prices for legally sold cigarettes, but also the highest illicit cigarette market share. This suggests a negative relationship between the illicit cigarette market share and the cigarette price level.

Joossens and Raw (1998) found the same situation in EU countries in 1995: many European countries with high tobacco taxes and prices had low estimates of cigarette smuggling, while illicit cigarette trade was prevalent in southern European countries where taxes and prices were low. The authors suggest that the size of illegal market in a country is determined by fraud and illegal trade, and not by the level of tobacco taxes/prices.

Data from southeastern Asia also point to no relationship between countries' tax rates, cigarette prices and the level of illicit cigarette trade. For example, in the early 2000s cigarette tax in Singapore was among the highest in the region (about 51% of retail price), but the estimated share of illegal cigarettes on the market was only 2% of domestic sales. On the other hand, illicit cigarettes accounted for about 37% of domestic sales in Cambodia, yet the tax represented only 20% of retail price, one of the lowest tax rates in the region (Ministry of Health Republic of Indonesia, 2004).

Differential treatment of domestic versus foreign products

Restrictions on the supply of imported tobacco (by imposing quotas, tariffs, and other non-tariff barriers such as a prohibition on sale, which is similar to an infinite tax) can lead to significant price differences and motivate illicit trade (Taylor *et al.*, 2000).

China (Hu & Mao, 2002), Viet Nam (Joossens, 2003) and the Islamic Republic of Iran (World Health Organization, 2003) have prohibited or severely limited the importation of foreign cigarettes. The tax on imported cigarettes in China was 244% in 1997 (reduced to 217% in 1999), but foreign cigarettes with prices lower than this tax were easy to find in urban China (Hu & Mao, 2002). Viet Nam banned cigarette imports from 1990 till 2007. Yet, foreign cigarettes were sold at a premium in the street of Hanoi (Joossens, 2003). Even after lifting the import ban, cigarettes and cigars are subject to an import duty of up to 225%. The illegally imported brands (primarily Winston and Magna) represented about 50% of the total cigarette market in the Islamic Republic of Iran in 1994, and the industry estimated that the illegal or tax-free products had 68% market share in the country (World Health Organization, 2003).

Two older studies suggest that smuggling in low- and middle-income countries increases with the level of tariffs and taxes (Bhagwati and Hansen, 1974; Simkin, 1974).

Differential pricing for cigarettes intended for export and for the domestic market can motivate re-import of products designated for export. To limit this behaviour, in 2000 the US federal government banned imports of cigarettes that are intended for export only (FIA International Research Ltd, 1999b).

Cost of supplying illicit tobacco to the market determines net profit

The costs of supplying illicit products include the cost of manufacturing and/or obtaining tax-free cigarettes, the cost of access to capital, transportation, distribution and countering the government's effort to control tobacco illicit trade as this relates to the possibility that the smuggler\counterfeiters will be apprehended and penalized if caught. In addition, these costs depend on the opportunity cost of time (as this influences the cost of labour) and social norms with respect to supplying illicit cigarettes (people who believe that engaging in cigarette smuggling is immoral will need to be compensated more to convince them to get involved in this activity).

The costs of obtaining legally produced cigarettes are related to export/wholesale prices and can vary by the country of destination (Yurekli & Sayginsoy, 2010).

New technology such as sophisticated and less-expensive computer scanners reduce the production costs of counterfeit cigarettes and boost their supply on the market, such that in 2007 these cigarettes made up 15% of illicit cigarette trade globally (Euromonitor International, 2008).

Obtaining tax-free tobacco can require capital investment into transportation equipment. Smugglers' transport costs are likely to be greater than those engaged in transporting a similar weight and volume of legal goods, because of the need to avoid detection (Bhagwati and Hansen, 1974). Therefore, this activity represents inefficient use of limited resources (Bhagwati and Hansen, 1974). In Malaysia, for example, smugglers use speedboats to increase their chances of escaping when chased by police and/or border patrol (Unknown, 1995).

On the other hand, Jensen and colleagues (1991) argued that transport costs in the USA account for only 0.5 percent of the value of tobacco products, and that their effect on smuggling is negligible.

Transportation costs may wary by geographical regions and the type of tax avoidance/evasion. The transportation costs for small-scale smuggling will be lower if a large share of the population lives near the border with another jurisdiction (Saba *et al.*, 1995). This is particularly relevant for Europe and the USA, where a sizable population lives in a close proximity to another state/country (Vedder, 1997; Cnossen, 2005).

Joossens (1998) argued that the ease of evasion of legal authorities might be more important than price when it comes to the proclivity of individuals to engage in tobacco smuggling.

The perceived probability of interdiction depends on the actual level of enforcement. Anthony (2004) suggests that drug smugglers ignore the risk of being caught up to a point, and that there is a threshold interception rate beyond which the smuggling rapidly declines. However, some smugglers are undeterred even when there is 100% probability of detection. This could be due to the practice of receiving advanced payments for taking the risk, which could be greater than the lost earnings due to jail time.

In the United States, small-scale smugglers often use the superhighways, where the likelihood of detection is minimal (Walsh & Ottaway, 2000). Compared to large-scale smugglers, they face lower costs of supplying illegal products to the market, because purchasing tax-paid tobacco in a low-price jurisdiction and transporting it to a high-priced one reduces the legal risk for those involved in the business (Licari & Meier, 1997).

Goel (2008) found that the probability of apprehension, measured by the number of police per 1000 inhabitants, plays a relatively minor role in cross-border cigarette smuggling in the USA.

Insufficient pack markings reduce the probability of illicit cigarettes being confiscated, therefore reducing the costs of involvement in illicit cigarette trade. Press articles have reported that introducing a tax-stamp by the state of Michigan in 1998 helped to reduce the sale of illicit cigarettes (Hyde, 1998).

The relatively weak government controls and the slowness of the judicial process reduce the opportunity costs of illegal cigarette manufacturing in Brazil (Ramos, 2009). The majority of cases involving illicit cigarettes do not fall under criminal jurisdiction, and contraband cases are mostly treated as low-priority misdemeanours that end with the release of the prisoner and sometimes even include the restitution of goods and/or vehicles involved. Inadequate legislation compounded by a lack or absence of specialized prosecutors and judges does not enable authorities to confront associated drug trafficking and money-laundering activities. In addition, handling illicit merchandise is socially accepted in Brazil. As a result, the production of illegal cigarettes in Brazil reached some 9 billion cigarettes in 2007, about 6.4% of the total cigarette market (Ramos, 2009). The size of the illegal market in Brazil is unclear, but experts estimate that it is about 30% of total sales (Ramos, 2009).

The opportunity costs of time can determine the willingness of population to engage in illegal activities. When Australian farmers' opportunity costs of time dropped due to declining official market price of raw tobacco and the diminishing legal outlet for tobacco, some of them began to divert their tobacco to illicit markets (Geis *et al.*, 2003; Geis, 2005).

The costs of distribution of illicit cigarettes are important motivators.

These are discussed in more details below.

The supply chain for illicit tobacco (distribution) reduces cost of illicit transactions

Increase in international/interstate trade. Large-scale organized cigarette smuggling generally involves cigarettes that have passed through a wide range of international traders (European Parliament, 1997). A loose export-import recording system combined with large quantities of traded cigarettes reduces the probability of detection. Pitt (1981) concluded that the greater the volume of legal trade, the lower the costs of smuggling. In Hong Kong Special Administrative Region, trucks with smuggled cigarettes have been disguised as containing duty-free components for assembly at factories within mainland China (Unknown, 1999). The opening of the market in Taiwan, China in 1987 led to an increase in cigarette smuggling measured by an increase in cigarette seizures and reports by the industry (Wen *et al.*, 2006).

Liberalization and frequency of international travel. The ease of small-scale smuggling is proportional to the total number of cross-border travellers taking into account the stringency of border controls (Merriman *et al.*, 2000).

Travellers can also take advantage of duty-free sales. In 1996, approximately 45 billion cigarettes were sold through duty-free outlets. This represents 0.8% of all cigarettes sold in the world (Market Tracking International Ltd, 1997).

Merriman *et al.* (2000) partially attributed a higher share of the German cigarette market being supplied via cross-border shopping and small-scale smuggling to high frequency of travel from and to Germany. Taal *et al.* (2004) reported that Finns made approximately 3 million visits to Estonia in 1998, and that travellers from Finland and Sweden consume up to 50% of total legal cigarette sales in Estonia. Higher prices in Sweden motivated airline passengers from the Russian Federation to bring with them cigarettes when they travelled to the country (Unknown, 1994). There is anecdotal evidence that youth in Scotland have been given free vacations in Europe in exchange for smuggling tobacco back to Scotland (Unknown, 1994).

Presence of tax free zones. Tax-free zones or free-trade zones play a significant role in illicit trade in both genuine and counterfeit cigarettes (World Customs Organization, 2007). The Financial Action Task Force (FATF) of the OECD estimated that there were about 3000 free-trade zones in 135 countries around the world in 2009 and that their numbers are growing (The Financial Action Task Force, 2010).

The International Consortium of Investigative Journalists discovered that free-trade zones on the island of Aruba and in Colombia are being used for cigarette smuggling into other areas of Colombia, such as the city of Bogota (Beelman, 2000).

Free-trade zones have been misused for money laundering and terrorist financing. A US company used a free-trade zone to repackage tobacco and ship it to another free-trade zone, ultimately smuggling it into US market. The profit was used to finance the Abu Sayyaf Group, a terrorist organization based in the Philippines (The Financial Action Task Force, 2010). Large-scale cigarette smuggling from China to the United States (state of Washington) has been facilitated by a free-trade zone in Hawaii. The cigarettes seized in this free-trade zone represented a US$ 2 068 668 revenue loss for the state of Washington (The Financial Action Task Force, 2010). Duty-free shops facilitated small-scale smuggling from Estonia to Finland and Sweden (Taal *et al.*, 2004).

The Akwesasne Indian reservation, located on the US–Canadian border, was used by the tobacco industry for re-importation of cigarettes exported from Canada to avoid Canadian taxes (Cunningham, 1996; Segal, 1999).

Native American reservations in the USA are also the primary source of tax-free cigarettes sold over the Internet. In 2005, nearly two thirds of the US web sites selling cigarettes were affiliated with a reservation. In 2003, 95% of Seneca tribe cigarette sales were conducted over the web or phone (Chen, 2008).

Informal market/retail networks, street-selling, existing smuggling routes and black markets. The opportunity cost of labour could determine the existence of the informal distribution networks. If the potential rewards from legal occupations are very small compared to engagements in shadow/underground economy, people should be more willing to provide an informal distribution network for illicit products including cigarettes (Merriman *et al.*, 2000). However, Merriman *et al.* (2000) found no association between experts' estimates of smuggling in 38 countries and these countries' income measured by per-capita GDP.

In some countries, illicit cigarettes are distributed via separate channels, but in some countries illicit tobacco products are distributed alongside the legal products via regular retail channels. The existence of smuggling routes and black markets for other products as well as the presence of unlicensed distributors reduce the transportation and the distribution costs of illicit tobacco supply (Thursby & Thursby, 2000; Campaign for Tobacco-Free Kids, 2008).

Joossens and Raw (1998) and Joossens *et al.* (2000) pointed to the association between the tradition of street-selling and higher share of illicit cigarettes in markets in Spain and Italy.

Social networks often serve as important distribution channels for illicit products (Merriman *et al.*, 2000). In the United Kingdom, between 2.5% and 3.3% of all cigarettes sold in 2002–2003 were supplied via an informal network of independent sellers (Hyland *et al.*, 2006). Coleman (1998) found that the majority of illegal tobacco products consumed in the United Kingdom were sold in pubs.

Technology allowing virtual transactions (online purchases and mail-orders). In the USA, the number of web sites selling cigarettes increased from 88 in 2000 to 772 in 2006 (Chen, 2008). Smokers in the US who purchase cigarettes online are primarily motivated by lower prices, because Internet vendors generally sell cigarettes without paying tobacco excise taxes for the destination state (Kim *et al.*, 2006). Almost all online cigarette sales are illegal due to failure to report the transaction and/or verify the age of the buyer (Chen, 2009). With the recent crackdown on this form of sale in the USA, the overseas internet vendors expanded their role in the US market. In 2003, 10% of all internet vendors were based outside the USA, but in 2006 over 45% of them were based overseas (Chen, 2009). These overseas vendors are beyond the reach of the US law enforcement.

Transaction cost associated with illicit tobacco products

The convenience of a transaction that reflects the opportunity cost of time is related to costs of illicit tobacco use. The less convenient the transaction, the higher the opportunity cost of time and the lower the probability of buying illicit products. In California, most smokers purchased their cigarettes from the most convenient (but more expensive) sources despite relatively large price differences between the legal and illegal cigarettes (Emery *et al.*, 2002). Very few (5.1%) of California smokers purchased cigarettes from non- or lower-taxed sources, such as out-of-state outlets, military commissaries or the internet (Emery *et al.*, 2002).

The opportunity costs of time seemed to be a major deterrent of cross-border shopping between California and Mexico, as the wait to enter Mexico was well over 30 minutes and travellers were also subject to a customs check on return to the USA (Emery *et al.*, 2002).

Using the 2003 CPS Tobacco Use Supplement (TUS) on individual purchase quantities and locations, Chiou and Muehlegger (2008) found that the impact of a state's tax change on cigarette sales depends upon the tradeoffs between the cigarette price difference and distance to the state with lower cigarette prices. They calculated that a consumer is willing to travel 2.7 miles to save $1 on a pack of cigarettes. The willingness to travel depends on the number of cigarette consumed: smokers who report smoking every day (or individuals who smoke more than 14 cigarettes a day) have a significantly lower marginal cost of travelling than smokers who only report smoking some days (or those who smoke less than 14 cigarettes a day), and are therefore more likely to travel across the border to purchase cigarettes. Everyday smokers purchase approximately 3 times as many cigarettes when crossing a border than do some-days smokers.

A minimum set of resources seems to be necessary for a person to have access to low/untaxed cigarettes. These resources are related, for example, to travel costs or to costs of getting internet access (Hyland *et al.*, 2005; DeCicca *et al.*, 2010).

Social norms with respect to the use of illicit products and government interventions can be an important determinant of the demand for non-taxed products. In Taiwan, China, smokers who opposed cigarette taxation policy were 1.69 times more likely to buy smuggled cigarettes (Tsai *et al.*, 2003). United Kingdom smokers living in socioeconomically deprived areas were quite supportive of smuggling, as they perceive it helpful in dealing with the rising financial costs of smoking (Wiltshire *et al.*, 2001). DeCicca *et al.* (2010) reports that anti-smoking sentiment reduces the likelihood of cross-border shopping.

Ineffective tobacco tax administration, insufficient tax enforcement resources, and lack of control over the movement of tax-free cigarettes

The lack of clarity regarding the regulations covering the control of free-trade zones is a major reason for their misuse for illicit trade according to the World Customs Organization. As the government and the customs authorities dispute who has the jurisdiction over free-trade zones, enforcement loopholes allow these zones to play a facilitating role in illicit cigarette trade (World Customs Organization, 2007).

Examining trade transaction between the USA and North Africa and between Hong Kong Special Administrative Region and the rest of SE Asia showed that inadequate controls over the in-transit cigarettes results in a substantial leakage, with many of the cigarettes failing to arrive at their intended destination (Joossens *et al.*, 2000).

In the USA, a change in the balance of enforcement activities between the US state and US federal authorities after passing the Contraband Cigarette Act (CCA) in 1978 generated a loophole in the tax audit (Thursby and Thursby, 2000). This led to an increase in illicit cigarette trade as well as to a change in the preferred method of tax evasion. Commercial/large scale smuggling began to focus on underreporting of the amount of cigarettes released to the distribution ("diversion") that could have been discovered by the tax audit. The study concluded that effective enforcement requires participation of both law enforcement agencies and tax administrators.

A law that would allow US states to recover taxes from cigarettes sold over the Internet (the Jenkins Act) is enforced by the US federal authorities, who are much less motivated than individual states to enforce the law (Goolsbee *et al.*, 2007). However, in October 2002 Washington State successfully applied the Jenkins Act to internet sales, leading to similar efforts in many other states (Chaloupka *et al.*, in press).

Corruption, war and organized crime facilitate law circumvention, reducing the cost of supplying illicit products

Criminal networks specializing in cigarette smuggling operate more easily in countries where corruption is high, the control of the authorities is lax and commodities other than tobacco are also being smuggled (Joossens, 1999). Using data from 38 countries, Merriman *et al.* (2000) found that the level of corruption (measured by the transparency index) is positively related to the size of the illicit cigarette market. A one-point improvement in a country's transparency index was associated with a two-percentage-point decrease in experts' estimate of cigarette smuggling. Since corruption is more pervasive in low-income and middle-income countries, these countries are at greater risk of large-scale smuggling activities.

Cambodia is an example of a country where a high level of corruption facilitates cigarette smuggling. It is estimated that 79% of cigarettes imported into Cambodia are re-exported or smuggled across Cambodia's borders (Ministry of Health Republic of Indonesia, 2004).

The European Commission (1998) identified over 50 criminal networks potentially engaged in large-scale tobacco smuggling. In 2005, the investigation by the European Council concluded that the threat imposed by cigarette smuggling within the European Union is primarily related to the involvement of organized crime (Council of the European Union, 2005).

Cigarette smuggling is claimed to be the third largest illegal business in Germany, behind drug trafficking and illegal gambling, with extensive involvement of organized crime (Von Lampe, 1999 as cited in Merriman, 2001). In southern Italy, Calabrian gangsters have been involved in the tobacco smuggling (Unknown, 1997).

The presence of organized crime networks can increase pressure on legitimate distribution networks by reducing their profitability or by forcing them to join in the black market (Joossens *et al.*, 2000).

Smuggling of various goods, and particularly cigarettes, was a prosperous "business" in the Yugoslav republics during the Balkan War in 1991–1995, helping to finance weaponry and otherwise supporting war operations (Hajdinjak, 2002). Smuggling was done with the close cooperation of politicians, their security forces and organized crime, and fostered the development of a regional net of smuggling channels affecting neighbouring countries like Bulgaria, Romania and Albania. These illegal activities became an important source of income during the war for people of all social groups (Hajdinjak, 2002).

The US Government Accountability Office reported that terrorist organizations including Hezbollah made money through the tobacco black market (United States General Accounting Office, 2003). The profit from large-scale cigarette smuggling via free-trade zones was used to finance the terrorist organization Abu Sayyaf Group based in the Philippines (The Financial Action Task Force, 2010).

Corruption and organized crime does not seem to be a predictor of small-scale smuggling and cross-border shopping. Goel (2008) found that the average number of public corruption convictions is not a statistically significant predictor of cross-border cigarette smuggling in the USA.

Tobacco companies' profit motivation translated to their marketing strategy and political agendas reduce the cost of supplying illicit cigarettes

The tobacco industry itself often promotes the smuggling of their products, because smuggling does not impact their profit margins, reduces the impact of higher tax/price on cigarette consumption and can be used to advocate for an excise tax reduction as a way to reduce smuggling and associated criminal activities (Leverett *et al.*, 2002). In fact, cigarettes confiscated and destroyed by law enforcement authorities increase demand for replacement cigarettes and therefore the profitability of the industry (Leverett *et al.*, 2002).

Delipalla (2009) developed a decision-making model analysing the factors motivating the industry to get involved in illicit tobacco trade. The model assumes that the industry operates as an oligopoly, and that the market does not differentiate between legal and illegal products (their prices are similar). To maximize its profit, each firm decides the total quantity sold on the market and the fraction of that total it will attempt to sell illegally (without tax) taking into account the probability of successful tax evasion, the level of enforcement, the cost of smuggling, and fines paid if caught. The paper then examines the relative effects of specific and *ad valorem* taxes on the firm's evasion decision given that it is optimal for a firm to engage in tax evasion. It concludes that the optimal fraction of tax-not-paid products is increasing in sales under purely specific taxation and when the *ad valorem* tax is imposed as a percentage of the fixed wholesale price. When the *ad valorem* tax is imposed as a percentage of the retail price, the optimal fraction of tax-not-paid products is decreasing. The analysis suggests that (for given tax rates and enforcement) if demand falls (for example due to effective tobacco control policies), smuggling will also be reduced under a specific tax regime, but it will increase under an *ad valorem* one. The impact of a mixed tax structure on optimal illicit trade is ambiguous. The analysis concludes that higher tax rates do encourage smuggling under purely or predominantly *ad valorem* taxation, but their effect is ambiguous under purely or predominantly specific taxation.

The industry has used the occasion of a tax increase to promote illicit cigarette trade to put pressure on the governments to reverse their decision.

Canada's significant increases in cigarette tax in 1980s and early 1990s motivated the tobacco industry to orchestrate smuggling of cigarettes to Canada to exercise pressure on Canadian government to reduce these taxes (Canadian Cancer Society, Non-smokers' Rights Association, Physicians for a Smoke-free Canada, & Quebec Coalition for Tobacco Control, 1999). The industry developed a tax-dodging scheme allowing the company to smuggle billions of cigarettes into Canada using a Native American reservation in the USA (Segal, 1999; Sugarman, 2002). In response, the government cut cigarette taxes in 1994. Imperial Tobacco Canada Limited and Rothmans Benson & Hedges, the two tobacco companies involved in this smuggling scheme, pleaded guilty in 2008 and admitted "aiding persons to sell or be in possession of tobacco products manufactured in Canada that were not packaged and were not stamped in conformity with the Excise Act" between 1989 and 1994. The companies agreed to pay CA$1.15 billion, the largest fine ever levied in Canada (Joossens and Raw, 2008). R. J. Reynolds, the third tobacco company involved in the smuggling scheme, has agreed to pay CA$325 million ($325 million) to the Canadian governments in April 2010 (Schneider, 2010).

There is evidence that British American Tobacco (BAT) in Bangladesh had some degree of control over the proportion of contraband products on the market. BAT has altered the flow of illicit cigarettes while making the argument that tax increases lead to higher consumption of illegal tobacco products (Collin *et al.*, 2004).

In South Africa, the Tobacco Institute of South Africa (TISA), a body which represents the majority of tobacco growers and cigarette manufacturers, has long argued that high taxes relative to those of neighbouring countries are responsible for the growth in illicitly traded cigarettes. They claim that illicit cigarettes represent 20% of the total market (Tobacco Institute of South Africa, 2008) without providing solid evidence to support this claim. A peer-reviewed academic study contradicts the industry estimates, estimating the maximum penetration of illicit cigarettes of 7.0% −11.2% of the total market in 2007 (Blecher, 2010).

Illicit cigarette trade can provide the industry a market entry for prohibited brands (brands that are not legally sold in the market). Producers then use customer loyalty as a political wedge to lobby for legal access to the market. The international trade journal World Tobacco reported in 1996 that "smuggling has helped to promote some of the world's leading brands in markets which had remained closed to foreign imports" (Market Tracking International Ltd, 1997).

Since the 1980s, the British American Tobacco (BAT) relied on illegal channels to supply markets in Africa (LeGresley *et al.*, 2008). Illicit cigarette trade has been an important component of BAT's market entry strategy to gain leverage in negotiating with governments for tax concessions, compete with other transnational tobacco companies, circumvent local import restrictions, and to gain a market presence. BAT exploited weak government capacity to combat illicit trade and gained substantial market share in major countries (LeGresley *et al.*, 2008).

Smuggling has been an important component of BAT's market entry strategy in Lebanon, a country with a state tobacco monopoly and chronic political instability. After the end of the civil war in the early 1990s, BAT and other transnational tobacco companies sought a legal presence in the country, but continued to achieve substantial sales through illicit cigarette trade (Nakkash & Lee, 2008).

Smuggling has been used as a market entry in Argentina, Italy, Islamic Republic of Iran, Bulgaria, the former Soviet Union and China, for example (Joossens & Raw, 1998; World Health Organization, 2003; Gilmore and McKee, 2004).

After the market opening in Taiwan, China in 1987, Japan Tobacco International (JTI) set up a Swiss plant as a legal cover for its smuggling operation to the country. This allowed JTI to overcome the existing legal quota of exports to Taiwan, China (Wen *et al.*, 2006).

The involvement of the industry in smuggling operations in Europe became clear when the level of illicit trade on the continent substantially declined following the 2004 and later agreements between major manufacturers (e.g. PMI, JTI) and the EU authorities without admission of liability. This agreement financially motivated the industry to control the illegal supply of their products to the EU market. Since counterfeit cigarettes are excluded from the agreement, companies have an incentive to have seized products declared as counterfeit (World Health Organization, 2007).

The improved collaboration between the industry and the United Kingdom government reduced the availability of genuine brand cigarettes on the black market. This can be regarded as evidence that cigarette manufacturers are indeed in a position to control the supply of illicit cigarettes to the market. However, counterfeit products began to play a larger role in the supply of illicit cigarettes as evidenced by the type of illegal cigarettes seized in the United Kingdom (HM Customs & Excise, 2001a, 2001b; House of Commons & Treasure Committee, 2005). The volume of seized counterfeit cigarettes increased threefold between 2000 and 2004. In 2003–2004, 54% of seized cigarettes were counterfeit (House of Commons, Treasure Committee, 2005).

Extent of tax evasion and tax avoidance globally, regionally and in key countries

Joossens, Merriman, Ross and Raw (2010) collected data on illicit cigarette trade from different sources. Their estimates of illicit market share (Table 8.1) are based on academic articles, official government publications, estimates from market research companies (whose clients include the tobacco industry and governmental organizations), tobacco trade journal articles, newspaper articles and sometimes estimates from personal contacts in customs organizations. The estimates vary greatly in rigour and in the measure of illicit trade used. Some for example express the size of the illicit market as a percentage but without saying what it is a percentage of, and some do not even state what measure was used. Nor is there a clearly defined methodology for assessing if an estimate is accurate. Joossens and colleagues (2010) have included in their estimates what seem reasonable in terms of the country's population, smoking prevalence, legal infrastructure and other relevant parameters. Thus a combination of methods, including informed expert judgement, is often necessary to cross-validate estimates. Bearing in mind these methodological challenges, the data on illicit and legal market estimates from 2007 show that almost 12% of global cigarette consumption is illicit, including 17% in low-income countries, 12% in middle-income countries, and 10% in high-income countries.

Europe

European Union. Using cigarette sales data 1989–95 from 18 European countries, Merriman *et al.* (2000) estimated that, in a typical European country, the share of cigarettes acquired by small-scale smuggling and/or cross-border shopping accounted for about 3% of domestic consumption.

Based on in-depth analysis of data collected by the professional services company Klynveld Peat Marwick Goerdeler (KPMG, 2005), a study commissioned by the European Commission estimated that in 2004 total market penetration of illicit cigarette trade represented approximately 8–9% of European Union (which had 25 Member States at the time, designated EU25) cigarette sales. The above-cited report noted also that the illicit market share in the new EU Member States (Estonia, Hungary, Lithuania, Poland and Slovakia) were far above the EU25 average (KPMG, 2005). The KPMG report has limitations, as it is based on cigarette seizures in the EU and on studies provided by the tobacco industry and governments, however as its estimate falls between the higher estimates from the United Kingdom and eastern and central European countries and the lower estimates from southern European countries like Spain and Italy, the overall figure of 8–9% is a reasonable estimate.

In 2008, the European Commission estimated that around 13% of total consumption in the 27 EU Member States had not been taxed in the country of consumption.

Table 8.1. Estimates of the illicit cigarette market around the world

Country	% illicit market	Measure used	Year	Illicit % total market
High-income countries				
Hong Kong Special Administrative Region	42	Percentage of legal sales	2005	30
UAE	30	Percentage of legal cigarette sales	2005	23
Singapore	18	Percentage of legal cigarette sales	2005	15
Canada	15–20	Percentage of total cigarette market: estimate based on multiple sources and surveys	2007	15–20
USA	13–25	Percentage of consumers that purchased lower-priced cigarettes	1992–2002	13–25
United Kingdom	13	Percentage of total cigarette consumption (not including hand rolled tobacco)	2006–2007	13
Taiwan, China	11	Percentage of legal cigarette sales	2005	10
Australia	6	Percentage of legal cigarette sales	2007	6
Israel	5	Percentage of legal cigarette sales	2005	5
Saudi Arabia	4	Percentage of legal cigarette sales	2006	4
Italy	2	Percentage of total cigarette market	2006	2
Japan	2	Percentage of legal cigarette sales	2006	2
New Zealand	1	Percentage of legal cigarette sales	2003	1
Spain	1	Percentage of total cigarette market	2006	1
Upper-middle-, lower-middle- and low-income countries				
Georgia	49	Percentage of total cigarette market	2005	49
Bolivia	46	Percentage of legal cigarette sales	2005	32
Albania	40–50	Not stated	Not stated	40–50
Bosnia & Herzegovina	35–45	Not stated	Not stated	35–45
Uzbekistan	40	Smuggling as a percentage of total cigarette consumption	2006	40
Ethiopia	38	Percentage of total cigarette market	2006	38
Brazil	35	Percentage of legal cigarette sales	2006	26
Lao People's Democratic Republic	35	Not stated	2005	35
Iraq	35	Percentage of total cigarette market	2006	35

Country	% illicit market	Measure used	Year	Illicit % total market
Former Yugoslav Republic of Macedonia	30–35	Not stated	Not stated	30–35
Cameroon	26	Percentage of legal cigarette sales	2005	21
Syrian Arab Republic	26	Percentage of total cigarette market	2007	26
Estonia	19–32	Percentage of total cigarette market	2003	19–32
Sudan	25	Percentage of legal cigarette sales	Not stated	20
Zambia	25	Not stated	2003	25
Croatia	25	Percentage of legal cigarette sales	2005	20
Malaysia	24	Percentage of total cigarette market	2008	24
Venezuela	23	Percentage of legal cigarette sales	2005	19
Russian Federation	23	Percentage of legal cigarette sales	2004	19
Peru	23	Percentage of total cigarette consumption	2006	23
Lebanon	23	Not stated	2000–2006	23
Morocco	23	Percentage of total cigarette market	2006	23
Algeria	20	Percentage of total cigarette market	2007	20
Philippines	19	Percentage of legal cigarette sales	2006	16
Nigeria	18	Percentage of total cigarette consumption	2006	18
Ghana	18	Percentage of legal cigarette sales	2005	15
Pakistan	17	Percentage of total cigarette market	2005	17
Armenia	16	Percentage of total cigarette consumption	2004	16
Côte d’Ivoire	15	Percentage of legal cigarette sales	2005	13
India	14	Percentage of total cigarette consumption	2004	14
Columbia	14	Percentage of total cigarette consumption	2004	14
Islamic Republic of Iran	14	Percentage of total cigarette market	2007	14
Ecuador	12	Percentage of total cigarette consumption	2006	12
Uruguay	12	Percentage of total cigarette market	2006	12
Guatemala	12	Percentage of total cigarette market	2006	12
Jordan	10–12	Percentage of total cigarette market	2007	10–12

Table 8.1. Estimates of the illicit cigarette market around the world

Country	% illicit market	Measure used	Year	Illicit % total market
Thailand	11	Not stated	Not stated	11
Yemen	11	Percentage of legal cigarette sales	Not stated	10
Turkey	11	Percentage of total cigarette market	2006–2007	11
Nicaragua	10	Not stated	2001–2002	10
Panama	10	Percentage of legal cigarette sales	2000	9
Tunisia	10	Percentage of total cigarette consumption	2007	10
El Salvador	10	Not stated	Not stated	10
Argentina	10	Percentage of total cigarette market	2006	10
Viet Nam	10	Smuggling as a percentage of total cigarette market	2004	10
China	8–10	Percentage of total cigarette market: extrapolated from multiple sources	Multiple	8–10
Kazakhstan	9	Smuggling as a percentage of total cigarette consumption	Early 2000s	9
South Africa	9	Percentage of total cigarette consumption	2007	9
Ukraine	9	Percentage of total cigarette market: multiple sources	Multiple	9
Costa Rica	9	Percentage of legal cigarette sales	2006	8
Indonesia	5–6	Percentage of total cigarette market	2005	5–6
Mexico	3	Percentage of total cigarette sales	2006	3
Chile	3	Percentage of legal cigarette sales	2006	3

Adapted from Joossens L, Merriman D, Ross H, Raw M. The impact of eliminating the global illicit cigarette trade on Health and Revenue. Addiction. 2010; 105(9):1640–1649 with permission from John Wiley and Sons. Notes: The% illicit market has been rounded to nearest integer; UAE = United Arab Emirates; Russian Fed. = Russian Federation; the EU-25 average illicit market share is 8.5%. In this table we list only countries for which we have country-specific data. The EU-25 countries, which are included in the model calculations using 8.5% illicit market share, are: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovenia, Slovakia, Spain, Sweden, United Kingdom. EU-27 includes in addition to the EU-25 Bulgaria and Romania. Estimates contained in Table 8.1 uses standardized terminology determined by the authors to facilitate cross-study comparison; verbatim study terminology are reported in the online version. The third column, 'Measure used', reports the measure used in each source document, as described in the original publication, including where the measure was not specified. There is no standard measure thus the table reflects the varied data sources.

About 8–9 percentage points had been attributed to tax evasion and around 4 percentage points to legal cross-border shopping (European Commission, 2009). These estimates are in line with the findings of the KPMG study cited above on the EU25 tobacco market in 2004 commissioned by the Commission in 2005 (KPMG, 2005).

According to a survey of 26 500 Europeans (EU27 plus Norway; EU27 is EU25 plus Bulgaria and Romania; see Table 8.1 footnotes) conducted in December 2008, just over one tenth of EU citizens (12%) had seen tobacco products being sold in the past six months which they think might have been smuggled into the country. The proportion of respondents who had seen potentially smuggled tobacco products being sold in the past six months was the highest in Lithuania (36%), followed by Greece (25%), then Poland, Hungary and Latvia (22–24%). In Belgium, the Netherlands, Italy, Portugal, Luxembourg and Denmark, on the other hand, only 5% of respondents had seen potentially smuggled tobacco products in the past six months. In Norway, where in January 2008 a packet of Marlboro cost $12 (the country with the highest cigarette prices in the world), only 6% of survey respondents had seen tobacco products during the last 12 months which they believed were smuggled. In Lithuania, where in January 2008 a packet of Marlboro cost $2 (the country with the lowest cigarette prices in the EU) the percentage was 36% (European Commission, 2009).

United Kingdom. According to United Kingdom customs officials the illicit market share (of consumption) in 2006–07 was 13% for cigarettes and 53% for hand-rolled tobacco in the United Kingdom. The United Kingdom is one of the few countries to produce reliable yearly estimates of illicit trade, with a methodology based on the discrepancy between trends in legal sales and household survey smoking habits (HM Revenue & Customs, 2008).

Finland. The Finish authorities reported that legal cross-border cigarette shopping by Finish travellers amounted to 12% of total national sales in 1996 (Lipponen *et al.*, 1998).

Poland. A 2004 survey of the Cancer Epidemiology & Prevention Division of the city of Warsaw also suggested that only 11% of smokers could have bought cigarettes on the illicit market in Poland (Gumkowsky *et al.*, 2006). Studies based on six surveys in the period 2004–6 concluded that 11% of cigarettes sold in Poland were illicit (Ciercierski, 2007).

Albania. In 2009, approximately 19% of smokers in urban areas and 27% in rural areas in Albania suspected that some of the cigarettes that they had purchased in the last year were illicit. Half of these respondents cited a missing tax stamp, and/or a missing Albanian health warning and/or not having nicotine/tar information in Albanian as features of an illicit cigarette pack. Another 29% cited tax stamps and health warnings written in a foreign language, and 27% cited the taste of cigarettes. It is important to note that is not illegal to purchase illicit cigarettes in Albania, and smokers would not be subject to legal sanction by providing this information (Zaloshnja *et al.*, 2010).

Russian Federation. The European Regional office of the World Health Organization estimates that in the Russian Federation 20–30% of cigarettes are smuggled, and concludes that the Russian Federation remains the biggest illicit European market in terms of volume (World Health Organization, 2007). Independent research estimated that 23% of legal sales were illicit in the Russian Federation in 2004 (70 billion cigarettes) (Ross *et al.*, 2008; Joossen *et al.*, 2009).

Americas

Canada. The Canadian tobacco industry contracted a research company, GfK Group, to assess smoking trends in Canada. Their research reported that 16.5% of smokers said in 2006 that they had purchased illicit tobacco products within the previous seven days, the figure rising to 22% in 2007. The major source of the Canadian illegal trade is cigarettes illicitly manufactured in aboriginal native reserves on the border between Canada and the USA, which are smuggled into Canada (mainly the provinces of Ontario and Quebec) (Royal Canadian Mounted Police, 2008)

USA. Cigarette taxes in the US vary at the different levels of government. Saba, Beard, Ekelund and Ressler (1995) used data from the 48 continental US states and the District of Columbia from 1960 to 1986 to estimate that small-scale smuggling accounts for a small portion of market, usually not exceeding 2% of legal sales despite the price/tax differences.

In a more recent study using data from the Behavioural Risk Factor Surveillance System (BRFSS), Stehr (2005) found that the tax avoidance represented up to 9.6% of sales in the US between 1985 and 2001. However, according to Stehr's findings the level of legal border crossing in the USA was low relative to other forms of tax avoidance.

Combined federal, state and city taxes are highest in New York City. In 2004, 57% of smokers in New York state purchased cigarettes at least once from a low-tax or untaxed source, while 37% purchased low-tax or untaxed cigarettes regularly (New York State Department of Health, 2006). The large tax differentials between Chicago and neighbouring jurisdictions provide an incentive for cigarette tax avoidance. Data from a random sample of cigarette packs littered in Chicago in 2007 reveals a high degree of tax avoidance: three fourths did not display a Chicago tax stamp (Merriman, 2010). Based on a comparison between cigarette sales data and cigarette consumption data from surveys, a researcher from the Department of Economics of Drexel University estimated that in 1985 in the USA, 7.2% of cigarettes were purchased without payment of state taxes and that this had risen to 12.7% in 2001 (Stehr, 2005). A researcher from the Stanford University Institute for Economic Policy Research estimated that between 13% and 25% (average 17.5%) of US consumers purchased cigarettes in a lower-price bordering state or Native American reservation over the period 1992–2002 (Lovenheim, 2007).

Asia and Australasia

China. There are varying and contradictory estimates of the level of illicit cigarette trade in China. China is by far the biggest producer in the world of counterfeit cigarettes, which are destined for domestic and foreign markets. A 2005 national survey conducted by the China National Bureau of Statistics on behalf of the China National Tobacco Company (CNTC) found that about 10% of cigarettes on the market were counterfeit (Joossens *et al.*, 2009). China's State Tobacco Monopoly Administration announced in January 2008 that it had seized 9.28 billion counterfeit cigarettes in 2007 (Globalink news service, 2008). Thus the production of counterfeit cigarettes can be estimated at 93–186 billion cigarettes if we assume that the seized cigarettes represent about 5–10% of total illicit counterfeit production, a plausible assumption.

Japan. Most observers in the field agree that illicit cigarette trade is low in Japan. A possible explanation for the low level of smuggling is the strict control of the distribution network in this country. All retailers of tobacco products have to be approved, and are licensed by the Ministry of Finance.

Australia. The large difference between the price received by tobacco farmers in Australia, and the price of raw tobacco purchased on the market has motivated tobacco growers to sell their products to illegal markets to increase their profit from tobacco growing (Geis *et al.*, 2003).

Middle East and Africa

Islamic Republic of Iran. Based on a report of the Iranian tobacco companies and the Central Headquarters of the Fight against Smuggling, which is a department of the Presidential office, the illicit cigarette market share in the Islamic Republic of Iran was 74% of the total market in 2001 (40 billion cigarettes) and 14% of the total market in 2007 (8.3 billion cigarettes) in the Islamic Republic of Iran (Joossens *et al.*, 2009). The extremely high level of smuggling in 2001 is probably because there was insufficient domestic production to meet demand, and imported cigarettes were subject to high import duties, so the Islamic Republic of Iran was a target for internationally smuggled cigarette brands. However, between 2001 and 2007 the market was liberalised and national production was increased, leading to a dramatic fall in smuggling. Studies on illicit cigarettes undertaken by the Tobacco Prevention and Control Research Center and relying on smoker self-reports, found that 22.5% of the cigarettes consumed in Teheran in 2006 were illegal (Heydari *et al.*, 2009). A similar study was undertaken during a randomized cross-sectional survey in Tehran in 2008–2009, finding that 21% of the cigarettes were smuggled (Heydari *et al.*, 2010).

South Africa. An independent researcher estimates the size of the illicit market in South Africa to have grown substantially from 1997 until peaking in 2000 between 9.4% and 11.5% of the total market. The most recent estimate for 2007 suggests that the illicit market occupied between 7.0% and 11.2% of the total market (Blecher, 2010).

North and West Africa. According to a report of the United Nations Office on Drugs and Crime, as much as 80% of the cigarette market in Guinea Bissau and the Libyan Arab Jamahiriya is illicit. In Mali the illicit market share is 40%; estimates are lower for other listed countries (United Nations Office of Drugs and Crime, 2009).

Impact of tax avoidance/evasion on public health

The impact of tax avoidance/evasion on tobacco products on public health can be classified as the impact on average tobacco price, on health disparity, on other tobacco control policies, and generally on public safety.

The impact of higher taxes/prices on tobacco use is not diminished by smuggling if the market equilibrium quantity of the taxed products in the absence of tax avoidance/evasion is equal to the quantity of their supply in the presence of tax avoidance/evasion. This equilibrium depends on the degree of substitution between legal and illegal cigarettes and whether the availability of illegal substitutes increases total consumption. To the extent that legal and illegal tobacco products are not perfect substitutes, an increase in cigarette taxes translated to increased cigarette prices will reduce their consumption even when smuggling is possible (Merriman *et al.*, 2000; Merriman, 2002).

The degree of substation between legal and illegal products is based on the notion that consumer incurs both "transaction" and "inconvenience" costs (Merriman, 2002). The transaction price/cost is the amount of money paid for the product at the point of sale. The inconvenience price/cost is the value of the additional time it takes to obtain a product illegally as well as the value of discomfort to engage in an illegal activity. Although the price of inconvenience does not require a monetary transaction, it represents real costs since black market purchasers may face potential legal sanctions and other risks. For example, the location of the street sellers can be undependable, there can be uncertainty about the authenticity of the brand, or consumers may fear embarrassment or legal penalties if caught buying smuggled cigarettes. The sum of the transaction price and inconvenience price represent the “effective” price, the price that consumers consider when deciding whether to make a purchase or not. In general, the higher the effective price, the lower the quantity of cigarettes demanded. Illicit products often have a lower transaction (or sales) price than legal products, because consumers who purchase smuggled cigarettes pay higher inconvenience price. Given that the general theoretical model of smuggling is applicable to a broad range of societies, it is reasonable to expect that conclusions based on empirical evidence from high-income countries will be applicable to certain degree to middle- and low-income countries (Merriman *et al.*, 2000).

Therefore, in theory, smuggling does not completely reduce the public health benefits of cigarette taxes (Merriman, 2002).

There is some empirical evidence that consumers are aware of the inconvenience price. A study in the United Kingdom found that 17% of adult smokers prefer to buy cigarettes from recognized outlets rather than individuals even if the transaction price of the cigarettes sold by the individuals is £1.00 per pack lower (DTZ Pieda Consulting, 2000).

Using United Kingdom data, Duffy (2006) also suggests that smuggled and non-smuggled tobacco products are imperfect substitutes. The majority of smokers are not inclined to break the law, and only some of them are willing to use illegal products. Therefore, the observed reduction in the legal consumption after a tax increase is only partially driven by substitution towards contraband.

Even though the theory suggests that the impact of illicit cigarette trade on cigarette prices is likely to be small, the competition between the legal and the illicit cigarettes could result in lower average cigarette prices and therefore in higher consumption (Joossens *et al.*, 2000).

The empirical evidence on prices of illicit tobacco products is mixed, as the price differences between legal and illegal cigarettes vary by country, the location of the selling point, and the brand name and the perceived quality of the illicit cigarettes. In general, the price of the illicit cigarettes is lower than the retail price of legal products. In the United Kingdom, for example, smuggled cigarettes in 2005 were sold at 50% of the duty-paid products (West *et al.*, 2008). In Germany, the price of the smuggled Chinese brand Jin Ling was 40% of the retail price of a premium brand in 2009 (Candea *et al.*, 2009). The price of illegal “chop-chop” tobacco in Australia ranged from AUS$45 to AUS$100 per kilogram in 2001, while a kilogram of legal roll-your-own tobacco was AUS$320 in the same year (Geis *et al.*, 2003).

Internet sites often sell cigarettes tax-free or with taxes from low-tax jurisdictions (Ribisl *et al.*, 2006). The average online site selling cigarettes in the USA passes about 90% of the tax savings through to the consumer (Goolsbee *et al.*, 2007) making cigarettes available at prices substantially lower than in stores.

In some markets, however, the price of illicit cigarettes can be higher. In Viet Nam, for example, the price of the smuggled brand 555, manufactured in the United Kingdom, was higher than the locally produced 555, because the smuggled cigarettes were perceived as being of higher quality (Joossens, 2003).

Several studies used the gap between the legal and illegal products and calculated the impact of eliminating this price difference on tobacco use and on public health. Joossens and colleagues (2009) used data from 84 countries and estimated that the global average cigarette price in 2007 was about 3.75% lower due to the presence of illegal trade in cigarettes. If the global illicit market were eliminated in 2002, 164 000 premature deaths would be averted a year from the year 2030 on. That means that by 2036, close to a million tobacco-related premature deaths would not occur.

A similar study has been conducted in the United Kingdom, where in the presence of smuggling the average tobacco product price was found to be about 11.6% under the legal market equilibrium. Eliminating the illicit cigarette trade in the United Kingdom would reduce the cigarette consumption by 5.0–8.2% and lower the tobacco death toll in the United Kingdom by 4000–6500 premature deaths a year (West *et al.*, 2008)

Experience from several European countries suggests that an increase in cigarette taxes can result in increased smuggling, but also in the decline in total cigarette consumption.

Two sizeable tobacco tax increases in Sweden (December 1996 and August 1997) led to a 43% increase in average cigarette prices, but also an increase in the estimated amount of cigarette smuggling (from 200 million cigarettes in 1996 to 500 million in 1998). However, smoking prevalence has also declined (from 1996 to 1997 there were 19.1%

and 4.4% declines among men and women, respectively), particularly among youth and young adults (in the age group 16–24 there were 25% and 17.4% declines among men and women from 1996 to 1997). In addition, tobacco tax revenue rose by 9% in 1997 compared to 1996 (Wendleby & Nordgren, 1998; Joossens, 1999).

After the Swedish government responded to pressure to reduce cigarette smuggling by reducing cigarette tax in August 1998, per-capita tax paid cigarette sales increased, but tax revenue went down (Joossens *et al.*, 2000).

France nearly doubled its nominal cigarette retail price between September 1991 and December 1996 (74% increase in real terms) by increasing tobacco taxes. During the same time, cigarette sales dropped from 97 billion cigarettes in 1991 to 83 billion in 1997, adult smoking prevalence decreased from 40% in 1991 to 34% in 1997 (Baudier, 1997), and youth smoking prevalence (12–18 years old) dropped from 30% in 1991 to 25% in 1997 (Arènes *et al.*, 1998). Tobacco tax revenue rose from 32 billion FF in 1991 to 57 billion FF in 1996 while illicit cigarettes kept occupying a relatively unimportant share of the market—around 2% (Baudier, 1997). The relatively low level of illicit cigarette trade in France has been explained by its efficiently controlled retail environment in which all tobacco retailers must be licensed.

A United Kingdom study found that higher taxes increased prices of both legal and illegal tobacco products and led to an overall decline in tobacco consumption (Duffy, 2006). However, the price elasticity of duty-paid tobacco has also increased since 1995 when cigarette smuggling began to grow, meaning that some of the drop in legal consumption was replaced by an increase in the consumption of products evading taxes.

Merriman *et al.* (2000) used data from 23 European countries during 1989−1995 and predicted that a tax increase in an individual country will increase small-scale cigarette smuggling, but coordinating these increases with neighbouring countries would reduce the incentives for this type of tax avoidance. For example, a unilateral 10% price increase in Germany would reduce annual sales by 6 packs per capita, but total consumption only by 3 cigarette packs per capita per year, with 3 packs per capita being smuggled to Germany from other countries. With a multilateral price increase, the consumption in Germany would still drop by 3 packs per capita, but domestic sales would drop by only 4 packs (with one pack still being supplied from other countries). This means that the health impact of a tax increase will be independent of the coordination of tax increases, but the revenue impact will depend on this coordination. If incentives for small-scale smuggling in Europe disappeared, legal cigarette sales would increase by 3%.

The European experience with tobacco tax increases and their impact on tobacco use in the presence of illicit cigarette trade has been very similar to what happened on the American continent.

Canada's significant increase in cigarette prices due to its tax policy in 1980s and early 1990s resulted in 43% decline in per-capita cigarette consumption from 1979 to 1993 despite the presence of illicit cigarettes on the market. Smoking prevalence fell sharply, particularly among youth (15–19 years old): from 43% in 1981 to 23% in 1991 for this age group (Canadian Cancer Society, Non-smokers' Rights Association, Physicians for a Smoke-free Canada, & Quebec Coalition for Tobacco Control, 1999). As in Sweden, the Canadian government responded to the political pressure to reduce cigarette smuggling and in 1994 reduced cigarette taxes. This led to a sharp increase in per-capita consumption (a 27% increase between 1993 and 1998) and higher smoking prevalence among youth and adults as well as loss of tax revenue (Canadian Cancer Society, Non-smokers' Rights Association, Physicians for a Smoke-free Canada, & Quebec Coalition for Tobacco Control, 1999).

Several empirical studies used Canadian data to study the response to these cigarette tax changes. Galbraith and Kaiserman (1997) used monthly sales data from 1980–1994 and found that the total consumption (taxed plus smuggled sales) was less responsive to price increases (short-run elasticity of –0.40) than taxed consumption (short-run elasticity of –1.01), meaning that 1% increase in price due to tax increased illicit cigarette trade by 0.5–0.6%. Gruber, Sen and Stabile (2002) and Goel (2004) confirmed that taxed cigarette consumption in Canada is more sensitive to price than is total cigarette consumption, meaning that there is a substitution between the illicit and legal cigarettes, but a tax increase is still an effective measure for reducing total cigarette use.

A similar conclusion has been reached in the USA. Baltagi and Levin (1986) showed that price elasticities of cigarette demand in the USA were lower after controlling for small-scale smuggling. Licari and Meier (1997) used a pooled time series of cigarette sales in all 50 US states from 1951 to 1994 and found that higher taxes reduce consumption, but their effect is lower when controlling for cross-state small-scale smuggling.

A study from California using data from the California Tobacco Surveys found that a significant cigarette tax increase in 1999 that resulted in relatively large price difference with all its bordering states (including Mexico) motivated only 5.1% of all smokers to purchase tax-free cigarettes. The study concluded that higher cigarette taxes did not pose a threat to the public health objective of reducing smoking despite the presence of tax avoidance/evasion (Emery *et al.*, 2002).

One US study using data from four waves of the CPS Tobacco Supplement 1992–2002 found that the possibility to obtain cheaper cigarettes from another state or Native American reservation could reduce the average price responsiveness of consumers to zero, but the price sensitivity also varied with the distance of residence to a lower-price border: a 1% increase in distance resulted in a decrease in the home state price elasticity by about 0.2 percent (Lovenheim 2007).The study found that cross-border purchases increase consumption by 4.0–8.2% and the smoking participation by 2.0–4.3%. The study concluded that cigarette price increases would be effective in reducing cigarette use if cigarette smuggling was eliminated.

Making cheaper cigarettes available via the internet can undermine the public health gain from imposing higher tobacco taxes. Kim *et al.* (2006) found that New Jersey adult smokers who purchased cheaper cigarettes via the internet significantly increased their consumption over time, compared to smokers who reported paying full price at retail stores.

Goolsbee, Lovenheim and Slemrod (2007) used US sales data, smoking prevalence and tax rates from 1980 to 2005 to find that there has been a considerable increase in the sensitivity of taxable cigarette sales that is correlated with the rise of internet use within states. The growth of internet penetration in the USA has induced an elevation in the taxable sales elasticity of over 60%. Cigarette tax evasion over the internet has substantially reduced the revenue-generating potential of cigarette tax increases: states have collected 8% less cigarette tax revenue between 2001 and 2005 due to tax-free cigarette internet sales. This has serious implications for funding of state programmes, including tobacco control and other public health programmes. In addition, unregulated web sites offer various price promotions or gifts with purchases, and many require a minimum purchasing quantity thus further encouraging cigarette consumption (Ribisl *et al.*, 2001). Of 88 internet sites selling cigarettes in the USA in 2000, one third featured promotional programmes (Ribisl *et al.*, 2001).

The evidence on the impact of higher prices/taxes on the substitution between legal and illegal cigarettes outside Europe and North America is limited.

Yurekli and Sayginsoy (2010) used the market shares of illicit cigarettes in 110 countries to estimate the impact of a tax increase on tax avoidance/evasion. Assuming a perfect substitution between legal and illegal cigarettes in their econometric and simulation models, they found that a global tax-induced increase in real cigarette prices would lead to higher smuggling if it is not accompanied by an improvement in law enforcement. Despite the tax avoidance, the overall cigarette use would be reduced: a 10% increase in total tax (excise and VAT) would reduce total consumption by 1.97% with no change in Gross Domestic Product (GDP) or by 0.2% with 5% real GDP growth. This reduction would be even larger if enforcement of anti-smuggling laws would improve at the same time.

The studies above estimate the impact of tax avoidance and tax evasion on the general public. There are also studies that have examined the impact of this behaviour on health disparities, since the availability of lower-priced smuggled cigarettes could have a disproportionate impact on smoking and health among children and the poor given their greater price sensitivity (Townsend *et al.*, 1994; DTZ Pieda Consulting, 2000; Joossens *et al.*, 2000). In addition, illicit cigarettes are primarily products of the multinational tobacco companies, because these are easy marketable and have price advantage over less-known brands (Joossens & Raw, 1998). Marlboro, for example, represented 66% of all seized cigarettes worldwide in 2005 (World Customs Organization, 2007). International brands, and particularly Marlboro, are favoured by young people in low-income and middle-income countries where Western products are especially attractive (Joossens & Raw, 1998).

This evidence of the impact of illicit trade on health disparities is much more scarce compared to the evidence on the general population, and most of it comes again from North America and Europe.

A study from Canada using data from 2006/2007 Youth Smoking Survey reported that over 13% of daily teenage smokers reported usually consuming contraband cigarette brands (Callaghan *et al.*, 2009). These smokers consumed significantly more cigarettes compared to those who smoke legally circulating cigarette brands. Contraband cigarettes represented 17.5% of all youth daily-smokers cigarette consumption in Canada, but in some regions such as Ontario and Quebec, the share of illegal cigarettes were much higher—over 25% of the youth cigarette market consisted of illicit cigarettes.

Another study analysing cigarette butts collected in 2007 at smoking locations near high schools in two Canadian provinces found that 26% and 36% of them were contraband in Ontario and in Quebec, respectively. The comparison with 2006 results when the share of illicit butts was 24% and 35%, respectively, suggests an increasing trend in illicit cigarette use among the teenage population (Canadian Convenience Stores Association, 2007; Unknown, 2008).

Gruber, Sen and Stabile (2002) used data from the Canadian Survey of Family Expenditure 1982 –1998 and concluded that cigarette smuggling disproportionally affects low-income groups: illicit trade reduces the average price of tobacco products, leading to the disproportionally higher consumption of tobacco among the poor, who are more price sensitive compared to the general population. Therefore, cigarette smuggling increases smoking-related disparities.

Cantreill *et al.* (2008) interviewed 614 Chinese-American smokers living in New York City between September 2002 and February 2003 and found that younger smokers were most likely to engage in tax avoidance behaviour and were also less likely to change their smoking behaviour in response to the tax increase. Close to 55% of male Chinese smokers engaged in at least one low- or no-tax strategy after a substantial increase of tobacco tax in 2002.

Smokers in socioeconomically deprived areas of Edinburgh in the United Kingdom admitted buying contraband products as a way to deal with the rising financial costs of smoking and perceived smugglers as “providing a valuable service” to the community (Wiltshire *et al.*, 2001). The availability of cheaper illicit cigarettes undermined the desire of many smokers to quit, thus reducing the impact tobacco tax policy can have on consumption (Wiltshire *et al.*, 2001).

One study from Asia, in Taiwan, China, indicated that low-income and poorly-educated smokers are more likely to purchase smuggled cigarettes (Lee *et al.*, 2009). Smokers who had a personal monthly income of less than NT$10 000 in 2004 (US$287) and had the least amount of education were 54% more likely to smoke smuggled cigarettes than those with just one or none of these characteristics.

Using data from 84 countries, Joossens *et al.* (2009) found that the burden of illicit trade falls disproportionately on lower-income countries, where the illicit cigarettes in 2007 made up on average 16.8% of the market; The average market share of illicit cigarettes in high-income countries was about 9.8% in that year. The tax loss associated with illicit cigarette trade was estimated at US$18.3 and US$13 billion in low- and high-income countries, respectively. If the problem of illicit cigarettes were solved, low- and middle-income countries would experience 132 000 fewer premature tobacco-related deaths per year from 2030 on. In high-income countries, the toll attributable to illicit cigarette trade is lower, about 32 000 per year.

In addition to the impact on the average tobacco price, the presence of illegal cigarettes on the market can interfere with other tobacco control regulations, such as those related to youth access to tobacco and requirements of tobacco product contents and labelling of products (Stephens *et al.*, 2005; Pappas *et al.*, 2007). In addition, the presence of smuggled cigarettes can result in a competitive disadvantage for legitimate retailers, increasing their motivation not to comply with tobacco-control laws (Joossens *et al.*, 2000).

There is some evidence that illicit cigarette trade undermines efforts to limit youth access to tobacco products, since vendors of smuggled cigarettes are less likely to comply with these restrictions (Joossens *et al.*, 2000). Data from the USA suggest that retailers selling tax-free cigarettes via internet, phone or by mail often fail to check the age of the buyer. Of the 88 internet sites selling cigarettes in the USA in 2000, 18.2% did not feature a minimum age of sale warning (Ribisl *et al.*, 2001). The issue of youth access to cigarettes via Internet may become more important with better retailers’ compliance with youth access laws, as it may drive youth to use the internet more frequently as their source of cigarettes (Ribisl *et al.*, 2006).

A US study found that only 28.4% of internet sites selling cigarettes featured the legally required health warning (Ribisl *et al.*, 2001). Only 3.5% (5 sites) of internet cigar vendors had health warning on their web sites (Malone & Bero, 2000). Internet sites selling cigarettes often failed to comply with advertising ban and, instead promote specific tobacco brands and use of other tobacco products such as cigars and loose tobacco, and feature links to pro-smoking or smoker’s rights organizations (Ribisl *et al.*, 2001).

Illicit tobacco trade can affect public safety by attracting organized crime and by increasing the general level of corruption (FIA International Research Ltd, 1999a). In New York City, cigarette smuggling has been associated with organized crime as well as activities of small-time crooks, and has led to murders, kidnappings and armed robberies to earn and protect illicit profits. Such crime has exposed average citizens, such as truck drivers and retail store clerks, to violence (Fleenor, 2003).

Money gained from illicit tobacco trade is used for other serious criminal enterprises, including terrorist operations (United States General Accounting Office, 2003). In 2002, a US federal court found Mohamad Hammoud guilty of providing material support for terrorists in his role as leader of a Charlotte, North Carolina–based cell that raised money for the Lebanese terrorist group Hezbollah by smuggling cigarettes within the United States (Fleenor, 2003). Thus, illicit tobacco trade can have implications for the overall welfare of the country (Bhagwati and Hansen, 1973; Ray, 1978) including the overall public health.

Policies to curb tax avoidance/ evasion; new policies/ technologies

Sweeting, Johnson and Schwartz made an extensive review of the effectiveness of policy measures to combat cigarette contraband in 2009. While focusing on the Canadian situation, the report provides updated information on anti-contraband policies in different parts of the world. Case studies in Brazil, Canada, Australia, United Kingdom, Spain and the EU are discussed in detail in the report (Sweeting *et al.*, 2009).

Their research methods consisted of three elements:

1. A systematic literature review was undertaken, collecting both academic and non-academic publications on contraband tobacco and relevant policies.
2. Interviews were conducted with representatives from academia, nongovernmental organizations, governments and international organizations. Key informants were chosen for their overall knowledge of tobacco smuggling or their intimate knowledge of a specific anti-contraband policy measure.
3. Four expert focus panels were convened to validate, enrich understanding of, and further assess the feasibility of implementing the various policy measures.

In its conclusions, the report identifies and defines the different forms of contraband tobacco, including casual small-scale smuggling, organized international smuggling, illicit manufacturing, tax avoidance from duty-free sources, and counterfeit cigarettes. The effectiveness of ten anti-contraband policy measures are explored: licensing, tax-markings/stamping, tracking and tracing, record-keeping/ control measures, enhanced enforcement, export taxation, tax harmonization, tax agreements/ compacts, legally binding agreements with the tobacco industry, memoranda of understanding and public awareness campaigns.

According to the authors, the analysis suggests that both the type of contraband and means of distribution influence the effectiveness of different policies and the unintended consequences of action. For example, policy measures that were effective in the 1990s for legally manufactured cigarettes smuggled across borders are less effective for the illicitly manufactured and counterfeit cigarettes that dominate contraband activity today in many countries.

Case studies indicate that while contraband sources often emerge domestically, given the ease of transport and manufacture, sources can be easily displaced to neighbouring or overseas jurisdictions. Inter-agency cooperation (both domestic and international) emerges as a vital component of all successful anti-contraband strategies. The dynamic nature of contraband supply requires a comprehensive approach that focuses on both immediate and future threats. Policies designed to ensure that contraband tobacco products do not appear in the legitimate retail sector (such as tax-paid markings, licensing and record-keeping) and measures to ensure that counterfeit products are easily identified (such as enhanced taxation stamps) are vital resources. Adequate investment in enforcement is also essential to the success of anti-contraband measures. Given the global scope of the phenomenon, greater international cooperation and information sharing is paramount.

A central theme in the research findings is the multifaceted nature of successful anti-contraband tobacco policies, which require combinations of regulation, fiscal/ taxation policy, enforcement, and public awareness campaigns.

The literature on the effectiveness of anti-contraband policies is rather limited, and even less evidence is available for measures to reduce tax avoidance. The methodology of the illicit trade estimates is often poorly described, and the research is underfunded for an area which is described as difficult. For evident reasons, smugglers do not keep records and are not interested in research on their activities. Enforcement agencies are often reluctant to make their findings public for confidentiality reasons. One of the major recommendations of Sweeting and colleagues (2009) is to make statistics and information regarding the tobacco trade and contraband tobacco much more available to the public, to assist with research and debate on this subject. For example, many jurisdictions (including Canada) do not provide official estimates of the size of the illicit market or comprehensive data on contraband tobacco seizures made by federal and provincial agencies, making it extremely difficult to evaluate and assess approaches in this area (Sweeting *et al.*, 2009).

There are many forms of illicit trade, and illicit activities may change over time as illicit traders adapt their business as a result of the measures taken by governments. Some examples of the changing nature of the illicit trade of tobacco products and the effectiveness of the anti-illicit trade policies are described below in the case studies of California, Washington state, Brazil and Europe.

Case study: California

The Californian Board of Equalization estimated in 2001–2002 that 25% of the state's retailers were selling counterfeit cigarettes (California State Auditor, 2006). To reduce the losses in revenue, the authorities introduced licensing obligations, high-tech tax stamps and investigative authority to better control the distribution chain. In January 2004, the Cigarette and Tobacco Products Licensing Act was introduced, which required all entities engaged in the sale of tobacco products within the state to be licensed. In January 2005, the attachment of tax stamps to tobacco products containing coded information that was more difficult to counterfeit than the stamps previously used was required. The stamping machines applied a new generation of tax stamps using invisible ink, featuring a unique covert code containing product data relating to each cigarette pack and uploaded to a central Data Management System.

Under the new system, retailers and distributors can easily detect counterfeit cigarettes by using specific hand-held scanners. Law enforcement field inspectors are equipped with more sophisticated scanners which give them access to a whole range of data for compliance verification. The legislation imposes fines of up to US $25 000 for possessing, selling or buying counterfeit cigarettes or fraudulent cigarette tax stamps.

The results of the Californian system have been evaluated positively. The costs have been calculated to be US$9 million per year in return for significant additional tax revenue on cigarettes—an additional US$75 million was collected between January 2004 and March 2006 as a result of the licensing act and the tax stamps. Investigators have tracked retailers' tax compliance since the provisions of the Act commenced operation. Their reports suggest that after implementation, the seizures of counterfeit products at retail locations and the percentage of retailers carrying counterfeit products decreased (California State Auditor, 2006).

In combating illicit trade, no one measure is likely to be effective when implemented in isolation. Tax stamps and coded information should be implemented in combination with other measures such as licensing. California had a problem with the retail selling of counterfeit cigarettes; the solution was easy detection of the counterfeit cigarettes combined with the introduction of high-tech tax stamps, better control over the distribution chain by the enforcement officers and the withdrawal of the licence for those retailers who sell illicit cigarettes.

Case study: Washington State

Cigarette tax evasion from Internet sales motivated the state of Washington to apply the Jenkins Act (15 USC 376a), a US federal statute originally intended to curb tax evasion resulting from the interstate sale of mail-order cigarettes (Chaloupka *et al.*, in press). The Act requires vendors who market or ship cigarettes across state lines to register with the tobacco tax administrator of the destination states, and to send that office monthly statements or copies of invoices documenting the names and addresses of recipients and the quantities of cigarettes shipped. This information should aid states with collecting excise taxes from recipients of cross-state shipments. However, the effort to apply the Jenkins Act met resistance from internet cigarette vendors and received little support from the US federal government. However, in 2002 the state of Washington filed a complaint against an online vendor who failed to provide information on Internet sales to Washington residents. A federal court decided that the state has the right to enforce the Jenkins Act to crack down on cigarette tax avoidance, and the online vendor agreed to provide the information required by the Jenkins Act (Banthin, 2004). Washington's success in applying the Jenkins Act led to similar efforts in many other US states. Comprehensive information on the extent of these efforts, their costs, and the revenues generated from them is not publicly available, but newspaper articles suggest that these efforts are cost-effective. For example, Michigan reported collecting US$5.9 million from about 9000 residents based on lists provided by 13 online vendors (Christoff 2006).

Case study: Brazil

The illicit tobacco trade has been a concern for the Brazilian authorities since the mid-1990s. In 1998, Brazilian manufacturers were exporting 34 billion cigarettes to neighbouring countries, many of which returned illegally to Brazil as contraband. To deal with this problem, the government imposed an export tax of 150% on cigarettes to neighbouring countries. After the export tax was introduced, exports of cigarettes declined rapidly, but cigarette smuggling continued, as newly established factories in a neighbouring country were fuelling the contraband market. In addition to the smuggling problem, 14 domestic cigarette companies were not paying the taxes on cigarettes. According to the Brazilian Ministry of Finance, the illicit cigarette trade represented 35% of the market in Brazil in 2006: 20% smuggling from neighbouring countries and 15% illicit domestic manufacturing (Fisch, 2006, 2009).

To tackle illicit domestic manufacturing, the licensing of manufacturers was made mandatory. Noncompliance with the legislation or failure to pay taxes could lead to the withdrawal of the manufacturer's license and the closure of the factory. In addition to the licensing obligations, a national integrated control and monitoring system for cigarette production was fully implemented in 2008. The system included the installation of automatic production counters at each production line and mandated the implementation of a digital tax stamp, with capabilities for identifying each individual pack. The purpose of the new legislation was to ensure that all due taxes were collected on cigarettes produced in Brazil and to verify the authenticity of the tax stamps applied by the manufacturers on the cigarette packs (Fisch, 2006, 2009).

The high-tech tax stamps contain a unique code using invisible ink for each cigarette pack. The codes on the tax stamps include product data relating to each cigarette pack, which is uploaded to a Data Manager Server under the control of the Ministry of Finance. Besides the possibility of verifying whether the products are authentic or counterfeit, the stamps are encrypted with the following information, such as name of the manufacturing site, the date the stamp was validated, and the tax category of the stamp.

If a manufacturer uses tax stamps whose electronic codes are not detected, not allocated to that specific manufacturer, or not in accordance with the fiscal category of the pack, the Data Manager Server will issue an alert to the Secretariat of Federal Revenues to start an investigation.

Inspectors, retailers and distributors can easily detect counterfeit cigarettes by using specific hand-held scanners. Law enforcement field inspectors can have access online to package related data available on the Data Manager Server by scanning the code.

According to the Brazilian Ministry of Finance, the implementation of the programme led to the closure of several companies that did not comply with the licensing rules and to US$100 million less tax evasion at the domestic market in 2008 (Fisch, 2009).

The new policy was not intended to have an impact on the smuggling of cigarettes from the neighbouring countries, and its impact on this type of illicit trade is probably minor or non-existent. As in the case of California, it was only a combination of policies (control and monitoring system, licensing of manufacturers and enforcement) that led to positive results.

Case Study: United Kingdom

In the United Kingdom, the main problem was genuine cigarettes produced in the United Kingdom that were exported in large numbers to dubious export markets, then illegally imported though smuggling networks back into the United Kingdom (Joossens and Raw, 2008).

Over the last decade, illicit cigarette trade fell from about 21% to 13% in the United Kingdom (HM Revenue & Customs, 2008). Anti-smuggling measures in the United Kingdom included scanners for container detection, prominent fiscal marks on packs, increased punishment for offenders, more customs officers, and parliamentary hearings, which exposed tobacco industry export practices. The United Kingdom strategy to tackle illicit trade was continuously updated and included a strong cooperation between different agencies. The approach includes improved intelligence, risk profiling, tasking and coordination to detect and disrupt the supply of illicit tobacco products (HM Revenue & Customs, 2008).

Case study: Italy and Spain

In the 1990s, cigarette smuggling was a significant problem in the EU. In 1996, US cigarette companies were exporting billions of cigarettes to Europe, under the transit regime, many of which disappeared during transport and ended up in the illegal markets of Italy, Spain, Germany and other EU markets. However, over the last decade illicit cigarette trade fell from about 15% to 1–2% in Italy and Spain (Joosens & Raw, 2008).

In Italy, following Italian and European investigations which led to legal action against the tobacco industry, and subsequently to a legally binding agreement with Phillip Morris, there was a dramatic fall in customs seizures and corresponding rise in legal sales. The supply of smuggled cigarettes into Spain was reduced by a combination of measures, including intelligence, customs activity in border areas, and international cooperation, both within Europe and with US authorities over the supply of seized US brands. The European Fraud Office (OLAF) investigation of the tobacco companies in the US in 1998 and the Spanish and Italian customs activities and ensuing lawsuit against American tobacco companies also appear to have had a significant impact. Over the period covered by these actions there was a dramatic fall in US exports to Europe (Joossens and Raw, 2008).

The European examples have common factors. Smuggling was reduced by interrupting the supply chain from the manufacturers to the illicit market, and the evidence suggests that the supply chain is to a great extent controlled by the tobacco industry. International cooperation was also crucial. Enforceable measures to control the supply chain, and international cooperative measures including information sharing and cooperation in the investigation and prosecution of offences are essential to deal with the cross border illicit cigarette trade.

One study (Merriman *et al.*, 2000) on small-scale smuggling and cross-border shopping in Europe using 1989–95 sales data suggests that coordinated multilateral increases in cigarette taxes would result in significantly less tax avoidance and tax evasion than unilateral tax increases.

Combating tax evasion remains difficult, but empirical evidence from around the world suggests that a combination of measures such as more investment in enforcement and dissuasive penalties, international cooperation, including information sharing and cooperation in the investigation and prosecution of offences, legislative measures to control the supply chain and the legal business can lead to positive results.

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Chapter 9
Health and economic impact of tobacco taxation

Introduction

According to evidence from around the world, raising the tax on tobacco products is a highly effective control policy instrument to improve population health and reduce smoking-related health risks (Jha & Chaloupka, 1999). A tax increase leads to an increase in cigarette prices, which in turn will cause some smokers to quit smoking or not to initiate or relapse to the smoking habit, while others may continue smoking but will smoke less. The act of quitting smoking itself and less secondhand smoke (SHS) exposure will reduce premature deaths and improve the health of the population, thereby reducing healthcare costs.

On the other hand, the cigarette industry is concerned with the possible negative impact on employment resulting from a reduction in cigarette consumption. Tobacco farming also may be affected by a loss in earnings. In addition to smuggling and the regressive effect on low-income smokers, these are key concerns that many governments or tobacco industries have used to argue against an increase in tobacco taxes.

Some officials also are concerned that with an increase in the tobacco tax, the demand for cigarette consumption will decrease, and with it government cigarette tax revenue. However, empirical studies (Chaloupka *et al.*, 2000) have shown that since the demand for cigarettes is inelastic (that is, the percentage of reduction in cigarette consumption is less than the percentage of increasing price), governments will in fact realize increased cigarette tax revenue as a result of an increase in the tobacco tax. Some governments allocate part of the additional tax revenue to tobacco control activities or tobacco-related medical care. Fiscal experts may argue against such an earmarked tax. There are other potential effects of tobacco taxation on the consumer price index.

This chapter reviews and summarizes the population health and economic impact of tobacco taxation from past published literature and empirical evidence. The overall conceptual framework for the impact analysis on this topic is displayed in Figure 9.1.

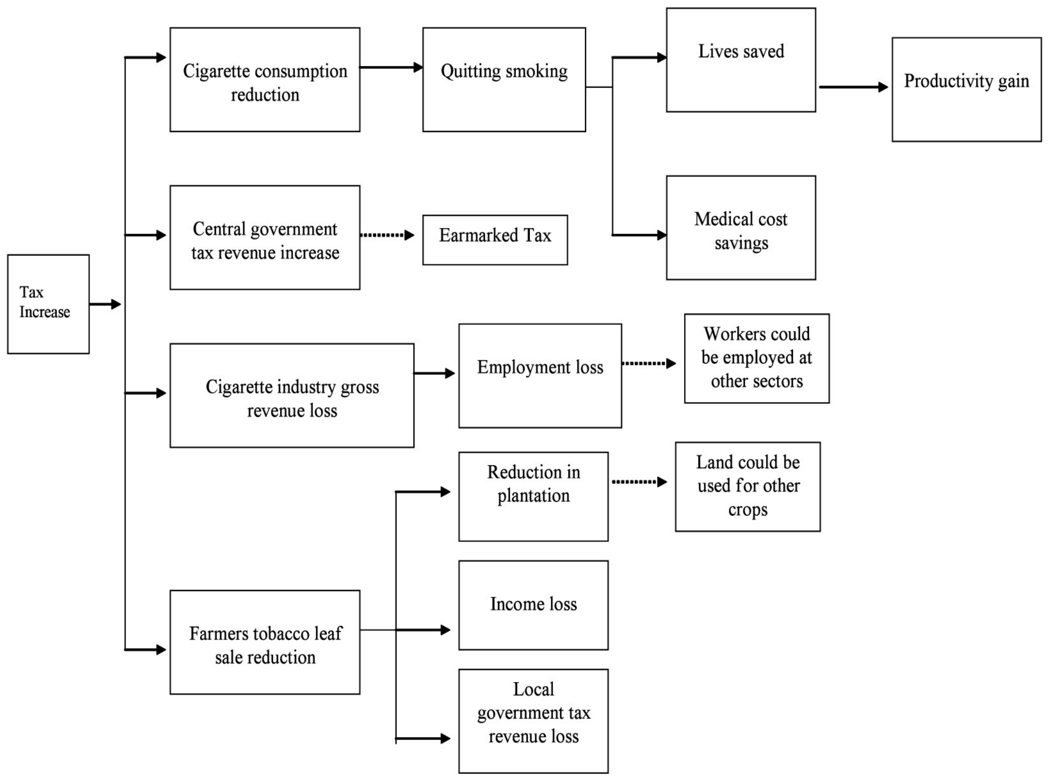
This review is organized as follows. The first section reviews the impact of tobacco taxation on population health, healthcare cost savings, and productivity gain. This is followed by a presentation of the impact of tobacco taxation on industry employment and tobacco farming. The next section summarizes the impact of tobacco taxation on government revenue, followed by a discussion of the pros and cons of earmarked tobacco taxation. The finally section reviews the impact of tobacco taxation increases on inflation and the consumer price index.

Impact on population health and healthcare cost savings

Direct impact of smoking on population health

Smoking is a major cause of premature death and morbidity. Smoking has been directly linked to cancer, cardiovascular disease and respiratory disease, among others (US. Department of Health and Human Services, 2000). A vast literature exists on the relationship between smoking and mortality (Peto *et al.*, 1992; Peto *et al.*, 1994; Peto, 1994). These studies estimate about 4 million deaths per year worldwide attributable to smoking. Half of these deaths are in low- and middle-income countries. By 2030, the annual death toll could reach 10 million if no tobacco control measures are taken. More recently, a country-specific study for China (Gu *et al.*, 2009) estimated that in 2005 a total of 673 000 deaths were attributable to smoking. The

Figure 9.1. The overall conceptual framework for the population health and economic impact of tobacco taxation



Adapted from Hu T-w, Mao Z, Shi J, Chen W. Tobacco Taxation and Its Potential Impact in China. Paris, France: The International Union Against Tuberculosis and Lung Disease, 2008, page 26.

leading causes were cancer (268000 deaths), cardiovascular disease (146 200 deaths) and respiratory disease (66 800 deaths).

Studies have also been conducted for the USA (Burns *et al.*, 1997), India (Gupta *et al.*, 2005; Jha *et al.*, 2008) and Germany (Neubauer *et al.*, 2006) that have provided a quantitative relationship between the length of smoking, smoking cessation, and benefits of quitting smoking for mortality. The risk of death declines with the length of time since an individual quits smoking, with the reductions in relative risk on heart disease and stroke more immediate than the effects on respiratory disease and cancer. Studies indicate that a large portion of heart disease deaths of those aged 40–64 are due to smoking, suggesting a reduction in economic productivity due to lost work years.

Increasing tobacco taxes can reduce smoking-attributable mortality and morbidity. The impact of tobacco taxation on the reduction of mortality depends on (1) the magnitude of the price increase resulting from a tobacco tax increase, (2) the magnitude of the price elasticity (the negative relationship between price and consumption), which includes smoking behaviour (quitting or initiating) in relation to the price increase, and (3) the relationship between mortality and quitting smoking. For example, if the price elasticity of demand for cigarettes is −0.5, a 10% price increase will reduce consumption by 5% (Chaloupka & Warner, 1999). Empirical literature indicates that about one third to one half of the 5% reduction in cigarette consumption is the result of people quitting or not initiating smoking (US Department of Health and Human Services, 2000).

The literature suggests that about one quarter to one half of those who quit smoking will avoid a smoking-related premature death (Jha & Chaloupka, 1999; Shafey *et al.*, 2009). The same analytical methods have been used in several studies supported by the International Union Against Tuberculosis and Lung Disease (Barber *et al.*, 2008; Hu *et al.*, 2008; John *et al.*, 2009a; Ross *et al.*, 2008). In China, it was estimated that an increase in the excise tax of 1 RMB (US$0.15) per pack could save one million lives if the price elasticity of demand is −0.15; 3.4 million lives could be saved if the price elasticity of the demand for cigarettes is −0.50 (Hu *et al.*, 2008). The India study indicates that with a price elasticity of demand for cigarettes of −0.34, a 75% price increase would save 2.7 million smokers lives (John *et al.*, 2009a). In the Russian Federation, with a price elasticity of the demand for cigarettes at −0.10, a 70% price increase would mean that 2.7 million tobacco-related deaths could be averted (Ross *et al.*, 2008). A study in another major cigarette smoking country, Indonesia (Barber *et al.*, 2008) indicates that with a price elasticity of −0.29 and an increase in the tax rate from 37% to 70% of the sales price, 2.5 million deaths could be averted. All of these estimated lives saved are only for those people who are already smoking before the tax increase. These examples show the impressive population health ramifications of raising the tobacco tax.

Several studies have empirically examined the direct relationship taxes/price and deaths. A study (Moore, 1996) used a national data for the USA to examine the effects of tobacco excise tax on changes of mortality. Controlling for state, year, socioeconomic variables and alcohol tax, he found that variations in tobacco taxes between 1954 and 1988 were inversely related to smoking-related mortality. He concluded that a 10% increase in the tobacco tax would save over 6000 lives a year. A study for Switzerland (Yamasaki *et al.*, 2005) using time series data between 1965 and 1994 found that taxes on tobacco were inversely related to the male standardized suicide rate. They concluded that a policy designed to reduce tobacco consumption has the benefit of reducing suicides, particularly for men.

Kaplan *et al.* (2001) generalized the analysis of health impacts to consider overall health benefits. They simulated the impact of a US$0.50 per pack cigarette tax increase in California. Assuming a price elasticity of −0.40, it would result in about 8389 quality-adjusted life years (QALYs) saved during the first year. Higher taxes would produce even greater health benefits in the long-term. Table 9.1 summarizes the impact of tobacco taxation on lives saved.

Table 9.1. Impact of tobacco taxation on lives saved

References	Country	Amount of tax	Assumptions	Lives saved
Asia				
Levy *et al.* (2006)	Viet Nam	From 36% to 72% of price	−0.3 to −0.6 by age	5921 lives per year after 20 years, 9490 lives per year after 30 years
Hu *et al.* (2008)	China	Additional 1 RMB (US$0.15 or from 40% to 51% of retail price)	Price elasticity −0.15 −0.50	1 million lives of current smokers 3.4 million lives of current smokers
Barber *et al.* (2008)	Indonesia	Raised from current level to 70% of retail price	−0.29	2.5 million lives of current smokers
John *et al.* (2009a)	India	Raised from current level to 75% of retail price	−0.34	2.7 million lives of current smokers
Europe				
Levy *et al.* (2008b)	Albania	Increase in price from 125 lek to 250 lek	−0.2 to −0.4 by age	462 lives saved per year after 20 years
Ross *et al.* (2008)	Russian Federation	Raised from current level to 70% of retail price	−0.10	2.7 million lives of current smokers
North America				
Moore (1996)	USA	10% tax increase	N/A	6000 lives per year
Kaplan *et al.* (2001)	USA (California)	Raised US$ 0.50 per pack	−0.40	8389 QALYs first year
Levy *et al.* (2008c)	USA (Kentucky)	Tax increase from 0.30 to $2.00	−0.1 to −0.4 by age	401 lives per year after 20 years
South America				
Ferrante *et al.* (2007)	Argentina	From 68% of price to 85% of price	−0.1 to −0.6 by age	5283 lives per year after 20 years, 7851 lives per year after 30 years
World				
Ranson *et al.* (2000)	Worldwide	10% tax increase		10 million lives of current smokers

Several studies have examined the impact of tobacco taxation on disease-specific mortality, such as heart disease or stroke, based on a pre-post tobacco control intervention programme. Studies for California statistically have identified a clear association between taxation and mortality. In 1989, California increased tobacco taxation and earmarked part of the revenue for a tobacco control programme. Lightwood & Glantz (1997), using data collected between 1980 and 1995, by comparing the pre- and post-tobacco control programme (1989–1995), showed via a regression model that the California tobacco control programme was able to reduce deaths by about 13 000 per year by preventing cardiovascular and stroke deaths. Another study (Fichtenberg & Glantz, 2000) compared per-capita cigarette consumption and the death rate from heart disease for California to that of the other 49 US states. Regression results indicated that between 1989 and 1992, California had 33 000 fewer deaths from heart disease than would have been expected if California had had no tobacco control programme. One major limitation of these studies is that tobacco control programmes in California include not only taxation, but also non-price tobacco control programmes. Although it is difficult to sort out the net effect of tobacco taxation from other tobacco control programmes that were also implemented, tobacco taxation is the key feature of the California tobacco control programme, and thus much of the effect of tobacco control in California can be attributed to taxes.

The effects of taxes and tobacco control in California have also been estimated using the SimSmoke tobacco control simulation model (Levy *et al.*, 2007a). Based on that model, the number of premature deaths avoided increases to over 5223 in the year 2010 alone. Over the years 1989 to 2010, the model estimates that about 55 444 lives were saved as a result of tobacco control policies in the state of California. Further, the model shows that about 60% of the deaths avoided can be attributed to cigarette price increases. For Arizona (Levy *et al.*, 2007b), which like California had mounted a major tobacco campaign, the SimSmoke model shows that price increases lead to 60% of the premature deaths avoided.

The SimSmoke model has also been applied to several nations. While the Arizona and California models applied price elasticities based on studies for the USA, the models for other nations use elasticity estimates based on studies conducted for the respective nation. A SimSmoke model for Thailand (Levy *et al.*, 2008a) estimates that between 1991 (shortly after tobacco control policies began) and 2026 about 320 000 premature deaths would be avoided due to tobacco control, of which approximately 60% would be again due to price increases. The Thailand estimate uses a relatively conservative estimate of the relative mortality risks of smoking. If relative risks increase to those for the USA, the number of premature deaths avoided could rise to about 540 000 by the year 2026. Price increases also played an important role in Korea's reduction in smoking prevalence (Levy *et al.*, 2010).

The SimSmoke model has been used to project the lives saved from imposing a hypothetical tax increase, and shows how the number of lives saved generally increases steadily per year. For example, using the SimSmoke model for Viet Nam, Levy *et al.* (2006) show that with the tax increasing from 36% of price to 72% of price, 5921 lives would be saved per year after 20 years and 9490 lives would be saved per year after 30 years. Despite a smaller population and using lower price elasticities, Ferrante *et al.* (2007) show that increasing the tax as a percentage of price from 68% to 85% in Argentina would yield 5283 lives saved per year after 20 years and 7851 lives saved per year. Based on studies of relative risk, a smaller total mortality relative risk was used for Viet Nam (1.35, based on studies for China) than Argentina (2.1, based on studies for the USA).

The SimSmoke models show that the effects of a price increase on mortality are small at first but grow over time, because 1) the reduction in the relative mortality risks increases with the time since quitting, 2) the effects on reduced initiation are delayed until about age 40 when deaths due to tobacco begin to appear, and 3) the effects of a price increase grow over time because its effects on initiation and cessation continue into the future, and because the larger effects of price on youth (see previous chapters on the higher price elasticity for youth) spread over time through to the population (Levy *et al.*, 2000).

In general, studies indicate that reductions in smoking rates due to increased taxes lead to a reduction in premature deaths due to smoking, including deaths during the ages of 40–64 when smokers would otherwise be working. Because the risks of death decrease with the years since quitting and the effects occur largely after the age of 40, the full effects of a tax increase will extend far into the future. Two limitations should be noted on previous work. First, studies for low-income nations, such as China, use relative risks of smoking much lower than those for high-income nations, such as the USA. The relative risks of smoking may be expected to increase in these low-income nations as the duration and intensity of smoking increase, thus suggesting that future deaths due to smoking may be understated. In addition, while some studies have distinguished the relative risks of cigarettes from bidis (Jha *et al.*, 2008), none of the studies of tax effects consider the effects on health of smokeless tobacco both alone and synergistically when used with smoked tobacco.

Impact of smoking on health cost savings

As shown in Figure 9.1, one of the immediate impacts of raising the tobacco tax is that some smokers quit smoking. Quitting smoking reduces the incidence of smoking-related illness, thus saving healthcare costs. The potential impact of health cost savings can be documented by numerous studies of the cost of smoking around the world.

There are two approaches to estimating the cost of smoking: one is based on the incidence rate, and the other is based on the prevalence rate. The incidence-based approach estimates the lifetime cost of smoking (Hodgson, 1992; Manning *et al.*, 1989) while the prevalence-based studies estimate the cost of smoking in a given year for the USA (Bartlett *et al.*, 1994; Miller *et al.*, 1998; Miller *et al.*, 1999), for Viet Nam (Ross *et al.*, 2007), for China (Sung *et al.*, 2006) and for India (John *et al.*, 2009b). The incidence approach requires extensive sources and numerous lifetime epidemiological and economic assumptions. Thus, most cost of smoking studies are estimated by the prevalence-based approach.

The key assumption used in the prevalence approach is to estimate the smoking-attributable fraction (SAF) for comparing the healthcare cost of current smokers, former smokers and never smokers, mainly for three disease categories: cancer, vascular disease and respiratory diseases. Using healthcare expenditures surveys and associating with these disease categories, the SAF is calculated by disease category and relevant socio-demographic distinctions (rural/urban, gender, age). The estimated SAF is then multiplied by each cost estimate of interest to obtain smoking attributable cost. For example, the product of SAF and total inpatient hospitalization expenditure is smoking-attributable hospitalization costs; the product of SAF and total morbidity cost is smoking-attributable morbidity costs. Most cost-of-smoking estimates for the United States (Rice *et al.*, 1986), China (Jin *et al.*, 1995; Sung *et al.*, 2006), Viet Nam (Ross *et al.*, 2007), and India (John *et al.*, 2009b) have used this SAF method.

An alternative method of cost estimation is to use a regression model comparing the overall healthcare expenditures between smokers (former and current) and never smokers, as employed in studies for the United States (Bartlett *et al.*, 1994; Miller *et al.*, 1998; Miller *et al.*, 1999). This method requires extensive data to compare various smoking states as well as a set of socio-demographic variables.

The magnitude of smoking costs is influenced by method of estimation, cost data source, assumption of SAF, and time period of the study. Even for the same country and the same year, costs could vary by these factors. For instance, the estimated cost of smoking in the United States for 1993 varied between \$53.4 billion (Miller *et al.*, 1999) and \$72.7 billion (Miller *et al.*, 1998); in China, the direct medical cost of smoking was US\$0.8 billion in 1989 (Jin *et al.*, 1995) and US\$5.0 billion in 2000 (Sung *et al.*, 2006). Using a similar method, the medical cost of smoking in India was \$907 million in 2004 (John *et al.*, 2009b). Comparing each country's healthcare cost of smoking to their respective total healthcare expenditures, the United States spends about 5% to 7% of its total healthcare costs for smoking-related costs, while China and Germany spend about 3% of their total healthcare costs in this area.

One approach for assessing the impact of tobacco taxation on healthcare cost savings is to first estimate the amount of healthcare services (inpatient, outpatient, medication) prevented or averted due to quitting smoking, and then to estimate the unit cost of these healthcare services. The relationship between tobacco taxation and healthcare cost savings can be seen in a Chinese study (Hu *et al.*, 2008). With a tax increase of one RMB (US\$0.15) per pack (tax rate at retail price from 40% to 51%) and a price elasticity of −0.15, 4.1 million smokers in China would quit. According to a cost-of-smoking analysis (Sung *et al.*, 2006), per-smoker medical costs attributable to smoking were about US\$25.4 in China in the year 2000. Thus, 4.1 million fewer smokers would result in savings of US\$100 million in medical care costs. Table 9.2 summarizes studies of the impact of taxation on healthcare cost savings.

A Netherland study (Barendregt *et al.*, 1997) compared healthcare costs among smokers and nonsmokers to estimate the effect of smoking cessation on healthcare costs over time. They found that the healthcare costs for smokers at any given age are as much as 40% higher than those for nonsmokers, but only in the short run. In the long run, the study compared the healthcare costs incurred by smokers and lifetime

Table 9.2. Impact of tobacco taxation on healthcare cost savings

References	Country	Amount of tax increase	Assumptions	Healthcare cost savings
Asia				
Hu *et al*. (2008)	China	1 RMB (US$ 0.15)	Price elasticity = −0.15	US$ 100 million
Europe				
Reed (2010)	United Kingdom	5% tax increase	Price elasticity = −0.35	£ 10.2 billion
North America				
Ahmad (2005)	USA (California)	20% tax increase	–	US$12 billion for 75 years paid
Lightwood *et al*. (2008)	USA (California)	US$ 0.050 increase per pack	Price elasticity = −0.30 – −0.70	US$ 86 billion (95% CI = 28, 151 billion) between 1989–2004

healthcare cost incurred by non-smokers; with the additional years gained, the total lifetime healthcare costs for non-smokers are higher than smokers. If these costs are converted into present value (with a discount rate of 3% to 5%), smoking cessation would not lead to increased healthcare cost.

The California 1989 tobacco control legislation has had a significant impact in reducing heart disease and lung cancer. Between 1989 and 1995, in California the cost savings from fewer cardiovascular hospitalizations and other medical services resulted in US$390 million in savings of 1997 direct medical costs (Lightwood & Glantz, 1997). A recent study on the effect of the California tobacco control programme on personal healthcare expenditures (Lightwood *et al.*, 2008) showed that between 1989 and 2004, the California programme was associated with $86 billion in reduced medical spending. It should be noted again that this estimated healthcare cost savings is attributable not only to the increase in the tobacco tax but also to other non-price tobacco control programmes implemented in California during this same period.

A California simulation study (Ahmad, 2005) projected the impact of a tobacco tax increase over a 75-year period. The study found that a 20% cigarette tax increase would increase tax revenue by almost $10 billion, and smoking-related medical costs would decrease by $188 billion during the period. The smoking prevalence level was projected to decrease from 17% to 12% over the 75-year period. Indeed, current California smoking prevalence rate is almost approaching this target due to active tobacco control programmes implemented in California.

While some studies have examined the healthcare costs of smoking for countries other than the USA (see Table 9.2), more research is needed on these costs, since these costs are likely to vary from country to country. In addition, the specific effects of a tax increase have only been estimated for California in the USA. A potentially important healthcare costs savings from higher tobacco taxes is through reduced maternal smoking and reduced secondhand smoke. These effects of taxes are discussed below.

Cost-effectiveness analyses

Several cost–effectiveness studies have been conducted to consider how the benefits of a tax compare to its costs. Ranson *et al.* (2000) used 1995 data and estimated that if the inflation-adjusted price of cigarettes were raised by 10% worldwide through tax increases, 42 million smokers would be induced to quit. This price increase would prevent a minimum of 10 million tobacco-related deaths. In comparison, non-profit measures, such as a comprehensive ban on advertising, bans on smoking in public places, prominent warning labels, and mass information programmes would prevent about 5 million deaths. Thus it is highly cost-effective to initiate an increase in tobacco tax. A study of the United Kingdom prepared for Action on Smoking and Health (Reed, 2010) provided an economic analysis of the impact of increasing tobacco tax on net benefits to the United Kingdom economy as a whole. Assuming −0.35 as prevalence elasticity, they estimate that an increase of 5% in tobacco prices would cause 190 000 smokers to quit smoking, a total cost savings of 10.2 billion in 2010 prices. These cost savings consist of £1.97 billion for National Health Services, £1.36 billion for reduced absenteeism, £1.15 billion for output from extra working life, and £5.74 billion for values of extra life years.

A cost–effectiveness study of tobacco tax increase from a healthcare perspective was published in the Netherlands (van Baal *et al.*, 2007). It was concluded that a tobacco tax increase is a cost-effective intervention for public health, even when considering additional medical costs from life years gained.

In a recent study to estimate the health efficacies and financial costs of strategies to reduce salt intake and control tobacco use (Asaria *et al.*, 2007), the authors used the WHO Comparative Risk Assessment project to estimate the effects of successful implementation of price tobacco control and non-price control strategies. With the assumption of price elasticities ranging between −0.40 and −1.20 for 23 low-income and middle-income countries, an increased real price of cigarettes to reduce smoking prevalence by 10% in combination with mid-range estimates of non-price interventions would reduce the smoking prevalence rate by 20%, and 2.19 million deaths from cardiovascular disease would be averted, as well as 2.12 million from respiratory disease, and 1.20 million from cancer, for a total of 5.5 million deaths averted. The cost of implementation of this tobacco control programme would range from US$.04 to US$.032 per person for the countries analysed. As the authors point out, implementation costs associated with an increase in tobacco taxes would be largely if not completely offset by the generated tax revenues.

Either from a conceptual model or empirical analysis, evidence shows that increasing the tobacco tax will improve health, prevent tobacco-related illness, and thus save on healthcare costs. Cost savings in health care is thus an added benefit from implementation of tobacco taxation policy.

Secondary effects of a tax increase

While most of the literature on health effects focuses on the direct effects of smoking on the smoker, some studies examine the relationship between cigarette taxes and the health of others or its relationship to other unhealthy life styles.

Not directly estimated in the above reviewed studies is the effect of tobacco tax increases on deaths due to SHS. Substantial evidence now exists that SHS increases the risks associated with heart disease, stroke, respiratory disease, lung cancer and sudden infant death syndrome (SIDS) (US Department of Health and Human Services, 2006). As tobacco tax increases cause smokers to quit, exposure to SHS is likely to decrease in the home and at work, thereby reducing the mortality risks associated with secondhand smoke and thereby saving lives.

A recent study examined the effect of taxes and smoke-free air laws on SHS (Adda & Cornaglia, 2010). They used the nationally representative sample from the US National Health and Nutrition Examination Survey from 1988–1994 and from 1999–2002, and quantified the relationship between the concentration of cotinine in body fluids of non-smokers over time. They found that tobacco excise taxes have a significant effect on SHS exposure. A 10% increase in the state excise tax reduced the cotinine concentration in nonsmokers by about 3.6% for children 8–12 years of age. The effect was particularly large for children who are exposed to their parents' smoke. Thus, excise tobacco taxes may have an important health effect through reducing the exposures of children living in families where at least one parent smokes.

Prenatal smoking and postnatal SHS exposure have been identified as a strong risk factor for SIDS, a leading cause of infant mortality. A US study by Markowitz (2008) found higher cigarette prices/taxes and smoke-free air laws are associated with reduced cases of SIDS.

Besides the effects of passive smoking, maternal smoking has been associated with low-birth-weight babies, which leads to substantial added costs over the life of the individual, as well as other health risks to the child (Adams & Young, 1999; US Department of Health and Human Services, 2004). A growing literature examines the relationship of cigarette taxes to birth outcomes. Using the US Natality Detail File data from 1989–1992, Evans and Ringel (1999) estimated that the maternal smoking rate falls by 5% for a 10% increase in cigarette prices. In addition, among those women who quit smoking in response to a tax increase, average birth weights rose by approximately 400 g. In their follow-up study, Ringel and Evans (2001) provide more detailed information about the impact of a tobacco tax on the propensity of pregnant women to smoke, and found that a 10% increase in cigarette price would reduce maternal smoking rate by 7%. Colman *et al.* (2003) examined the effect of cigarette excise taxes on smoking before, during and after pregnancy, and found a statistical association between taxes and prenatal smoking through both quitting and relapse during and after pregnancy. The price elasticity of prenatal quitting and postpartum relapse was close to one in absolute value. Finally, Lien and Evans (2005) estimated the impact of large cigarette tax hikes in four US states on maternal smoking and infant birth weight. Smoking during pregnancy doubled the chance that an infant was born with a low birth weight.

Several studies have examined the interrelationship between tobacco prices and other unhealthy lifestyles. To date, studies have considered the effect on alcohol, marijuana use and obesity.

Most econometric analyses addressing tobacco and alcohol use are based on estimating demand functions and calculating cross-price effects from estimated price coefficients. Some studies rely on aggregate data at regional or national level. Using aggregate quarterly expenditure data for the United Kingdom over the period 1964–1983, Jones (1989) estimated budget shares equations which included four categories of alcoholic beverages and tobacco. He found tobacco to be a complement to all four categories of alcohol. Goel and Morey (1995) used a pooled set of data organized by year and state on US cigarette and liquor consumption for the period 1959–1982, and found the two goods to be substitutes. However, the cross-price effects differed markedly: from +0.33 for liquor to +0.10 for cigarettes, suggesting that there may be some asymmetry in the number of people who smoke and drink liquor and those who only smoke or only drink liquor. Bask and Melkersson (2004) modelled the demand for alcohol and cigarettes as two separate equations and then as a simultaneous system, taking into account habit formation. They used aggregate annual time series on sales volumes for the period 1955–1999 in Sweden, and found that alcohol and cigarettes are complements in consumption.

Several other studies have used survey data at the level of individual consumers. Jimenez and Labeaga (1994) estimated demand equations in a demand system using individual expenditures taken from the Spanish Family Expenditure Survey (SFES). The resulting cross-price elasticity of tobacco with respect to alcohol price averaged −0.8, suggesting complementarity between the two commodities. Decker and Schwartz (2000) considered two separate demand equations for alcohol and cigarettes where each included the price of both goods among other factors. The overall cross-price elasticity of alcohol with respect to cigarettes was +0.50, suggesting that the two goods are substitutes, while that of cigarettes with respect to the price of alcohol was −0.14. Fanelli and Mazzocchi (2004) developed a dynamic modelling approach, which is consistent with the rational addiction theory and with the hypothesis of adjustment costs. A strong complementarity between alcohol and tobacco consumption was found. Picone *et al.* (2004) examined the increases in the costs and barriers to smoking in the USA to study the relationships between smoking and drinking behaviours. They found that past consumption of cigarettes was positively related to current alcohol consumption, that increasing the cost of smoking (through the introduction of smoking bans) was associated with reduced alcohol consumption, and, finally, that higher cigarette prices were associated with increased alcohol consumption (suggesting a substitute effect).

Several studies of the adult population considered the use of marijuana along with tobacco and alcohol. Cameron and Williams (2001) showed that decisions of participation in tobacco, alcohol and marijuana are closely related, with marijuana being a substitute for alcohol and a complement of tobacco, and alcohol and tobacco being complements. Zhao and Harris (2004) investigated marijuana, alcohol and tobacco consumption using micro-unit data from the Australian National Drug Strategy Household Surveys. Consistent with findings of complementarity, the results indicate a positive relationship across all three substances, with the correlation between marijuana and tobacco use being the highest.

Studies have also focused specifically on the relationships between cigarette taxes and prices and other substance use among youth. Chaloupka *et al.* (1999) found that higher cigarette prices were associated with a reduced frequency of youth marijuana use. Farrelly *et al.* (2001) reached similar conclusions, finding that higher cigarette taxes reduced the probability that young males would use marijuana as well as the intensity of youth marijuana use. Pacula (1998a, 1998b) provides additional support, finding that youth marijuana use was lower in US states with higher cigarette taxes, although her estimates were not statistically significant. Extending this work to allow for habit formation, Pacula found that higher past and current cigarette prices significantly reduced current youth marijuana use, but that higher past cigarette prices were associated with greater current alcohol use, suggesting that cigarettes and alcohol are economic substitutes for youth. In contrast, based on an analysis of teen smoking and drinking using state-level data, Dee (1999) concluded that stronger alcohol control policies reducing youth smoking prevalence and higher cigarette taxes reduced the prevalence of youth drinking. Finally, using longitudinal data, Markowitz and Tauras (2006) found negative (though generally non-significant) effects of beer prices on youth smoking prevalence, and their proxy for marijuana prices generally indicated negative and significant effects on youth smoking prevalence, consistent with most of the rest of the literature implying that cigarettes, marijuana and alcohol are economic complements (i.e. used together) for youth.

Most of the studies find negative cross-price effects and therefore conclude that alcohol and tobacco are complements. Two notable exceptions, however, are Goel and Morey (1995) and Decker and Schwartz (2000).

Studies have also examined impact of tobacco taxes on obesity, since quitting smoking may be associated with an increase in appetite. Using US deaths between 1984–1999, Chou *et al.* (2004) found a positive effect of cigarette prices on body weight. Since tobacco taxes are associated with higher cigarette prices, this study suggests that quitting smoking would lead to weight gain. However, a follow-up study (Gruber & Frakes, 2006) used the same data set and found no evidence that reduced smoking leads to weight gain. Chou *et al.* (2004) used the cigarette price as the key variable in the model, while Gruber and Frakes (2006) used the cigarette tax as a key variable, suggesting that the results are sensitive to model specification. Future research is needed to address the issue between tobacco taxation and the effect of smoking cessation on weight gain.

Impact on earmarked tobacco tax revenue

Pros and cons of earmarking tobacco tax revenue

As discussed in Chapter 2, an earmarked tax is defined as the amount of tax revenue designated for spending on specific government or public services (Buchanan, 1963). In other words, earmarking calls for a simultaneous choice both on the level of taxation and expenditures on an item-by-item basis.

Earmarking of tax revenue has been adopted by countries worldwide and has a long history. Justification is often based on the benefit principle. For example, gasoline or automobile tax proceeds are used for highway financing, property tax revenue is used by the local government for residential services and local public school education, and social security taxes are used for retirement income. Here, the benefits to the smokers in light of the effects of secondhand smoke can be considered a justification for earmarking.

Earmarking the tobacco tax for health-related activities is often justified not only on the benefit principle but also as a “users’ fee” or a “sin tax.” It is argued that the tobacco tax covers the external costs of smoking (Manning *et al.*, 1989; Manning *et al.*, 1991) and discourages smokers from using cigarettes, thus leading to a reduction in tobacco-related healthcare costs and secondhand smoke exposure, by reducing the morbidity and mortality associated with cigarette smoking. Since the 1980s, countries such as Australia, Canada, New Zealand, Finland, Egypt, Thailand, and some states in the United States (California, Massachusetts, Oregon and others) have designated part of their tobacco tax revenue to finance tobacco control activities, health promotion, disease prevention, and healthcare insurance.

Some public finance experts have argued that earmarking may not be a good tax budgeting procedure because it introduces rigidities and does not permit proper allocation of general revenue among competing uses. Earmarking may be an arbitrary fiscal policy that does not lead to an optimal social welfare budget allocation principle (Musgrave & Musgrave, 1980). Furthermore, relying on a particular type of tax revenue may generate uncertainty for future tax revenue streams. However, researchers in the tobacco control field have shown that since earmarked tobacco taxes are used to fund health promotion and disease prevention programmes, this practice is consistent with the “benefit principle” of taxation and can reduce the welfare losses resulting in higher tobacco taxes (Hu *et al.*, 1998). Furthermore, given that many publicly provided health insurance programmes target lower-income populations, this type of earmarking is consistent with the objective of a tax and transfer system.

Examples of an earmarked tobacco tax and its impact on tobacco control

In the 1980s, earmarking tobacco taxes was adopted in Australia and New Zealand via the “Vic-Health” model that used tobacco tax revenue to fund sports and artistic events previously funded by the tobacco industry. Also, some of the tax revenue was dedicated to help tobacco farmers and those employed in the tobacco industry to move to other crops and industries.

Perhaps the first most comprehensive earmarked tobacco tax revenue programme was initiated in California. The California Tobacco Tax and Health Promotion Act was passed in 1988 by a popular vote. The cigarette tax was raised from 10 cents per pack to 35 cents per pack. The goal was to achieve a 75% reduction in the smoking prevalence rate by the year 2000. The Act created the Tobacco Product Suntax Fund, which allocated the revenue into six accounts (Bal *et al*., 1990):

(1) 20% of the funds for health and anti-smoking media campaigns;
(2) 35% for indigenous hospital services;
(3) 10% for indigenous physician services;
(4) 5% for research on tobacco-related diseases;
(5) 5% for the environment; and
(6) 25% for the government general account.

The basic philosophy behind this earmarked tobacco tax is that population-based tobacco control programmes offered through media, schools, websites and public areas will both reduce smoking prevalence and protect nonsmokers. Between 1989 and 1995, about US$1.5 billion in revenue was appropriated for these earmarked accounts.

Between 1990 and 1993, the State of California spent $26 million on a state-wide media campaign designed to change tobacco-related attitudes and behaviours of the adult population. To evaluate the possible impact of this earmarked media campaign together with the impact of the additional tobacco tax on cigarette consumption, Hu *et al.* (1995) employed a time-series regression model. They found that during the study period, cigarette sales were reduced by 819 million packs attributable to the state tax increase, and by 232 million packs attributable to the anti-smoking media campaign. This study suggests that earmarking the tobacco tax for a non-price tobacco control programme (i.e. anti-smoking campaign, bans on advertising and promotion of tobacco products, health-warning labels, and others) had an additional impact on tobacco consumption. Levy *et al.* (2007 a, 2007b) found that the media campaigns funded by the earmarked taxes played an important role in reducing smoking rates in the states of Arizona and California. A national study (Chaloupka & Grossman, 1996) further confirmed that the states that have earmarked a portion of their tobacco tax revenue for anti-smoking campaigns have all experienced a significant impact on both reducing the probability that a youth will initiate smoking and on reducing cigarette consumption among young smokers.

Besides the United States, Thailand is another example of success with earmarking. In 2001, the Thailand government passed the Health Promotion Foundation Act, which allocates 2% of the total national tobacco tax revenue (about US$93 million per year) to establish the Thai Health Promotion Foundation. This Foundation serves as a key organization working on public health issues, including tobacco control programmes. Levy and collaborators show the importance of these programmes in Thailand (Levy *et al.*, 2008a). The Thai Health Promotion Foundation not only been actively working with the Thai government and parliament to enact tobacco control legislation and conduct tobacco control policy research, but it has also provided tobacco control technical assistance to neighbouring countries, such as Viet Nam, Cambodia, and the Lao People's Democratic Republic.

Taiwan, China also was inspired by the California Tobacco Tax and Health Promotion Act in passing the Tobacco and Alcohol Tax Act in 1999 and implementing it in 2002. This act specified that about 70% of the additional tobacco tax revenue would go towards the national health insurance, 10% to anti-smoking activities, 10% to health promotion and disease prevention, and 10% to social welfare programmes. A follow-up public opinion analysis regarding the earmarked cigarette tax in Taiwan, China (Tsai *et al.*, 2003) indicated that more than half of respondents were in favour of earmarking tobacco taxes for health programmes; this was especially true among nonsmokers with higher income and higher education.

A World Bank report on financing healthcare services in China (Saxenian & McGreevey, 1996) noted that, since China is the world's largest cigarette consumption country and a large portion of its rural low-income population lacks health insurance coverage, raising the tobacco tax in China could double health benefits. A 10% increase in the cigarette tax would reduce cigarette consumption by 5%, and the increased 5% in government revenue could have been used for one third of China's poorest 100 million uninsured population. While the World Bank in general does not support the practice of earmarked taxes, the World Bank Report noted that, in the case of tobacco taxation, the benefits of earmarking tax revenue for health and tobacco control exceed its cost with respect to fiscal rigidities.

Several studies have examined the impact of tobacco control programme expenditures on reducing prevalence of smoking. For the USA, Farrelly *et al.* (2003) analysed the impact of funds used in those states from 1981 and through 2000 on per-capita consumption. Controlling for the effect of price and other factors, they found that campaigns meeting the CDC-recommended minimum per-capita expenditures reduced per-capita cigarette consumption by 8.5%, with ranges depending on the model specification between 3.4% and 21%. Tauras *et al.* (2005) examined the relationship between state-level tobacco control expenditures and youth smoking prevalence and quantity smoked using 1991 through 2000 national representative youth survey. They found that real per-capita expenditures on tobacco control had a negative and significant impact on youth smoking prevalence and on the average number of cigarette smoked by smokers (Tauras *et al.*, 2005). A similar conclusion was reached by another US study (Farrelly *et al.*, 2008) for reducing adult smoking prevalence. The effect of state tobacco control programme expenditures, if all states had invested at the CDC-recommended minimum ($9.19) or optimum ($22.18) levels from 1995 to 2003, would be relative declines in prevalence of 5.4% and 17.4%, respectively, and translate into an estimated 2.2 million to 7.1 million fewer adult smokers in the United States (these numbers were calculated using 25% discount for expenditures). Thus, these studies provide confirmation of the potential benefits from earmarking revenues from taxes to tobacco control programmes.

Thus, the earmarking of taxes to tobacco control has been used to further reduce smoking rates beyond the effects of a tax and to pay for the healthcare costs associated with smoking. As described in earlier sections in this chapter, the reduction in smoking rates from funding non-price programmes can also further reduce healthcare expenditures for smokers and non-smokers. In particular, funding for cessation treatment programmes and media campaigns can help those quit who have not been induced by the tax to quit, and those smokers thereby avoid the higher personal expenditures associated with the tax. The promotions and enforcement of smoke-free air laws can help to reduce secondhand smoke exposure and thereby the effects on non-smokers. Generally, studies find that comprehensive strategy of smoke-free air laws, media campaigns, cessation treatment programmes, and advertising restrictions can most effectively reduce smoking and the harms associated with smoking (US Department of Health and Human Services, 2000). Chapter 3, however, discusses some of the complexities involved in the implementation of earmarked taxes.

Impact on government revenue

As discussed in Chapter 2, two major purposes of tobacco taxation are (1) to generate government tax revenue and (2) to reduce smoking to promote public health. As discussed in an earlier section of this chapter, research evidence shows that raising the tobacco tax improves population health and reduces healthcare costs. This section will address the impact of tobacco taxation on government revenue.

When tobacco taxes are increased, the tax is generally shifted to consumers (see Chapter 3) through an increase in retail prices. Consumers reduce their cigarette purchases as price increases. It has been shown in previous chapters that the percentage change in the demand for cigarettes is negatively related to the percentage change in price (i.e. price elasticity of demand). Therefore, the tobacco tax is a very important policy measure for tobacco control.

Taxing tobacco products is considered an efficient tax for the following reasons: (1) the demand for cigarettes is less elastic (somewhere between −0.20 to −0.80; see Chapter 4) such that a significant amount of government revenue can be generated through a small percentage reduction in cigarette consumption, and (2) the administrative cost of tax collection is relatively low compared to other tax bases, such as income tax or property tax.

Tobacco tax revenue and price elasticity of the demand for cigarettes

The magnitude of tobacco tax revenue that a government can generate largely depends on (1) the level of taxation (either a percent of the price or absolute amount of tax per pack) and (2) the price elasticity of the demand for cigarettes. The more inelastic the demand, the more government revenue can be generated. When the amount of additional tax increases with an inelastic demand, the proportional reduction in cigarettes purchased by the consumer is smaller than the proportional increase in taxes generated. In a simple example provided by Sunley (2009), if the price elasticity of demand is −0.6, a 10% increase in price would reduce the percentage of consumption by 6%; however, the tax revenue would increase by 25%. As the price elasticity of demand increases in absolute value, consumption is reduced and the smaller the increase in government revenue.

Many examples can be found from around the world of how raising the tobacco tax has led to an increase in government revenue and, at the same time, a reduction in cigarette consumption. For instance, in 1998 California (USA) passed a law (Proposition 99) to increase the tobacco tax beginning in 1989 by US$0.25 (20% of price) per pack of cigarettes. Between 1989 and 1992, the per-capita annual sales of cigarettes in California dropped by about 10.8 packs, while the state tobacco tax revenue increased by $2.0 billion. The estimated tax elasticity with respect to reduction of cigarette sales was about −0.60, i.e.

a 10% increase in tax resulted in a 6% reduction in cigarette sales (Sung *et al.*, 2005). To further achieve the goal of reducing the smoking prevalence rate in California, in 1999 the state increased the cigarette tax by an additional $0.50 per pack and at the same time the industry increased the price another $0.45 following the Master Settlement Agreement (MSA). From 1999–2002, this additional increase in price resulted in a further reduction of annual per-capita cigarette sales by 9.6 packs. At the same time, the state cigarette tax revenue increased by an additional $2.1 billion during the four-year period. The impact of this tax increase on cigarette consumption was −0.40 in the short run and −0.48 in the long run (Sheu *et al.*, 2004; Sung *et al.*, 2005). Again, this example shows that higher taxes will generate more government revenue and reduce cigarette consumption.

For the United States as a whole, tax increases have led to revenue increases. Giovino *et al.* (2009) shows the pattern of average state taxes rates as adjusted for inflation relative to average state tax revenues. In a graphical display they show that as average state taxes have increased, tax revenues have increased and the tax revenues declined as average state taxes went down (corresponding to figure 37 in page 69 in the above cited report). The large price increases following the MSA and other tobacco control policies implemented during the 1990s and early 2000s have somewhat dampened the magnitude of the effect of tax increases on tax revenues, because these policies have reduced smoking rates independent of the state tax increases. Nevertheless, tax revenues still increased over that time period. In addition, data in the report by Giovino and colleagues (2009) show that in each state that experienced a tax increase showed an increase in tax revenues, with the exception of New Jersey, where a small increase in tax was accompanied with a stronger smoke-free air law that reduced smoking rates.

During a similar time period, the South African government initiated a tobacco tax increase as a means of tobacco control. The government gradually raised the tobacco tax rate (Van Walbeek, 2002). Other examples from around the world of how an increase in the tobacco tax rate is associated with an increase in government revenue include the United Kingdom (Townsend, 1998) and Thailand (World Health Organization, 2009).

Additional studies have been funded by the International Union Against Tuberculosis and Lung Disease to estimate the impact of a tobacco tax increase on government revenue for major smoking countries such as China, India, Indonesia, and the Russian Federation, who have yet to implement tobacco taxation as a measure to control tobacco use. The China study (Hu *et al.*, 2008) used a demand model to estimate the effect change tax on the quantity demand. The study found that an increase of one RMB (or US$0.15), an increase from a tax rate 40% of retail price to 51% of retail price per pack of cigarettes, would raise US$31.2 billion in tax revenue at a price elasticity of −0.15 or an additional US$28.7 billion in tax revenue at a price elasticity of −0.50. If the tax rate increased to 68% of the retail price, even at a low price elasticity of −0.15, the government would gain an additional US$54.5 billion in tax revenue. In Indonesia, at a price elasticity of −0.29, a tax rate increase from 37% to 70% of the sale price would garner the government an additional US$8.3 billion in revenue, even though the number of smokers would be reduced by 7.3 million (Barber *et al.*, 2008). In India, with a tax rate increase from 38% to 50%, the Indian government would gain Rs.11 billion, and consumption of cigarettes would be reduced by 8 billion sticks (John *et al.*, 2009a). Finally, the Russian study also indicated that a tax of 70% of the retail price of cigarettes would increase tax revenue by US$5.98 billion at a price elasticity of −0.10 (Ross *et al.*, 2008).

In sum, all of the post-tax implementation examples and simulation studies uniformly show that the tobacco tax is an effective policy instrument to raise government revenue. Several qualifications should be mentioned. First, other tobacco control policies that reduce smoking rates may offset some of the effects of the tax increase, as they reduce smoking rates independent of the tax increase. Second, tax revenues will fluctuate with the general state of the economy, e.g. a recession may lead to temporary reductions in the quantity of cigarettes sold independent of the tax. Third, with additional life years gained attributable to tobacco tax, government may need to incur additional pension funds. Fourth, cross-border shopping and smuggling may offset some of the increase or in exceptional cases reduce tax revenues, as discussed in Chapter 8. Finally, at some point, even in the absence of the factors described above, tax increases may reduce tax revenues when there are so few smokers left.

Impact of a tax increase on overall employment

One of the arguments that has been raised against increasing tobacco taxes is that the reduction in tobacco consumed either through quitting or reducing the quantity smoked will translate into a reduction in employment, or more generally a shrinking economy. The impact has been estimated as a reduction in the gross number of tobacco-related jobs in tobacco industry-sponsored reports (Agro-Economic Services Ltd & Tabacosmos Ltd, 1987; Arthur Andersen Economic Consulting, 1993; PEIDA, 1991; Price Waterhouse, 1992; Tobacco Merchant Association, 1995). These effects are compounded as multipliers are applied to the tobacco-related job losses to account for the reverberations in other parts of the economy from lost consumer expenditures (Jacobs *et al.*, 2000). In addition, tobacco industry-sponsored studies overestimate the number of tobacco-related jobs, since many jobs are part-time and seasonal, and few farms grow only tobacco.

The estimates from the tobacco-sponsored studies present only part of the picture. They should not be interpreted, as has been suggested, as the number of people who would be unemployed if the tobacco industry is reduced. Unlike tobacco industry-sponsored studies, economic-based studies consider the employment impact of shifting consumer spending from tobacco products to other goods and services for a nation or a region. In a dynamic economy, resources—including workers—are constantly shifting between industries due to changes in prices. Thus, economic studies estimate the contribution of the tobacco industry to net employment, the change in employment in a nation or a region after considering the redistribution of the same resources to alternative uses.

The effect on net employment

In general, as tobacco consumption in a country is reduced, e.g. due to taxes, resources for the most part will transfer to other industries. As consumers spend less on tobacco, they spend more on other goods or increase their savings. The increased spending in other goods and service directly creates new jobs in the economy. Likewise, additional tax revenues generated from raising tobacco product taxes do not disappear from the economy, but are redirected into other uses by the government, creating employment and other benefits in those sectors. In general, reallocation generates alternative business opportunities in other sectors of an economy, along with the associated employment and income that counteract the loss in the tobacco sectors.

Studies taking into account the change in production and spending patterns have assumed that money not spent on tobacco is spent on other goods and services according to consumers' existing (average) expenditure patterns, or, if the data is available, they have considered how expenditures are modified by those of smokers who have recently quit (which may further vary depending on whether the individual quit or cut back the quantity smoked). For those who became former smokers, Buck *et al.* (1995) found that the marginal increase in income in the short term was spent more on luxury items, recreational goods, transport, communication and educational services (Buck *et al.*, 1995).

Instead of spending the money saved from not purchasing cigarettes, some portion of the additional money in Indonesia (Barber *et al.*, 2008) and in China (Hu *et al.*, 2008) could be saved. This would mean a reduction in consumption, but would also mean lower interest rates which would translate into an increase in investment and thus future growth.

A higher cigarette tax may also be associated with changes in the government sector. If the tax change is not too large, revenue from taxes will probably increase at least in the short run, because demand is inelastic. While more money will be drawn out of the economy by the government, the increased revenue may be used to replace other taxes that would otherwise be raised. Alternatively, government could pay off the national debt (which would reduce the interest rate, but probably also reduce consumption) or increase government expenditure (which could generate additional employment). As taxes increase and with sufficient time for adjustment, tax revenues will eventually decline. Commonly, studies of the employment effects assume that government will then react either by decreasing government expenditure, which would result in government job losses, or by increasing taxes from other goods and services. However, some increase in taxes would occur naturally as consumer expenditure is switched from tobacco to other goods and more taxes are collected on these items. Thus, even a long-run demise of the tobacco industry would cause a governmental revenue shortfall only if the tobacco tax revenue were not replaced with an equal-yield alternative revenue source.

Empirical studies on the effect on overall employment of reduced tobacco use

Most studies that have attempted to investigate the impact of falling tobacco consumption on employment were done between 10 and 15 years ago, and have been reviewed by Jacobs *et al.* (2000). Since then, studies have been conducted for China, Indonesia and Bulgaria and have been added to the paper. Table 9.3 summarizes the results of the empirical studies.

Table 9.3. Studies of the effect on employment of a fall in cigarette consumption

Country (reference)	Assumptions	Finding
Net exporters		
Canada (Allen 1993 as cited in Jacobs *et al.*, 2000)	Domestic cigarette sales are 0 in 1989, $ switched to "average" expenditure patterns	Little change in jobs
Canada (Irvine & Sims, 1997)	20% decline in tobacco product expenditure Expenditure allocated by average expenditure pattern. Government spending reduced.	Net loss of 6120 jobs (< −0.1% employment)
Indonesia (Ahsan & Wiyono, 2007)	Tax increases of 25, 50 and 100% from 26% of price allocated by average expenditure pattern. Government spending reduced	Net gain in jobs of 281 135 (0.3% of employment), 140 567 and 84 340 for a 100%, 50% and 30% increase in the cigarette tax
United Kingdom (Buck *et al.*, 1995)	Tobacco sales fall by 40%, switch to "recent stopper" expenditure patterns	Net gains of 155 542 jobs (+0.5%)
United States (Warner *et al.*, 1996)	Eliminate all domestic consumption, switch to "average" expenditure patterns	Net job gains of 47 in first year, and 133 000 over 8 years (0%)
Zimbabwe (van der Merwe, 1998b)	All domestic production and consumption eliminated, agriculture shifts to alternative crops, expenditures shift to average input-output pattern	Net loss of 88 000 jobs in first year, agriculture production shifts restore about half (−12.4%)
Balanced tobacco economies		
Bulgaria (Petkova *et al.*, 2001)	10% consumption fall, expenditures shift to average input-output pattern	Net loss of 5567 jobs (−0.02% employment)
China (Hu *et al.*, 2008)	A linear production relationship between production volume and employment loss a price elasticity of −0.15 and −0.5 An additional US$0.15 (1 RMB) per pack tax increase	With elasticity of −0.15, loss of 1656 jobs (<0.01% of jobs). At a price elasticity of −0.5, loss of 5 49 jobs
Scotland (McNicoll & Boyle, 1992)	Eliminate all domestic consumption in 1989, switch to "average" expenditure patterns	Net gain of 7869 jobs (+0.3% employment).
South Africa (van der Merwe & Abedian, 1999)	Eliminate all domestic consumption, switch to "recent stopper" expenditure patterns	Net gain of 50 236 jobs (+0.4% employment)
Net Importers		
Bangladesh (van der Merwe, 1998a)	Eliminate all domestic consumption and all domestic production of cigarettes and bidis in 1994, switch to "average" expenditure patterns	Net gain of 1 098 919 (+2.0%) jobs.
United States; Michigan State (Warner & Fulton, 1994)	Eliminate all domestic consumption in 1992, switch to "average" expenditure patterns	Net gain of 7100 jobs over time (+0.1% employment)

Most of the studies have compared the actual level of employment in their different economies with the predicted level of employment when tobacco expenditure is reduced. All studies have assumed that consumers who stop smoking reallocate their tobacco expenditure to other goods and services in the economy. Falling employment in the tobacco industry will thus be offset by increases in employment in other industries, depending on how labour intensive these other industries are relative to the tobacco industry. This is the first logical underpinning of all the research on this topic.

To simulate the change in employment from a reduction or elimination of tobacco consumption, the amount of expenditure released from tobacco spending distributed according to an assumed expenditure pattern is then applied to either a static input-output model or a dynamic regional econometric model. Both types of models contain the interdependencies or relationships between industry sectors or subsectors in the economy and can be used to simulate the impact of an external policy change on outputs and employment of each sector of the economy. The static approach usually compares two alternative situations in a given year, one with and one without (or with reduced) tobacco expenditure taking place. The dynamic model allows one to simulate trade flows and feedback effects over time.

McNicoll and Boyle (1992) estimated the impact on the Scottish economy of a reduction in spending on cigarettes in Glasgow in 1989 using a static input-output model. Their results indicated a net gain of nearly 8000 jobs (+0.1% of employment) if everyone in Glasgow had stopped smoking in 1989 (McNicoll & Boyle, 1992; Jacobs *et al.*, 2000). A study by Buck *et al.* (1995) used a static model of the United Kingdom comparing the economy with one where 40% of tobacco expenditure was switched to other forms of spending. Where other studies had all assumed that consumers would spend their money according to average consumption expenditure patterns, this study considered four patterns of changed consumer spending: (1) average consumers (the usual assumption), (2) all nonsmokers, (3) all former smokers, and (4) recent stoppers (the more realistic case). All categories showed net increases in jobs, except if released expenditure followed nonsmokers' spending patterns, which was considered unrealistic. If ex-smokers spent freed money like recent stoppers, a net increase of 115 688 full-time equivalent jobs was predicted for the UK (+0.5% of employment).

Static input-output models were conducted for four low- and middle-income nations. For South Africa, van der Merwe and Abedian (1999) found a net gain of 50 236 jobs (+0.4% employment) in 1995 with tobacco elimination, using expenditures of recent quitters, and assuming the same government spending. For Bangladesh, van der Merwe (1998a) found a net gain of 1 098 919 jobs (+2.0% employment) in 1994 with domestic consumption expenditure and all tobacco production for tobacco products and bidis in 1994 eliminated, and with previous average expenditures and no change in government spending by other taxes. For the tobacco-growing nation of Zimbabwe, van der Merwe (1998b) calculated 87 798 jobs lost in 1980 (−12.4% employment) and 47 463 jobs when all domestic consumption expenditure is eliminated and farming moves to alternative agriculture. For Bulgaria, Petkova *et al.* (2001) found that a 10% decrease in consumption with an expenditures shift to average input-output pattern yielded a net loss of 5567 jobs (−0.02% of employment).

A recent study by Ahsan and Wiyono (2007) for Indonesia used price elasticities to examine tax effects. They found that new jobs would increase by 281 135 (0.3% of employment), 140 567 and 84 340 for a 26% (100%), 13% (50%) or 8% (25%) increase in the cigarette price (tax), respectively (Ahsan & Wiyono, 2007). Other non-tobacco crops showed the largest gain. In Indonesia, 13% of expenditures are for tobacco in households with at least one smoker.

To estimate the potential impact of cigarette tax increase on cigarette industry employment in China, a linear production relationship between production volume and employment loss was used (Hu *et al.*, 2008) to show that under a price elasticity of −0.15 and with an additional US$0.15 (1 RMB) per pack tax increase, only 1656 individuals would be unemployed. At a price elasticity of −0.5, with the same amount of tax increase, approximately 5549 individuals would lose their jobs, as compared to the loss of 59 000 employees due to company merging in 2006. The amount of employment loss from an increase in taxes would be minimal. Furthermore, the effect of the reduction in cigarette consumption would lead the cigarette industry to diversify into other products.

In contrast to the static models, Warner and Fulton (1994) developed a dynamic regional economic model to examine falling consumption in the state of Michigan, a non-tobacco-producing state. They examined two scenarios: a complete and instantaneous cessation of tobacco expenditure, and a more realistic gradual acceleration in the rate of decline in tobacco consumption. Their results indicate that Michigan would experience a net gain of 5600 jobs in 1992, and 1500 more jobs (+0.1% employment) by the year 2005. The Michigan study was extended to include the entire US to assess whether declining tobacco product sales significantly reduced employment across all tobacco-producing and non-tobacco-producing states from 1993 to the year 2000 (Warner *et al.*, 1996). The results showed that the tobacco-producing region would have lost jobs, but collectively all other regions would have gained enough employment to completely offset the losses. Eliminating all tobacco spending was predicted to result in a net gain of 133 000 jobs (~0.0% of employment) in the US economy by the year 2000, while a gradual decline in tobacco consumption would result in a net gain of 19 719 jobs.

A study for Canada (Allen, 1993) argued that, first, with consumption dropping slowly, those jobs that were lost would mostly be met by attrition. Second, technological changes caused many of the job losses in the industry, and third, the most potent cause of falling consumption was increased excise taxes and the government revenues that were raised through these taxes were spent to maintain public services, which created many new jobs. However, Irvine and Sims (1997) conducted a static analysis for a 20% decline in tobacco expenditure, and found a net loss of 6120 jobs (<0.1% of employment) in Canada. However, they assumed government spending was reduced, and Jacobs *et al.* (2000) note that Canada is a tobacco-growing region.

Economic studies generally conclude that reducing tobacco consumption has a small positive effect on the total output and employment of the national economy, except in countries and some states that are heavily dependent on tobacco production. A reduction in smoking does lead to job losses in those sectors immediately associated with tobacco product production, such as tobacco manufacturing and farming, and supplier sectors indirectly associated with tobacco such as the fertilizer and paper industries. But these losses are generally outweighed by increases in employment in all other industries. For any country or region, the estimated net change of employment depends on the specific assumptions used in the studies (e.g., the reactions by government and assumed spending patterns of those who reduce consumption) and the structure of the domestic economy.

The effects of a tax increase on employment will also depend on whether a country is a net importer or exporter of tobacco. In particular, worldwide demand for tobacco products has been declining in most regions of the world and is likely to continue to decline as rapidly, and more rapidly if tobacco control is successful. Therefore, the value of investments made in these industries is likely to decline in those exporting countries regardless of tax increases in the country in which they are located.

Two other savings may be realized by economies that reduce tobacco consumption—the savings from reduced medical costs (some of which will be offset by higher medical costs as the individual lives longer) and productivity gains. For example, the annual economic cost associated with reduced productivity for the United States as a results of deaths due to smoking and secondhand smoke exposure was estimated to be approximately US$96.8 billion (US$64.2 billion for males and US$32.6 billion for females) from 2000–2004 (Centers for Disease Control and Prevention, 2008). These costs did not include other potentially important costs, such as the value of lost work time from smoking-related disability, absenteeism, excess work breaks, and secondhand smoke-related disease morbidity and mortality (Centers for Disease Control and Prevention, 2005). Nevertheless, there are costs associated with the transition from the current tobacco economy to a smaller or tobacco-free economy.

Transition costs

As suggested by Warner (2000), an economic presence of tobacco does not imply an economic dependence. The extent and speed at which resources are shifted from the tobacco industry to other industries will depend on the opportunity cost of resources used in the production of tobacco and tobacco products. For example, agricultural resources, such as land and capital, currently used in tobacco leaf production can be used for other agricultural purposes, and tobacco farmers can produce other crops or engage in other economic activities if tobacco leaf production ceases. Similarly for the resources used in tobacco product manufacturing, wholesaling, and retailing.

The transition costs of switching resources in response to a tax increase will depend on the extent to which resources currently involved in tobacco-related industries are specific to those industries. Many of the jobs involve tobacco in a limited way (e.g. retailers who sell tobacco products, jobs in the heavy industry sector where farming equipment is produced), and are not dependent on tobacco. Primarily jobs in tobacco farming (which are often part-time and for which other crops besides tobacco are grown), tobacco leaf drying and warehousing (which generally involves few jobs) and tobacco product manufacturing are partially dependent on tobacco. Labour and land currently used for tobacco leaf production are sometimes considerably more productive in tobacco than in other uses, since tobacco grows well on some lands where most other crops do not. The ability to transfer skills and experience specific to tobacco growing to other crops may also be incomplete. Similarly, the equipment, technology and labour skills used to produce tobacco products may have limited value when released from tobacco product manufacturing.

While there may be some costs due to dislocation, these costs will be lessened if the reduction in demand for tobacco is gradual, as is typically the case. Tobacco farmers and manufacturers can adjust by not replacing equipment as it depreciates, not hiring additional workers, and making the land available for other purposes. In addition, for a country that imports tobacco, these effects will be minimal, and for a country that exports tobacco, the exported shares will depend on the tobacco control efforts of other countries. Furthermore, independent of tobacco control policy-induced changes in domestic tobacco use, employment in tobacco dependent sectors has been falling over time as farming techniques and manufacturing process have improved (Capehart, 2000; Van Liemt, 2001).

Various studies for the United States (e.g. Chase Econometrics, 1985; Price Waterhouse, 1992; Sumner & Alston, 1985; Brown, 1998) have concluded that increased cigarette taxes would reduce demand for tobacco, and reduce the incomes of tobacco farmers. For example, Price Waterhouse (1992) estimated that increases in the federal tax on cigarettes from 24 to 48 cents per pack in the United States would lead to a loss of farm revenues by US$50 million and farm jobs by 8140. In contrast, Sumner and Alston (1985) and Brown (1998) claimed that the impact of tobacco measures such as increasing cigarette taxes on farmers' revenues would depend on the response by the federal government to the lower demand for tobacco due to the governmental intervention in tobacco farming. They concluded that adoption of a policy to fix the tobacco quota while allowing the support price to fall would lead to a loss of revenue for quota owners and no change in revenue for the tobacco farmers who rent quotas for growing tobacco, while adopting the converse policy would lead to a revenue gain for the quota owner and a revenue loss for the quota renter.

While reducing cigarette consumption can create economic hardship for those whose livelihood depends on tobacco, programmes can be implemented to reduce these hardships. In high-income nations, efforts have been made to diversify the economic activities for tobacco farmers and reduce their dependence on tobacco farming. In the United States, the efforts have had limited success. Although the high return from growing tobacco has generally limited the impact of efforts to encourage the production of alternatives, many tobacco-growing households are already quite diversified. For example, in the United States, some flue-cured tobacco farms also grow soybeans, corn, cotton and wheat (Jacobs *et al.*, 2000). In Canada, the Tobacco Diversification Plan provided tobacco farmers with incentives to stop growing tobacco and to develop alternatives in the 1980s (Pan American Health Organization, 1992). Many farmers have ceased tobacco production through this programme, but many participants acknowledge that they would have quit tobacco farming without the programme. In addition, 24% of the participants continue to work in tobacco farming as employees, rather than as entrepreneurs (Pan American Health Organization, 1992). Tobacco farmers are unlikely to reduce their tobacco production as long as tobacco remains more profitable than the other crops.

Several studies have evaluated the alternative crops for tobacco in developing counties. Those crops include cassava in Brazil, sugar cane in Kenya and chillies, soybeans, cotton and mustard in India (Jacobs *et al.*, 2000). A study on potential crops in Bangladesh has found that several vegetable species could be more profitable than tobacco (Naher & Efroymson, 2007). Rose blooms have been identified as profitable alternatives to tobacco in Zimbabwe (Maravanyika, 1998). Yach (1996) reported that more than fifty alternative crops and land use have been identified.

Crop diversification programmes and retraining for workers in tobacco product manufacturing could be funded by some of the new revenues that result from the tax increase. In Turkey, for example, the government-sponsored alternative crop programme was implemented in anticipation of privatization of the country's monopoly (Yurekli *et al.* 2010). For Brazil, a World Bank report (Vargas & Campos, 2005) found that diversification strategies, especially those part of broader rural development programmes, were successful despite considerable barriers.

Impact of tobacco tax increases on inflation and the consumer price index

Consumer price indices reflect the average prices paid by the typical consumer in a country. The percentage increase in the consumer price index measures the inflation rate, which directly affects domestic interest rates and foreign exchange rates. These rates are key economic indicators for most countries and often a key determinant of monetary policy. In many countries, changes in wages, social security benefits, and other payments are tied to a price index to keep pace with inflation. In addition, some countries link taxes to price indices in order reflect current prices.

An argument made against raising cigarette taxes is that tobacco taxes have an inflationary impact, especially in countries where wages are indexed to inflation or where government policy is to keep inflation low. The effect of tobacco product tax increases on inflation depends on the percentage of the tobacco price increase due to the tax, and the weight that tobacco prices are given in computing a price index. For example, if taxes account for 50% of tobacco product prices, a doubling of the tax (100% increase) will increase prices by 50%. If the weight given to tobacco products in the price index is 3%, the index will rise by 1.5% in response to the tax increase.

For estimating the impact of cigarette expenditures on the consumer price index, the total percentage of tobacco expenditures from the entire population (smoking and non-smoking) is used. Indonesia and China households with smokers spend about 6% to 12.4% of their total household expenditures on tobacco (Barber *et al.*, 2008; Hu *et al.*, 2008). However, slightly more than 1% of all household expenditure (smoking and non-smoking) in China is for cigarettes (Djibuti *et al.*, 2007). The US cigarette expenditures are less than 1% (Busch *et al.*, 2004) and in the Russian Federation tobacco accounts for between 1 and 3% of household expenditures (Djibuti *et al.*, 2007).

Thus, tobacco is likely to play a small role in the price index. Furthermore, since the weights used to compute price indices in many countries change infrequently, the inflationary impact of tobacco product tax increases will be overstated as consumption of these products falls in response to tax increases.

While cigarette tax increases are not likely to have a major impact on the price index, some governments have excluded tobacco from the index. The European Union, for example, has recommended that its member countries exclude tobacco products (Baille, 1998). France since 1992 and Belgium since 1994 have excluded tobacco products from the price index used for adjusting wages (Guindon *et al.*, 2002). Since 1991, Luxembourg has excluded tobacco products, hard liquor, and other certain other products from its consumer price index because they are considered unnecessary or inappropriate. To date, however, most countries include tobacco products in their most widely-used indices—especially those used for indexing wages, pension payments and other outlays. Excluding tobacco products from price indices would increase the public health impact of tobacco tax increases by providing less of a cushion for users whose wages or benefit payments are indexed (Alchin, 1995).

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Chapter 10
Summary

Overview of tobacco taxation

Worldwide, different types of taxes apply to tobacco products, with different tax levels (rates) contributing to significant price differentials. Historically, revenue generation has been the primary aim of tobacco taxation. However, the retention and the increase of excise taxes on tobacco products increasingly aim to improve public health by reducing tobacco consumption and accounting for the external cost of smoking. Nonetheless, when determining their taxation policy, governments will take into account other, at times competing, political, social or economic considerations. These considerations are often reflected in the applicable tax structure and rates.

Moreover, tax levels are generally directly related to income levels by country, with high-income countries having high taxes and vice versa. Simultaneously high-income countries tend to favour specific (per-unit) excise tax structures, while low- and middle-income countries rely more on *ad valorem* (value-based) excise taxes. Some countries have designed more complex taxation structures in an attempt to find a balance between budgetary, health and competition objectives.

Specific excise taxes generally result in higher tobacco product prices. Specific excises can increase tobacco companies' pricing power, raise profits and increase market concentration.

About 75% of the world's tobacco product market is accounted for by cigarettes. However, in some countries tobacco products other than cigarettes have an important, sometimes significant, market share. Tax levels are often much lower on these products as compared to cigarettes. Differential rates are sometimes applied within the same product category. These differences result in price gaps and opportunities for product substitution to lower-taxed products and brands. Applying a similar tax level would reduce the incentive for substitution and increase the effectiveness of taxation policy in reducing tobacco use.

Given their important revenue-generating potential, part or all of tobacco tax revenues have been used to fund health or tobacco control activities in some countries. This practice can be adopted in low-resource countries as a way to strengthen weak health systems, as proposed by the Taskforce on Innovative International Financing for Health Systems.

Industry pricing strategies and other pricing policies

This chapter examines industry pricing strategies, pricing and price-related marketing strategies, as well as industry efforts to influence all dimensions of tobacco tax policy, including tax structure, tax levels, and earmarking of tobacco tax revenues.

The impact of tobacco taxes on prices will vary according to how the industry reacts to the tax increase. Early empirical evidence was mixed in the extent to which taxes were passed through in prices. More recent studies in the USA, South Africa and Jamaica found that tax increases led to price increases larger than the tax increase (overshifting).

Tobacco companies employ a variety of marketing techniques that reduce prices on some tobacco products or brands. These efforts are targeted at some specific populations, including young people, and have been used to soften the impact of tobacco tax increases and other tobacco control interventions.

Tobacco companies have lobbied aggressively to influence tobacco tax levels and the earmarking of tobacco tax revenues. Evidence, almost entirely from North America, shows that industry lobbying has been successful, particularly at the federal level. At the subnational level, adequately funded tobacco control efforts have been more successful in overcoming industry opposition. The industry has been more successful at the subnational level combating the earmarking of tax revenues, arguing that the revenues will be diverted or misused.

The industry has also attempted to influence tobacco excise tax structures. Studies from the USA, the former Soviet Union, Hungary, China and Lebanon show that different companies support different tax structures, favouring those that will benefit their brands at the expense of their competitors.

Governments can influence tobacco product prices through tobacco taxes, price regulations, and limits on price-related marketing. Some have implemented minimum pricing policies where such policies are allowed under competition law; higher specific taxes can have similar effects where minimum pricing policies are not allowed. Others have included bans on price-reducing marketing as part of a comprehensive ban on industry marketing. WHO FCTC Article 5.3, which aims to limit tobacco industry influence in tobacco control policy-making, may provide a tool for governments to constrain tobacco company lobbying efforts focusing on tax policy or other tobacco control policies.

Conclusions

- Most tobacco product markets are highly concentrated. In these markets, recent empirical evidence indicates that tobacco taxes are generally overshifted.
- Tobacco companies use price-reducing marketing techniques to counteract the impact of tobacco excise tax increases and other tobacco control policies.
- Tobacco companies lobby against tobacco tax increases and earmarking of tobacco tax revenues.
- Tobacco companies try to influence the structure of tobacco taxes to work in their interests and against those of their competitors.

Tax, price and aggregated demand for tobacco

A large and growing body of empirical literature, dominated by studies from the USA and to a lesser extent the United Kingdom, has found that tobacco consumption decreases when the price of tobacco increases. The highly-influential World Bank publication Curbing the Epidemic states that the price elasticity of demand (the percentage change in consumption of a product that results from a 1% price increase) is around −0.4 for developed countries and between −0.4 and −0.8 for developing countries.

The evidence that has emerged since the World Bank's publication suggests that, at least based on aggregate demand studies, the consensus price elasticity of around −0.4 is still valid for high-income countries, although the price elasticity estimates for high-income countries other than the USA and United Kingdom are somewhat more dispersed. The majority of price elasticity estimates from aggregate demand studies for low- and middle-income countries lie between −0.2 and −0.8. However, many lie outside this range (especially on the inelastic side).

Income is a significant determinant of tobacco product demand; as aggregate income increases, the aggregate demand for tobacco increases. Most estimated income elasticities (the percentage change in consumption of a product that results from a 1% income increase) are positive, with greater elasticity observed in low- and middle-income countries. With the exception of the United States, where income elasticity has declined, there is no evidence that income elasticity has changed in other countries. This implies that for a growing economy, the price of cigarettes would have to increase at the same rate as income to maintain the affordability of cigarettes.

There is significant variation in the theoretical models employed and the econometric methods used to estimate them. Given the development in economic models of addiction, estimated specifications should account for addiction where the data allow. While it has become the norm to control for addiction in the model specifications, the use of state-of-the-art time series techniques has not become prevalent. However, despite the variety of techniques that have been used, estimates from studies using different techniques are similar.

Conclusions

- Studies that are based on aggregate data are useful in estimating price and income elasticities of overall demand for tobacco products.
- There is a negative relationship between cigarette prices and cigarette consumption in countries at all levels of income. While fewer studies have examined the demand for other tobacco products, those that have done so have reported a similar negative relationship.
- Price elasticities of cigarette demand in high-income countries average −0.4. Most estimates from the USA and the United Kingdom fall in a relatively narrow range between −0.2 and −0.6, while there is greater variation in high-income countries

other than the USA and the United Kingdom.

- There is greater variation in price elasticity estimates in studies from low- and middle-income countries, likely due to differences in affordability and availability of different tobacco products across and within countries. Most estimates indicate that demand in low- and middle-income countries is less price-inelastic than in high-income countries, as most estimates lie between −0.2 and −0.8.
- Most income elasticites are positive and lie between 0 and 1 in both high-income and low-and-middle-income countries. There is evidence of declining income elasticities over time in the USA.
- Affordability has become an increasingly recognized measure, especially in rapidly growing low- and middle-income countries where the impact of price increases might be offset by growth in income.

Tax, price and adult tobacco use

A large and growing number of studies have used individual-level or household-level survey data to assess the impact of tobacco product taxes and prices on adult tobacco use. Studies have used survey data to examine the differential impact of tax and price on tobacco use among population subgroups defined by gender, age, socioeconomic status and/or other characteristics, as well as to assess the separate effects of price on different aspects of tobacco use, including prevalence, frequency, intensity, initiation, uptake and cessation. This chapter reviews studies that examine the effects of price on adult tobacco use, with subsequent chapters (Chapters 6 and 7) reviewing studies on tobacco use among young people and different socioeconomic groups.

Empirical methods for estimating tobacco demand using individual or household data have become more sophisticated over time, and greater computing power has allowed the application of these methods to increasingly large survey data sets, including repeated cross-sectional and longitudinal survey data sets.

Most studies based on survey data come from the United States, because of its extensive subnational and temporal variation in taxes and prices. These studies find that adult smoking prevalence, frequency and intensity are negatively related to cigarette taxes and prices. As with the elasticity estimates obtained from aggregate data for the USA, most of the total elasticity estimates from the studies based on US survey data fall within the range from −0.2 to −0.6, with roughly half of the impact of price on adult prevalence and the remainder on the number of cigarettes consumed by adult smokers. Several studies have examined adult smoking cessation, generally finding that higher taxes and prices reduce the duration of smoking, raise interest in quitting, boost quit attempts, and increase the number of smokers who successfully quit smoking. Finally, a few US studies found similar effects of tax and price on the use of other tobacco products such as smokeless tobacco and cigars, and produced some evidence of substitution among tobacco products in response to changes in the relative prices of these products.

While several studies employing survey data on adult tobacco use have been conducted in other high-income countries, relatively few of these have estimated the effects of tax and price on adult tobacco use in these countries, largely due to the limited price variation within most countries. Studies on the price elasticity of adult smoking have been done in Canada; Taiwan, China; Italy; the Republic of Korea; Spain; and the United Kingdom. These studies generally find that cigarette smoking prevalence and intensity are inversely associated with cigarette prices, with the size of the association varying across countries. Estimates from these studies are generally in the range produced by the aggregate demand studies from high-income countries other than the USA, as discussed in Chapter 4. Studies that consider gender differences produce contrasting conclusions about the relative price elasticities of men and women, depending on the country for which the study was done. A few studies from high-income countres have concluded that higher prices increase cessation.

There exists a larger number of survey-based studies of adult tobacco demand in low- and middle-income countries—including Bulgaria, China, Estonia, Egypt, India, Indonesia, Mexico, Myanmar, Nepal, the Russian Federation, South Africa, Sri Lanka, Thailand, Turkey, and Viet Nam—with many of these studies based on household expenditure survey data. The sophistication of the methodological approach used in these studies varies considerably. Several studies use self-reported prices, which almost certainly produce biased estimates that suggest greater price elasticity. Some studies use composite tobacco price measures rather than product-specific measures of price. The range of price elasticities for adult tobacco use produced by these studies varies considerably. Despite these limitations, these studies generally confirm that various aspects of adult tobacco use are responsive to price, with higher prices reducing adult prevalence and intensity of use.

No clear patterns emerge from the small number of studies from countries other than the USA that consider substitution among tobacco products in response to changes in the relative prices of these products. The same is true for studies that examine differences in price elasticity by gender.

Conclusions

A relatively large body of literature on adult tobacco demand based on US survey data shows that:

- Adult smoking prevalence is inversely related to price, with prevalence falling as prices rise and vice versa;
- Intensity of smoking among adults is inversely related to price, with cigarette consumption among smokers falling as prices rise and vice versa;
- The price elasticity of adult smoking is in the range from −0.2 to −0.6, with about half of the effect of price on smoking prevalence and the remainder on intensity of smoking among adult smokers; and
- Cigarette prices affect cessation-related outcomes, with higher prices increasing interest in quitting, quit attempts, and successful cessation.

A few studies from the USA indicate that:

- Higher cigarette prices increase the likelihood that smokers will smoke only on some days rather than every day;
- Changes in other tobacco product taxes and prices inversely affect the use of these products; and
- There is substitution between cigarettes and smokeless tobacco products in response to changes in the relative prices of these products.

A small number of studies from other high-income countries show that adult smoking in these countries responds to changes in price, with estimates of price elasticity consistent with those found in aggregate demand studies for these countries, with total elasticity estimates in the range from −0.2 to −0.6.

Studies from a growing number of low- and middle-income countries indicate that adult tobacco use in these countries is inversely related to tobacco product prices. Methodological differences and other factors contribute to the considerable variation in the price elasticity estimates produced by these studies.

Tax, price and tobacco use among young people

Economic theory predicts that tobacco use among young people would be more responsive to price than would adult tobacco use. To a great extent, the empirical evidence supports this. Many econometric studies from countries at all income levels find that smoking prevalence and intensity among young people decreases as cigarette price increases. The estimated overall price elasticity of demand for young people in most high-income country studies ranges between −0.50 and −1.2; however, the dispersion of price elasticity estimates for young people in low- and middle-income countries is greater. While the studies examining the impact of price and tax on other tobacco products are fewer in number than those for cigarettes, a similar relationship exists for other tobacco products.

Studies of smoking initiation that use cross-sectional data produce mixed results primarily because of the measurement error inherent in using retrospective measures of initiation. Most studies that use longitudinal data find that higher prices of cigarettes significantly decrease youth smoking initiation and vice versa. Studies from the USA, using cross-sectional or longitudinal data, consistently find that higher prices lead to smoking cessation among young people. Similar studies find that higher prices deter progression into later stages of smoking uptake.

Conclusions

- As tobacco price and tax increases, smoking prevalence among young people falls, and vice versa.
- As tobacco price and tax increases, smoking intensity among young people falls, and vice versa.
- Most longitudinal studies from high-income countries find that smoking initiation is inversely related to price.
- Estimates from studies on tobacco use among young people indicate that their tobacco use is more responsive to price than is tobacco use among adults.
- The same conclusions generally apply in low- and middle-income countries but are based on fewer studies.
- A few studies, nearly all from the USA, find:

- Cigarette prices influence different stages of uptake of cigarette use, with a relatively larger impact at later stages of uptake.
- Price has both a direct effect and an indirect effect, through peer and family influences, on tobacco use among young people.
- As cigarette prices increase, smoking cessation among young people increases.

Tax, price and tobacco use among the poor

In most countries, tobacco use is inversely related to indicators of socioeconomic status, with the possible exception of some upper middle-income countries. Spending on tobacco diverts spending from other goods and services, and this tends to be greater for lower-income households. There is a two-way relationship between tobacco use and poverty.

Current excise taxes on tobacco are generally regressive in high-income countries; that is, the amount of tax as a percentage of income increases as income decreases. Few studies have examined the regressivity of tobacco taxes in low- and middle-income countries, finding mixed evidence of regressivity of tobacco taxes, in part because of the structure of these taxes.

The price responsiveness of tobacco demand is generally found to be higher among the poor than among the rich in high-income countries, based largely on evidence from the USA and the United Kingdom. Given this evidence, increases in tobacco taxes can reduce the regressivity of these taxes.

Evidence from other countries does not suggest an obvious relationship between price responsiveness and socioeconomic status. This may be due to differences in the extent of opportunities for tax avoidance and evasion across countries, tax structures and the resulting price gaps, and other factors. Given this mixed evidence, the equity implications of tobacco tax increases in low- and middle-income countries is unclear.

Conclusions

The price responsiveness of tobacco demand is generally higher among the poor than the rich in high-income countries, based largely on evidence from the USA and the United Kingdom.

Evidence from other countries on the relationship between price responsiveness and socioeconomic status is mixed.

Tax avoidance and tax evasion

Tax avoidance refers to legal methods of circumventing tobacco taxes, and tax evasion refers to illegal methods of circumventing tobacco taxes. Illicit trade includes both legally produced products illegally traded across borders (smuggling) and illegally manufactured products. Most activities that comprise tax avoidance include the payment of some tobacco taxes. In most cases, tax avoidance is practiced by individuals. Tax evasion includes both small and large quantities of tobacco products, and usually no taxes are paid. These activities may involve criminal networks, tobacco companies, or other large-scale operations.

Several studies show that tax and price differentials play an important role in individual tax avoidance and small-scale smuggling operations. Other important factors include the extent of tourist travel, access to duty-free and other tax-free outlets, and technology allowing virtual transactions such as internet sales.

The determinants for large-scale illicit trade are far more complex. The greater the reward and the lower the costs of supplying these illicit products, the greater the probability that this activity will occur. Research shows that these determinants include corruption, informal distribution networks, the presence of organized crime, the extent of cross-border trade and strength of border controls, insufficient penalties, weak tax administration and enforcement, differential treatment of domestically-produced and imported products, the pre-tax price of tobacco products, and the strategies of tobacco companies, as well as price and tax levels.

Comprehensively measuring tax avoidance and tax evasion presents challenges that researchers have attempted to overcome via innovative methodologies. No single method addresses all of these difficulties, and each method is inherently limited. A combination of methods is needed to fully assess the extent of these measurement challenges.

Studies show that tax avoidance and tax evasion reduce but do not eliminate the effectiveness of tobacco tax increases in reducing tobacco use and raising revenues. Tobacco tax avoidance and evasion undermine other tobacco control measures. Tax evasion adds to health disparities between socioeconomic groups.

Research on the effectiveness of strategies aimed at reducing tax avoidance and evasion is limited and difficult. Tax evasion can be reduced via a combination of various strategies such as international cooperation, legislative measures to control the supply chain, increased enforcement and strong penalties, as shown by evidence largely from case studies. The modus operandi for the supply of illegal tobacco products may change over time as illicit traders adapt their practises in response to government actions.

To reduce cross-border shopping, small-scale smuggling, and some types of tax avoidance, effective strategies include coordination of tobacco tax levels and increases across jurisdictions, and elimination of duty-free shopping.

Conclusions

- The primary determinant of tax avoidance and small-scale smuggling is differentials in taxes and prices across jurisdictions.
- There are multiple determinants of tax evasion. These include the level of corruption, informal distribution networks,

the presence of organized crime, the extent of cross-border trade and strength of border controls, insufficient penalties, weak tax administration and enforcement, differential treatment of domestically-produced and imported products, the pre-tax price of tobacco products, and the strategies of tobacco companies, as well as price and tax levels.

- The majority of existing studies capture both tax evasion and tax avoidance to some extent. The limited empirical evidence indicates that tax evasion is much larger in scale than tax avoidance.
- Cigarette tax evasion is higher in countries that have lower cigarette prices and taxes.
- Data indicate that the size of this illicit market is inversely related to a country's income.
- The threat of smuggling discourages governments from raising tobacco taxes or motivates tobacco tax reductions.
- Studies demonstrate that an increase in cigarette taxes will reduce cigarette consumption and increase cigarette tax revenues even in the presence of illicit cigarette trade.
- Eliminating the supply of illicit tobacco would result in larger than average reductions in smoking among young people and the poor.
- Illicit trade in tobacco products undermines the impact of other tobacco control policies such as youth access laws and health warnings.
- To reduce tobacco tax evasion, a multifaceted and flexible approach is most effective.
- To reduce cross-border shopping, small-scale smuggling, and some types of tax avoidance, effective strategies include coordination of tobacco tax levels and increases across jurisdictions, and elimination of duty-free shopping.

Economics and health impact of tobacco taxation

Tobacco taxes can be expected to have a large impact on society through several different channels. A large body of literature examines the effect of smoking on health care expenditures and health outcomes. These studies find that reducing smoking through increased taxes increases the life expectancy of smokers by reducing cancers (especially lung cancer), respiratory diseases and cerebral and cardiovascular diseases. The reduction in smoking that results from higher taxes also reduces the medical costs attributable to smoking. Further health gains can be expected through reductions in secondhand smoke exposure and reduced maternal smoking. In addition, reductions in tobacco use through price increases have been associated with reduced alcohol and illicit drug use, although the evidence is mixed. The effects on obesity of reduced smoking resulting from higher taxes are less clear. Given the low costs of administration, tax increases are a highly cost-effective intervention for improving health.

Tobacco tax increases generally increase tax revenues. Some governments have earmarked tax revenues for tobacco control programmes and/or other health promotion efforts. Tax-funded tobacco control programmes further reduce tobacco use and its health and economic consequences.

Most economic studies on the employment impact of reduced tobacco consumption have found that reductions in tobacco-dependent employment are more than offset by increases in employment elsewhere. Finally, increased tobacco taxes have been shown to have minimal if any effect on general price inflation.

Conclusions

- Increasing tobacco excise taxes is a cost-effective way to improve population health and reduce medical costs.
- Empirical evidence from around the world shows that increasing tobacco taxes will generally increase government revenue.
- Most studies on the employment impact of reductions in tobacco use find that reductions in tobacco-dependent employment are more than offset by increases in employment elsewhere.
- Earmarking of tobacco taxes for tobacco control programmes has been shown to be an effective policy instrument to achieve tobacco control.
- Increased tobacco taxes have been shown to have minimal, if any, effect on general price inflation.

Chapter 11
Evaluation

The Working Group evaluated the strength of the evidence for drawing the conclusions shown in the accompanying table using categories defined as follows:

- **Sufficient evidence:** An association has been observed between the intervention under consideration and a given effect in studies in which chance, bias and confounding can be ruled out with reasonable confidence. The association is highly likely to be causal.

- **Strong evidence:** There is consistent evidence of an association, but evidence of causality is limited by the fact that chance, bias or confounding have not been ruled out with reasonable confidence. However, explanations other than causality are unlikely.

- **Limited evidence:** There is some evidence of association between the intervention under consideration and a given effect, but alternative explanations are possible.

- **Inadequate/no evidence:** There are no available methodologically sound studies showing an association; the available studies are of insufficient quality, consistency or statistical power to permit a conclusion regarding the presence or absence of a causal association between the intervention and a given effect. Alternatively, this category is used when no studies are available.

- **Evidence of no effect:** Methodologically sound studies consistently demonstrate the lack of an association between the intervention under consideration and a given effect.

	Concluding Statements	Sufficient Evidence	Strong Evidence	Limited Evidence	Evidence of No Effect	Inadequate / No Evidence
1	Increases in tobacco excise taxes that increase prices result in a decline in overall tobacco use.	X				
2	Increases in tobacco excise taxes that increase prices reduce the prevalence of adult tobacco use.	X				
3	Increases in tobacco excise taxes that increase prices induce current tobacco users to quit.	X				
4	Increases in tobacco excise taxes that increase prices lower the consumption of tobacco products among continuing users.	X				
5	Increases in tobacco excise taxes that increase prices reduce the prevalence of tobacco use among young people.	X				
6	Increases in tobacco excise taxes that increase prices reduce the initiation and uptake of tobacco use among young people, with a greater impact on the transition to regular use.	X				
7	Tobacco use among young people responds more to changes in tobacco product taxes and prices than does tobacco use among adults.	X				
8	The demand for tobacco products in lower-income countries is more responsive to price than is the demand for tobacco products in higher-income countries.			X		
9	In high-income countries, tobacco use among lower-income populations is more responsive to tax and price increases than is tobacco use among higher-income populations.		X			
10	In low- and middle-income countries, tobacco use among lower-income populations is more responsive to tax and price increases than is tobacco use among higher-income populations.			X		
11	Changes in the relative prices of tobacco products lead to some substitution to the products for which the relative prices have fallen.		X			
12	Tobacco tax increases increase tobacco tax revenues.	X				
13	Tobacco tax increases that increase prices improve population health.	X				
14	Tobacco tax increases do not increase unemployment.		X			
15	Tax avoidance and tax evasion reduce, but do not eliminate, the public health and revenue impact of tobacco tax increases.	X				
16	A coordinated set of interventions that includes international collaborations, strengthened tax administration, increased enforcement, and swift, severe penalties reduces illicit trade in tobacco products.		X			
17	Higher and more uniform specific tobacco excise taxes result in higher tobacco product prices and increase the effectiveness of taxation policies in reducing tobacco use.	X				
18	Tobacco industry price discounting strategies, price-reducing marketing activities, and lobbying efforts mitigate the impact of tobacco excise tax increases.	X				

Chapter 12
Recommendations

Based on the body of evidence examined in this volume, the Working Group made the following research recommendations:

Overview of tobacco taxation

- Research is needed to assess the impact of complex tax structures on prices, profitability, market concentration and public health.
- Research is needed to identify a comparable taxable base for the wide range of smoking and smokeless tobacco products.

Industry pricing strategies and other pricing policies

- Empirical studies on industry pricing are limited in number and geographic coverage, and have focused exclusively on cigarettes. Research is needed to assess the impact of tobacco tax structure on prices and industry short- and long-term pricing strategies, particularly for products other than cigarettes. Surveillance systems that include brand-specific data on tobacco product prices and price-reducing marketing are needed for such research.
- More research is needed on tobacco companies' use of price-related marketing techniques. Including measures of these techniques in surveillance systems is necessary for such research.
- Most research on industry efforts to prevent large tax increases or earmarking of taxes and to reduce current taxes focuses on North America. Further research on these issues in other countries is required.
- Research on industry efforts to influence tax structures is limited to a small number of countries. More research on these efforts in other countries is needed.
- Almost no empirical evidence exists on the impact of minimum tobacco pricing policies or on bans on tobacco company price-related marketing efforts. Research is needed to evaluate the effectiveness of these policies.
- Context-specific evidence documenting the effective implementation of Article 5.3 of the WHO FCTC and research evidence addressing industry arguments aimed at influencing tobacco tax policy are needed.

Tax, price and aggregated demand for tobacco

- In countries with limited research on price elasticity, a well conducted time series study can provide a major contribution.
- Given advances in time series research and economic modelling of addiction, future time series analyses should apply state-of-the-art methods as the data allow.
- Future research should study how price elasticities vary over time and at different price levels, for different magnitudes of price increases and under different tax structures to provide a better understanding of the shape of the demand curve and hence the design of taxation policies.
- Studies that pool aggregate data from multiple countries over time should investigate the homogeneity of the countries and consider the use of heterogeneous estimation techniques.

Tax, price and adult tobacco use

- Research on how price elasticity of adult tobacco use changes over time, varies with price levels, and differs for large versus small price changes is needed in all countries.
- Research is needed on the effects of tax and price on various aspects of adult tobacco use, including prevalence, frequency, intensity, and cessation, as well as on differences in the impact of tax and price on male and female tobacco use.

- More research is needed on the effect of tax structures and differences in relative prices on substitution among tobacco products.
- Global adult tobacco surveillance systems such as those described in *IARC Handbooks of Tobacco Control, Volume 12* should regularly collect data on adult tobacco use in more countries.

Tax, price and tobacco use among young people

- More studies from low- and middle-income countries are necessary to explore price effects on tobacco demand, initiation, cessation, uptake and substitution between tobacco products.
- More research is needed on how price influences the availability of tobacco through peers and family, and how this affects tobacco use among young people.

Tax, price and tobacco use among the poor

- More research is needed to examine the price elasticity of tobacco use among individuals from different socioeconomic groups, and the implications of this for the impact of tax increases on equity. These studies should examine the price elasticity of demand for the full range of tobacco products, as well as across price tiers for a given product, particularly for those used by people in low-income strata.
- Research is also needed to understand the choices between licit and illicit products, particularly among those of lower socioeconomic status.

Tax avoidance and tax evasion

- Research on tax avoidance and tax evasion must apply clear definitions for the type of circumvention being addressed.
- All studies measuring tobacco tax evasion and tax avoidance should clearly describe the type of data and methods used, as well as their limitations.
- Information, statistics, reports and research findings on tobacco tax evasion and tax avoidance from government agencies should be made publicly available.
- More research is needed to estimate the size and the scale of the illicit tobacco trade and to examine the effectiveness of the measures taken to address this problem. Particular attention needs to be paid to low- and middle-income countries.
- Research is needed into the extent of tax avoidance, its impact on tobacco use and measures to address this issue.

Economics and health impact of tobacco taxation

- There is a need for studies on the impact of cigarette taxation on health care spending attributable to smoking, particularly for countries other than the USA.
- There is a need for further study on the impact of taxation of other tobacco products on health outcomes and costs.
- There is a need for further study on the impact of taxation of smoked tobacco products on secondhand smoke exposure (SHS) and its related health outcomes and costs.
- There is a need for further studies on the impact of tobacco taxation on other unhealthy behaviours.

Proposed policy recommendations

1. To improve public health by reducing tobacco use, governments should adopt relatively simple tobacco excise tax structures that emphasize specific taxes and that include regular tax increases that outpace growth in general price levels and incomes.
2. To further reduce tobacco use, tobacco tax revenues should be used to fund comprehensive tobacco control programs and other health promotion activities.
3. A multinational surveillance and monitoring system should be implemented that regularly collects data on tobacco use among adults and young people, tobacco product taxes and prices, price-reducing marketing and lobbying efforts of tobacco companies, tax avoidance and evasion, and tax administration and enforcement activities.

Working procedures

Starting in 2006, the series of International Agency for Research on Cancer (IARC) Handbooks of Cancer Prevention added tobacco control as a new area of prevention for their reviews. When appropriate, in addition to cancer, other health outcomes preventable by avoiding tobacco use or exposure to secondhand smoke (SHS) may be included when evaluating the effectiveness of interventions in a Handbook.

The Working Procedures described herein are largely taken from the Handbooks of Cancer Prevention devoted to Chemoprevention and Screening, and from the IARC Monograph Preamble (updated in January 2006).

The text that follows is organised in two principal parts. The first addresses the general scope, objectives, and structure of the Handbooks with emphasis on tobacco control. The second describes the scientific procedures for evaluating cancer-preventing agents and tobacco control policy interventions.

The term "exposure" appears repeatedly in these procedures, borrowed from the IARC Monographs devoted to the evaluation of carcinogenicity. Epidemiological studies conducted to assess the association between exposure to a given hazard and disease outcome, are based on the meaning of the term "exposure" implying increased risk to an undesired health effect. However, in this series of Handbooks, dedicated to the evaluation of the preventive effects of compounds, biological or pharmaceutical products, behaviours, programmes, and policy interventions, the traditional meaning of the term "exposure" is unfitting. Therefore in several instances the term "intervention," which lacks a hazardous connotation, is preferred. Examples of interventions with expected benefits in the area of tobacco control are tobacco use cessation, banning of smoking in public places, and taxation on tobacco products.

Part one: General principles

General scope

The prevention and control of cancer are the strategic objectives of IARC. Cancer prevention may be achieved at the individual level by avoiding cancer-causing agents (e.g. not using tobacco products), and at the population level by adopting programmes or legislation to reduce or eliminate exposure to cancer-causing agents (e.g. removing exposure to SHS through banning smoking in public and workplaces).

The Handbooks on tobacco control will evaluate the strength of the available evidence on the effects of interventions intended to prevent or reduce tobacco use, tobacco supply, and, when possible, tobacco-associated morbidity and mortality. The aim of the Handbook series is to provide the scientific community, policymakers, and governing bodies of IARC member states, as well as other countries with evidence-based assessments of these interventions at the individual and population levels, with the ultimate goal of assisting in the global implementation of tobacco control provisions within national and international programmes aimed at reducing tobacco-related morbidity and mortality.

Objectives

The objective is to prepare and publish, in the form of Handbooks, critical reviews and consensus evaluations of evidence on the effects of interventions focusing on tobacco control, with the help of an internationally formed Working Group (WG) of experts. The Handbooks may also indicate where additional research efforts are needed, specifically when data immediately relevant to an evaluation are not available. The evaluations in the Handbooks are scientific and qualitative judgments of peer-reviewed, published data, conducted during a six-day meeting of peer review and discussions by the WG.

Topic for the Handbook

The topic to be evaluated in a Handbook is selected approximately 12 months prior to the meeting by the head of the Lifestyle, Environment, and Cancer Group, after consultation with IARC scientists involved in tobacco research. A Handbook may cover a single topic or a group of related topics in the area of tobacco control.

Meeting participants

Soon after the topic of a Handbook is chosen, international scientists with relevant expertise are identified by IARC staff (usually through literature searches), in consultation with other experts. Each participant serves as an independent scientist and not as a representative of any organisation, government, or industry. Every effort is made to achieve a balanced group of experts in terms of gender, geographic origin, expertise, and diversity of scientific opinion.

Five categories of participants may attend Handbook meetings: WG members, Invited Specialists, Representatives of national and international health agencies, Observers, and the IARC Secretariat. Participants in the first two groups generally have published significant research related to the topic being reviewed or in tobacco control in particular. All participants are listed, with their addresses and principal affiliations, at the beginning of each Handbook volume. A description of each participant type, and their responsibilities, is listed below.

1. The Working Group is responsible for the critical reviews and evaluations that are developed during the meeting. WG members are selected based on knowledge and experience pertinent to the topic evaluated and absence of real or apparent conflicts of interest. The tasks of the WG are: (i) to ascertain that all appropriate data have been collected; (ii) to select the data relevant for the evaluation on the basis of scientific merit; (iii) to prepare accurate summaries of the data to enable the reader to follow the reasoning of the WG; (iv) to critically evaluate the results of epidemiological, clinical, and other type of studies; (v) to prepare recommendations for research and for public health action; and (vi) if the topic being reviewed so permits, to make an overall evaluation of the evidence of a protective effect or reduced risk associated with the exposure or intervention focus of the evaluation.

2. Invited Specialists are experts who also have critical knowledge and experience, but have a real or apparent conflict of interest. These experts are invited, when necessary, to assist in the WG by contributing their unique knowledge and experience during subgroup and plenary discussions. They may also contribute text on the intervention being evaluated. Invited Specialists do not serve as meeting chair or subgroup chair, redact summaries, or participate in the evaluations.

3. Representatives of national and international health agencies may attend meetings because their agencies are interested in the topic of a Handbook. Representatives do not serve as meeting chair or subgroup chair, draft any part of a Handbook, or participate in the evaluations.

4. Observers with relevant scientific credentials may be admitted to a meeting by IARC in limited numbers. Priority will be given to achieving a balance of Observers from constituencies with differing perspectives. They are invited to observe the meeting and should not attempt to influence it. Observers serve as sources of first-hand information from the meeting to their sponsoring organisations. They can play a valuable role in ensuring that all published information and scientific perspectives are considered. Observers will not serve as meeting chair or subgroup chair, draft any part of a Handbook, or participate in the evaluations. At the meeting, the chair and subgroup chairs may grant Observers the opportunity to speak, generally after they have heard a discussion.

5. The *IARC Secretariat* consists of scientists who have relevant expertise and are designated by IARC to attend a meeting. They serve as rapporteurs and participate in all discussions. When requested by the meeting chair or subgroup chair, they may also draft text or prepare tables and analyses.

The WHO Declaration of Interest form is sent to each prospective participant at the first contact, with the preliminary letter presenting the Handbook meeting. Before an official invitation is extended, each potential participant, including the IARC Secretariat, completes the WHO Declaration of Interest form to report financial interests, employment and consulting, and individual and institutional research support related to the topic of the meeting. IARC assesses the declared interests to determine whether there is a conflict that warrants some limitation on participation. WG members are selected based on the absence of real or apparent conflicts of interest. If a real or apparent conflict of interest is identified, then the expert is asked to attend as an Invited Specialist. The declarations are updated and reviewed again at the opening of the meeting, approximately eight months later. Interests related to the subject of the meeting are disclosed to the meeting participants and in the published volume (Cogliano *et al.*, 2004).

Data for the Handbooks

The Handbooks review all pertinent studies on the intervention to be evaluated. Only those data considered relevant to evaluate the evidence are included and summarised. Those judged inadequate or irrelevant to the evaluation may be cited but not summarised. If a group of similar studies is not reviewed, the reasons are indicated.

With regard to reports of basic scientific research, epidemiological studies, and clinical trials, only studies that have been published or accepted for publication in the openly available scientific literature are reviewed. In certain instances, government agency reports that have undergone peer review and are widely available can be considered. Exceptions may be made ad hoc to include unpublished reports that are in their final form and publicly available, if their inclusion is considered pertinent to making an evaluation. Abstracts from scientific meetings, and other reports that do not provide sufficient detail upon which to base an assessment of their quality are generally not considered.

Inclusion of a study does not imply acceptance of the adequacy of the study design or of the analysis and interpretation of the results, and limitations identified by the WG are clearly outlined in square brackets (i.e. [ ]). The reasons for not giving further consideration to an individual study are also indicated in square brackets. Important aspects of a study, directly impinging on its interpretation, are brought to the attention of the reader. In general, numerical findings are indicated as they appear in the original report; units are converted when necessary for easier comparison. The WG may conduct additional analyses of the published data and use them in their assessment of the evidence. These analyses and their results are outlined in square brackets or in italics in the Handbook.

Working procedures

Chair of the meeting

The chair of the Handbook meeting is identified among leading international experts soon after the topic of a Handbook is chosen. The chair will help develop an outline for the Handbook early on and aid in identifying prospective experts to form the WG. The chair participates on conference calls with WG members and Invited Specialists in preparing for the meeting, provides early feedback on working papers, directs the meeting, and helps resolve queries emerging on the working papers once the meeting is over.

Literature to be reviewed

After the topic of the Handbook is chosen and invited experts have accepted to take part in the Handbook meeting, participants are expected to conduct their own literature searches in support of their working assignments. Only upon expressed request by any of the members of the WG, pertinent studies are identified by IARC from recognised sources of information, such as PubMed, and made available to WG members and Invited Specialists to prepare the working papers for the meeting. Paper and/or electronic version of the studies cited in the working papers are available at the time of the meeting for consultation by the WG and all other participants including the IARC Secretariat.

Working papers

Working papers are due about six to eight months after original contact of invited experts. The first version of the working papers is compiled and formatted by IARC staff about two months prior to the meeting, or as soon as they are received, and made available ahead of time through IARC's internet to all WG members, Invited Specialists, and the IARC Secretariat. Reception of working papers ahead of the established deadline is encouraged, as it allows review of their content, facilitating identification of information gaps from the start. When possible, or when deemed necessary, working papers may be discussed early on among experts to expedite the review process to be accomplished during the meeting. Conference calls will be scheduled after reception of all working papers and prior to the meeting, with the aim of identifying areas deserving additional work by experts before the meeting.

Acknowledgement of significant contributions to the chapters by colleagues of the invited experts, either at their home institution or elsewhere, can be included in the Handbook under an acknowledgement paragraph to be shown following the listing of the meeting participants.

Meeting

The meeting participants convene at IARC for six days to discuss and finalise the texts of the working papers that will constitute the Handbook and to formulate the evaluations. The WG members and Invited Specialists are grouped into subgroups according to their area of expertise. Subgroups meet during the first three to four days to review in detail the first versions of their working papers, develop a joint subgroup draft, and write summaries. During the last few days the participants meet in plenary session to review the subgroup working papers and summaries and to develop the consensus evaluations. Scheduling of plenary and subgroup time may change from one Handbook meeting to another.

Post-meeting

After the meeting, the draft Handbook is verified by consulting the original literature, edited, and prepared for publication by IARC staff. The aim is to publish Handbooks within 12-15 months of the meeting. If applicable, summaries reporting the results of the evaluation may be available on the IARC website (http://www.iarc.fr) soon after the meeting, and a short report may be published in the international literature.

Part two: Scientific review of the evidence and evaluation

Scientific review

The evidence forming the foundation of the evaluation results from the studies reviewed. The validity of these studies will be examined critically to determine the weight they contribute to the assessment. This entails judging the appropriateness of study design, data collection (including adequate description of the intervention and follow-up), data analysis, and ultimately, deciding if chance, bias, confounding, or lack of statistical power may account for the observed results. The experts will ascertain how the limitations of the studies affect the results and conclusions reported. The criteria that follow apply to epidemiological and clinical studies, and therefore may not be as relevant to studies where other quality criteria would be indicated (e.g. those assessing the impact of economic policies or when health outcomes are not contemplated).

Quality of studies considered

It is necessary to take into account the possible roles of bias, confounding, and chance in the interpretation of epidemiological studies. Bias is the operation of factors in the study design or execution that leads erroneously to a stronger or weaker association than in fact exists between the exposure/intervention being evaluated and the outcome. Confounding is a form of bias that occurs when the association with the disease is made to appear stronger or weaker than it truly is, as a result of an association between the apparent causal factor and another factor that is associated with either an increase or decrease in the incidence of the disease. The role of chance is related to biological variability and the influence of sample size on the precision of estimates of effect.

In evaluating the extent to which these factors have been taken into account in an individual study, the Handbook considers a number of aspects of design and analysis as described in the report of the study.

First, the study population, disease (or diseases), and exposure/intervention should have been well-defined by the authors. Cases of disease in the study population should have been identified independently of the intervention of interest, and the intervention assessed in a way that was not related to disease status.

Second, in the study design and analysis, the authors should have taken into account other variables that can influence the risk of disease or impact of an intervention and that may have been related to the intervention of interest. Potential confounding by such variables should have been dealt with either in the design of the study, such as by matching, or in the analysis, by statistical adjustment. In cohort studies, comparisons with local rates of the disease may or may not be more appropriate than those with national rates. Internal comparisons of disease frequency among individuals at different levels of the intervention are also desirable in cohort studies, since they minimise the potential for confounding related to difference in risk factors between an external reference group and the study population.

Third, the authors should have reported the basic data on which the conclusions are founded, even if sophisticated statistical analyses were employed. The numbers of exposed and unexposed cases and controls in a case-control study, and the numbers of cases observed and expected in a cohort study should have been provided. Further tabulations by time since exposure began, and other temporal factors, are also important. In a cohort study, data on all cancer sites and all causes of death should have been given to reveal the possibility of reporting bias. In a case-control study, the effects of investigated factors other than the exposure of interest should have been reported.

Finally, the statistical methods used to obtain estimates of relative risk, absolute rates of cancer, confidence intervals, and significance tests, and to adjust for confounding should have been clearly stated by the authors.

Aspects that are particularly important in evaluating experimental studies are: the selection of participants, the nature and adequacy of the randomisation procedure, evidence that randomisation achieved an adequate balance between groups, the exclusion criteria used before and after randomisation, compliance with the intervention in the intervention group, and 'contamination' with the intervention in the control group. Other considerations are the means by which the endpoint was determined and validated, the length and completeness of follow-up of the groups, and the adequacy of the analysis.

Detailed analyses of both relative and absolute risks in relation to temporal variables, such as age at first exposure, time since first exposure, duration of exposure, cumulative exposure, peak exposure (when appropriate), and time since exposure ceased, will be reviewed and summarised when available.

Independent, population-based studies of the same exposure or intervention may lead to ambiguous results. Combined analyses of data from multiple studies may be a means of resolving this ambiguity. There are two types of combined analysis: the first combines summary statistics, such as relative risks, from individual studies (meta-analysis); the second involves a pooled analysis of the raw data from the individual studies (pooled analysis).

Advantages of combined analyses include better precision due to increased sample size, as well as the opportunity to explore potential confounders, interactions, and modifying effects that may explain heterogeneity among studies in more detail. A disadvantage of combined analyses is the possible lack of compatibility of data from various studies due to differences in subject recruitment, data collection procedures, measurement methods, and effects of unmeasured covariates that may differ between studies.

Meta-analyses may be conducted by the WG during the course of preparing a Handbook and are identified as original calculations by placement of the results in square brackets or in italics. These may be de novo analyses or updates of previously conducted analyses that incorporate the results from new studies. Whenever possible, however, such analyses are preferably conducted preceding the Handbook meeting. Publication of the results of such meta-analyses prior to, or concurrently with, the Handbook meeting is encouraged for purposes of peer review. The same criteria for data quality that would be applied to individual studies must be applied to combined analyses, and such analyses must take into account heterogeneity between studies.

Criteria for causality

After the quality of each study has been summarised and assessed, a judgment is made concerning the strength of evidence that the exposure or intervention in question reduces the risk of disease or is protective for humans. Hill (1965) lists areas for evaluating the strength of epidemiological associations used in the review of human data when assessing carcinogenesis. These criteria, in many instances, will apply to the assessment included in a Handbook:

- Consistency of observed associations across studies and populations;
- Magnitude of the reported association;
- Temporal relationship between exposure/intervention and change in disease;
- Exposure-response biologic gradient;
- Biological plausibility;
- Coherence of results across other lines of evidence; and
- Analogy present in related exposures and their effects on health.

If the results are inconsistent among investigations, possible explanations are sought (e.g. differences in level of exposure/ intervention). Results of studies judged to be of high quality are given more weight than those of studies judged to be less methodologically sound. When several studies show little or no indication of an association between an intervention and cancer prevention, the judgment may be made that, in the aggregate, they show evidence of lack of effect. The possibility that bias, confounding, or misclassification of exposure or outcome could explain the observed results should be considered and excluded when reasonable certainty exists.

Assessing studies reporting the impact of tobacco control policy interventions not necessarily contemplating health outcomes

Evaluating the outcomes of population level tobacco control policy involves three interrelated questions: (1) Does the policy have an impact? (causality); if so, (2) Under what conditions? (moderation); and (3) How (mediation)?

The choice of design elements will depend on which questions are considered to be a part of the evaluation effort. It is important to ensure that the appropriate concepts are chosen, and, that for each, measures are identified that are suitable to answer the evaluation question.

In the absence of a randomised trial, there are two study design strategies that can be employed for the rigorous evaluation of the effects of policies. First is the use of measurements both before and after the policy's implementation. These measurements can be taken from either units (usually, but not limited to, individuals; the same logic would apply if the measures were of households, schools, or other venues) that are either the same (as in a cohort design) or different, but drawn from the same sampling process (as in a repeat cross-sectional design). The second design strategy is the use of a quasi-experimental design, in which one group that is exposed to a policy is compared to a similar unexposed group, as discussed above. Combining these two strategies in a single study yields a two-group, pre-post design, which offers a higher degree of internal validity than either feature alone. The utility of longitudinal designs is strengthened if there are multiple data collections before and/or after policy implementation, allowing more precise specification of effects (e.g. taking into account temporal trends that were occurring before the implementation of the policy).

A distinction between study designs and study features is worth noting. In addition to the two design considerations stated above, there are two study feature strategies that contribute to increasing an evaluation study's internal validity. The first is the measurement of policy-specific variables that are theorised to be affected initially after the policy is implemented. A second strategy is the measurement of policy-specific variables for policies that have not changed; such variables act as another form of control. Recommendations for measures pertinent to the evaluation of each WHO Framework Convention on Tobacco Control policy domain are provided in Handbook Volume 12 (IARC, 2008).

Combining the two design and two study feature strategies, along with the inclusion of other explanatory variables (covariates) that might help explain differences between two jurisdictions, creates a powerful research design, allowing more confident inferences to be made about the causal effects of policies and/or combinations of policies.

Evaluation efforts should be informed by knowledge of the nature of the policy being evaluated, and the goals of the evaluation study should be clearly stated. Evaluation planning should be guided by understanding what threats to internal validity may be present in the study of a given policy situation, and then adding design elements and other measures to reduce or eliminate those threats.

Knowledge of the mediational pathways that are theorised to explain how policy affects behaviour and environment (or environmental risk) should lead to an appropriate study design, the inclusion of appropriate constructs and measures, and the selection of analytic tools that are well-suited to estimating the causal impact of policies by providing an explanatory pathway and helping to eliminate alternative explanations.

The utility of longitudinal designs is strengthened if there are multiple data collections before and/or after policy implementation, as this allows more precise specification of effects (e.g. taking into account temporal trends that were occurring before the implementation of the policy). The role of time series analysis on aggregate sales/consumption data that demonstrate the effect of price on consumption is a good example of the power of multiple measurements.

Both repeated cross-sectional and longitudinal (cohort) designs are useful for assessing the impact of a given policy. The use of cohort designs provides an additional capability for tracking the impact of policies within individuals, allowing stronger tests of mediational pathways.

Addition of samples from other populations to either or both intervention and control arms, also adds strength to the evaluation design, as does having varying levels of intensity of the intervention.

Similarly, parallel assessment of alternative explanations for observed changes in outcomes (e.g. possibly being due to other policies or industry counter-actions) adds strength over assessing these effects in separate studies.

The existence of studies with complementary strengths and weaknesses is particularly useful in triangulating the results of a corpus of evaluation studies to see if a consistent pattern emerges.

The use of probability sampling in an evaluation study increases its external validity - the extent to which the findings of a policy evaluation study can be generalised to draw conclusions about the impact of the policy on the larger population.

At a broader level, the design of an evaluation study should be guided by knowledge of how prior evaluation studies in the same policy domain have been conducted. An analysis of the similarity or differences in policy impact across similar studies can yield powerful conclusions about the overall impact of a policy.

Summary of the data reviewed (evidence)

This section summarises in a concise manner the results of the evidence presented in the preceding sections in a Handbook. Traditionally, this section does not include citation of literature, as do preceding sections presenting and discussing the evidence.

Evaluation of the evidence

An evaluation of the strength of the evidence for disease prevention or reduction in morbidity and mortality is made using standard terms described in previous volumes of the Handbooks of Cancer Prevention (e.g. Volume 11). In evaluating the strength of the evidence on the effects of tobacco control interventions directed at the population, disease prevention or health outcomes may not always be a measurable endpoint. Also, it is conceivable that not every exposure/intervention reviewed in a Handbook of tobacco control will permit a formal evaluation of the evidence, as traditionally done in other Handbooks of Cancer Prevention and in the Monographs.

The following criteria are proposed when evaluating the weight of the evidence on the effects of tobacco control interventions:

Sufficient evidence: The WG considers that an association has been observed in studies in which chance, bias, and confounding can be ruled out with reasonable confidence. The association is highly likely to be causal. A statement that there is *sufficient evidence* should be followed by a separate sentence that identifies the nature and magnitude of the observed effect.

Strong evidence: There is consistent evidence of an association between the intervention under consideration and a given effect, but evidence of causality is limited by the fact that chance, bias, or confounding have not been ruled out with reasonable confidence. However, explanations other than causality are unlikely.

Limited evidence: There is some evidence of association between the intervention under consideration and a given effect, but alternative explanations are possible.

Inadequate/no evidence: There are no available methodologically sound studies showing an association. The available studies are of insufficient quality, consistency, or statistical power to permit a conclusion regarding the presence or absence of a causal association between the intervention and a given effect. Alternatively, this category is used when no data are available.

Evidence suggesting lack of effect: There are several methodologically adequate studies that are mutually consistent in not showing an association between the intervention and a given effect.

Overall evaluation

The overall evaluation, usually in the form of a narrative, will include a summary of the body of evidence considered as a whole, and summary statements made about the strength of the evidence for policy effects, including changes in tobacco use, changes in health risks, and incidental effects.

IARC WGs make every effort to achieve a consensus evaluation. Consensus reflects broad agreement among WG members, but not necessarily unanimity. The chair may elect to poll WG members to determine the diversity of scientific opinion on issues where consensus is not readily apparent.

Recommendations

After reviewing the data and deliberating on them, the WG may formulate recommendations, where applicable, for further research and public health action.

References

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