Section 3
Price Determinants of Demand

Chapter 4
The Impact of Tax and Price on the Demand for Tobacco Products

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Tobacco taxes and prices are key factors in controlling the demand for tobacco products and essential components of an integrated approach to tobacco control. This chapter examines the evidence surrounding tobacco taxation and pricing and the impact of taxation and pricing on the prevalence of tobacco use and the consumption of tobacco products. This chapter discusses:

- Models of the demand for tobacco products, including economic models of addiction
- The evidence on the impact of taxes and prices on the demand for tobacco products
- The effect of factors such as age and gender on sensitivity to changes in the price of tobacco products.

Taxes on tobacco products tend to be higher in high-income countries (HICs) than in low- and middle-income countries (LMICs). Tobacco products are often more affordable in HICs than in LMICs, but over time, cigarettes have generally become less affordable in HICs and more affordable in LMICs. Significant tax and price increases can have a particularly strong impact on some of the groups most affected by the tobacco epidemic, including youth and people in LMICs.

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Introduction

Governments and policymakers have access to a substantial number of tobacco control tools designed to reduce tobacco consumption. There is a consensus that the single most consistently effective tobacco control tool is significantly increasing the excise tax on tobacco products.[1–5] The principle is simple: By increasing excise taxes on tobacco products, retail prices will increase, in turn causing decreases in the consumption of tobacco products. Not only does an increase in the excise tax reduce tobacco use, but overwhelming evidence also suggests that it raises government revenue. (See chapter 5.)

Other tobacco control tools are discussed in subsequent chapters, including bans on tobacco marketing, smoking in public places, and youth access to tobacco, as well as services to help people quit using tobacco, among others. Although these tools are important in a comprehensive tobacco control strategy and help create an environment in which tobacco use is no longer acceptable, their direct effect on tobacco consumption is more modest than the impact of significant increases in the excise tax. Moreover, prohibiting certain practices (e.g., tobacco marketing or indoor smoking) has a limited effect because after such practices are prohibited, they cannot be prohibited further. Increases in tobacco excise taxes are not subject to such constraints; excise taxes can continue to be increased, even if the tax rate is already very high.

Increasing the excise tax, more than any other tobacco control tool, is firmly rooted in economic theory and application,[6] thus economists are well placed to analyze the rationale and workings of this tobacco control tool. Other tobacco control interventions also have an economic aspect, but they typically have a far more multidisciplinary focus and benefit from inputs from a wider variety of disciplines, such as ethics, philosophy, and social policy.[6]

Price elasticity of demand is the key economic concept used to understand or measure changes in cigarette consumption resulting from changes in the excise tax and in the retail price of cigarettes. In an economic context, *elasticity* refers to the responsiveness of one variable to a change in another variable. The price elasticity of demand measures how responsive demand (or consumption) is to a change in the price of the product. Technically, the price elasticity of demand is the percentage change in the consumption of a product in response to a 1% change in the price of the product, with all else remaining constant. As will be discussed below, nearly all empirical studies have found that the price elasticity of demand for tobacco products lies between zero and minus one. Estimates for high-income countries (HICs) are clustered around –0.4; estimates for low- and middle-income countries (LMICs) are more variable and somewhat greater in absolute terms (further from zero), with estimates clustered around –0.5. In other words, for HICs, a 10% increase in the price of tobacco is expected to decrease tobacco consumption by 4%. For LMICs, a 10% increase in price would be expected to decrease tobacco consumption by 5%.[2] Thus, tax and price increases are a potentially potent tobacco control tool in all countries.

Many econometric studies have estimated price elasticities for other aspects of tobacco use beyond consumption, including prevalence, cessation, initiation, duration of smoking, frequency of smoking (e.g., daily vs. non-daily), and conditional demand (amount of the product consumed conditional on being a user of that product).[2] Still others have estimated cross-price elasticities of the demand for tobacco products—that is, the impact of a change in the price of one tobacco product (e.g., cigarettes) on the use of another tobacco product (e.g., smokeless tobacco), or of a change in the price of a subcategory of one product (e.g., premium cigarette brands) on the use of a different subcategory of that product (e.g., discount cigarette brands). Finally, while many studies have estimated income elasticities of

tobacco use, few have estimated affordability elasticities, which focus on the role of price relative to income in influencing the demand for tobacco products.

This chapter reviews the rationale for levying excise taxes on tobacco products; recent theories on how to model the demand for tobacco products; important statistical trends in cigarette consumption, pricing, and taxation; and empirical data on price elasticity of demand from studies in LMICs and HICs.

Rationale for Levying Excise Taxes on Tobacco Products

Controversial and luxury items have been subject to taxes for centuries. As far back as 1776, Scottish philosopher and political theorist Adam Smith argued in an oft-quoted paragraph that "sugar, rum, and tobacco, are commodities which are nowhere necessaries of life, which are become objects of almost universal consumption, and which are, therefore, extremely proper subjects of taxation."[7,p.775] By taxing these commodities "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."[7,p.777] In Smith's day, the primary rationale for levying a tax on tobacco was to raise revenue for the government. As governments have subsequently expanded greatly and diversified their sources of revenues, the relative share of tobacco excise taxes has decreased in most countries. However, lower income countries typically depend more on indirect taxes, including tobacco and other excise taxes, than on direct taxes, such as income taxes; thus, the contribution of a tobacco excise tax in such countries can be quite substantial (see chapter 5).

The literature identifies a number of reasons for levying an excise tax on cigarettes, of which raising government revenue is only one. In 1995, a group of economists in the United States and the United Kingdom of Great Britain and Northern Ireland proposed the following reasons for raising tobacco taxes: (1) to raise revenue, (2) to have smokers pay for the burden they impose on others through their smoking (the externality argument), (3) to protect children from becoming addicted to a harmful substance at an age when they do not have the capacity to make an informed choice, and (4) to improve public health by reducing the mortality and morbidity impact of smoking.[8]

The second and third of these reasons reflect the notion that tobacco taxes can be used to address the failures that exist in the markets for tobacco products. As Jha and colleagues[9] describe, these market failures include (a) imperfect information about the harms caused by tobacco use and the addictiveness of tobacco products, which is complicated by the uptake of tobacco use during childhood and adolescence—that is, at ages when people lack the cognitive ability to make informed choices, and (b) the physical and financial impacts (or externalities) that result from tobacco use.

As described further in chapter 8, many people are either unaware of or underestimate the numerous adverse health effects of tobacco use and secondhand smoke (SHS) exposure.[10,11] Smokers tend to hold erroneous beliefs about smoking and health: They think they will be able to quit when they want to, that low-tar cigarettes are less harmful than other cigarettes, that they are in a lower risk group compared with other smokers, or that the general health risks do not apply to them as individuals.[12] In fact, many adult tobacco users struggle with quitting, the great majority of smokers regret having started,[13,14] and young people taking up tobacco use significantly underestimate the addictive potential of these products and overestimate their likelihood of quitting in the future.[15]

These market failures provide an economic rationale for governments to intervene in tobacco product markets, in addition to the clear public health rationale resulting from the considerable death and disease caused by tobacco use. According to Jha and colleagues,[9] while other interventions may more directly address these market failures (e.g., prominent warning labels on cigarette packs and comprehensive smoke-free policies), their reach and effectiveness may be more limited, particularly when it comes to reducing tobacco use in the most vulnerable populations. Tobacco taxes have a greater impact on tobacco use among young people, those who are less educated, and the poor, as described below.

Modeling the Demand for Cigarettes

The relationship between price and cigarette consumption has become the subject of a lively methodological economic debate. One major source of contention is how to model consumption of an addictive product, because the assumptions underlying the different models used have fundamentally different implications for the optimal tax level.[16] Modeling of tobacco consumption, rooted in traditional economic models of choice, has undergone continuous evolution in response to expanding knowledge and insights into addictive behavior. This section outlines the evolving models of tobacco consumption and their strengths and weaknesses.

The Rational Choice Model

Conventional models of demand assume that consumers are fully rational and self-controlled and that utility in each period depends solely on the consumption during that period. Conventional models explicitly embrace the paradigm of consumer sovereignty: Consumers are the best judges of their own behavior and of what goods and services to buy. Within this framework, a chosen behavior is *a priori* assumed to be optimal simply because a person has rationally chosen it. Based on this assumption, it is held that the government has no reason, in the absence of market failures, to interfere with this revealed preference.

However, conventional models of demand either ignore the addictive nature of goods like cigarettes when estimating demand or assume that behavior such as smoking is rational. Under an assumption of irrationality, addictive goods might not follow the fundamental economic law of an inverse relationship between price and consumption.[17] If this is the case, higher cigarette prices through increased cigarette taxes would not be an effective way to reduce consumption. This view has been overturned by a substantial body of economic research that demonstrates that the demand for cigarettes clearly responds to changes in price.

Economic Models of Addiction

Early economic models of addiction and their applications to tobacco use generally assumed myopic behavior, recognizing that current consumption of tobacco was dependent on past consumption, while ignoring the dependence of future consumption on current and past consumption.[18] This is in contrast to the rational addiction model, developed by Becker and Murphy,[19] which treats consumers as "rational" addicts and tobacco consumption as rational behavior involving "forward-looking maximization with stable preferences."[19,p.675] Addicts are postulated to be forward-looking if current consumption depends on past and future consumption, and by implication, on past and future prices. In this context, price includes the retail price and all costs associated with obtaining and consuming tobacco, such as medical expenses and even intangible costs like social disapproval. Empirical studies testing whether expectation

of higher prices in the future will tend to lower consumption today, as would be expected with forward-looking addicts, provide some support for the model.[20–23]

The rational addiction model has become widely used when modeling the consumption of addictive goods such as cigarettes. By definition, rational addicts formulate decisions about current consumption by accounting for both current and future costs of their behavior. If this is the case, then price-based policies are more effective than models that ignore the addictive nature of tobacco use would predict, because a tax will reduce current consumption by raising expectations about future prices. However, the rational addiction model has been criticized on several grounds, most notably for its underlying assumptions of perfect foresight and consumer rationality. The assumption of perfect foresight implies that addicted individuals are "happy addicts" who do not regret their past decisions.[24] This assumption is contradicted by the evidence that most smokers would like to quit and regret having started. For example, Fong and colleagues[13] found that more than 90% of adult smokers in the United States, Canada, Australia, and the United Kingdom regret having started smoking and say they would not start if they had to do it over again. Feelings of regret are not exclusive to Western countries. Sansone and colleagues[14] reported that regret about smoking was common in four non-Western countries: In Thailand (93%) and Republic of Korea (87%) expressions of regret were comparable to those in the four countries analyzed by Fong and colleagues; lower prevalences were found in Malaysia (77%) and the People's Republic of China (74%). Similarly, numerous studies contradict the assumption that consumers possess adequate knowledge on which to base their consumption decisions and that they use this knowledge to maximize their long-term welfare.[16] For example, Chaloupka and Warner[17] observed that adolescents often underestimate the addictive nature of smoking.

Some economic models of addiction attempt to address this lack of perfect foresight by treating behavior as "boundedly rational," implying that individuals make current consumption choices that maximize current utility rather than choosing a lifetime consumption path.[25,26] Bounded rationality can help explain seemingly incongruous behaviors—for example, smokers who buy single packs of cigarettes instead of cartons, which are priced lower than single packs, in an effort to limit their consumption and/or increase their likelihood of quitting. This approach has important implications for the relative effectiveness of other tobacco control policies. Suranovic[26] applied this concept of bounded rationality to youth smoking initiation, concluding that policies that raise the present costs of smoking will be more likely to reduce youth smoking initiation than policies that highlight the long-term health consequences of smoking.

Becker and Murphy's[19] original rational addiction model also assumes that people's preferences do not change over time. However, results from laboratory experiments and psychological research suggest that consumers generally have time-inconsistent preferences and exhibit self-control problems.[27] For example, consumers may place a higher value on smoking a cigarette now but have a desire to quit tomorrow. But when tomorrow arrives and they have the desire to smoke another cigarette rather than quit, they will be in conflict with their own previously stated preference. Preferences become time inconsistent when the tradeoff between two time periods changes, such that a person's relative preference for well-being may not necessarily be the same when asked on different occasions.

Internality Theory

Self-control problems are introduced into economic models through the idea of a competing internal self, whereby an individual's preferences change at different times with a view to improving the welfare of the current self, sometimes at the expense of the welfare of the future self.[28] Most people exhibit present-biased preferences; they have a tendency to pursue gratification now in a way that they may disapprove of later. The large time delay between the onset of tobacco use and the onset of disease makes smokers particularly prone to this phenomenon, because the health consequences of their current actions are most often realized at a distant future date.[9] Thus, smoking can be viewed as an outcome of "multiple selves."[28] Many smokers want to quit smoking, but the immediate desire to relieve intense withdrawal symptoms dominates the desire to quit. In this framework, the model of cigarette consumption assumes that consumers are time inconsistent. The existence of an "internality" arising from the psychological phenomena of hyperbolic discounting, present bias, and unstable preferences supports an argument for a cigarette tax, not only on the grounds of externalities that result in costs to others, but also because smoking creates internal costs such as disease and income loss that markets fail to correct.

If consumers exhibit present-biased preferences (i.e., the time inconsistency model), then assumptions of rational and time-consistent behavior (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, decisions about tobacco consumption are governed by the same rational decision-making process as any other good, and they invoke the same normative rules as "normal" goods.[24] Under this paradigm, the optimal role for government is to correct for the external costs of smoking. The imposition of an excise tax on cigarettes makes smokers worse off, in the same way that the imposition of a tax on any normal good makes the consumers of that good worse off. According to this approach, "addiction per se does not constitute market failure and the costs that smokers impose on themselves are irrelevant for taxation unless rooted in misperceptions about the harmfulness of smoking."[16,p.6] In contrast, internality theory concludes that government policies should account for internality costs in the same way that they account for externality costs. Thus, taxation may be justified theoretically even without externalities.[23]

As a result, time inconsistency (internality theory) models generally prescribe an optimal tax level that is higher than that of the rational addiction model because internal costs often dwarf external costs.[27] In contrast to Becker and Murphy's rational addiction model, internality theory holds that an increase in taxation can increase smokers' utility. To test this hypothesis, Gruber and Mullainathan[24] linked data for cigarette excise taxes to surveys of self-reported happiness in the United States and Canada. The study found that higher excise taxes on cigarettes are associated with increased happiness of smokers. Similarly, Choi and Boyle[29] found that Minnesota smokers who tried to quit smoking were more likely to perceive the 2009 federal cigarette tax increase in the United States as helpful in promoting smoking cessation, a finding they ascribe to the tax increase being seen as a commitment device by smokers who want to quit.

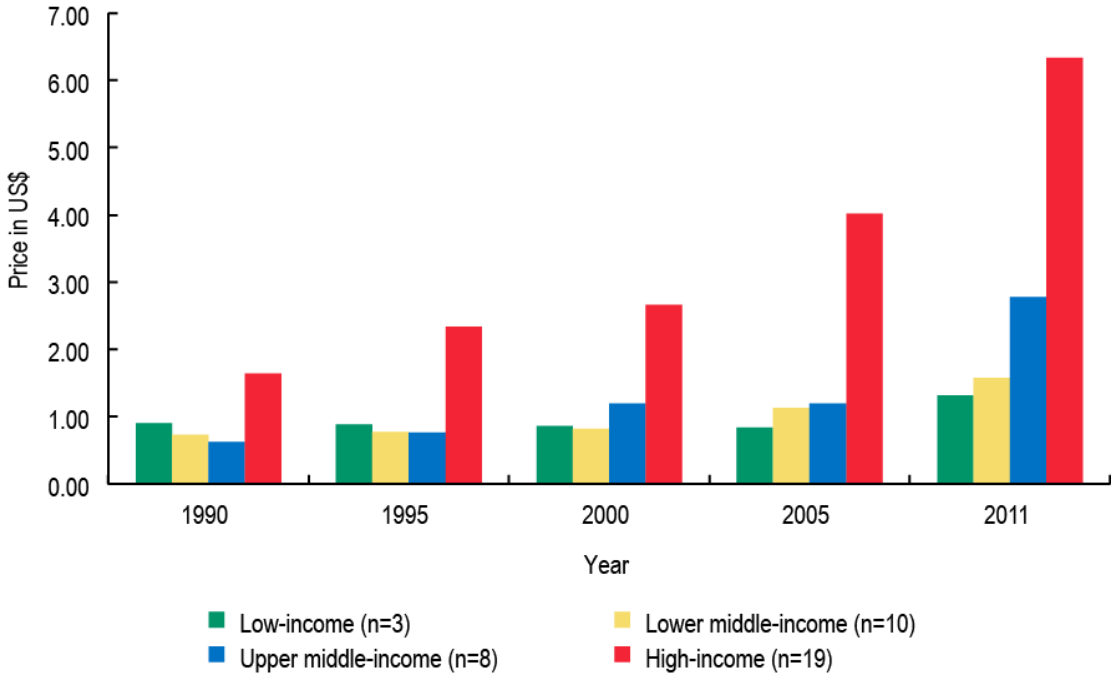
Empirical Data on Cigarette Price, Affordability, and Taxes

Cigarette Prices

Empirical studies have shown unambiguously that the retail price of cigarettes is a crucial determinant of cigarette consumption. Some studies have focused on differences in cigarette prices between countries.[3,30] Figure 4.1 displays the median price of a pack of cigarettes in 40 countries (low-income [n=3], lower middle-income [n=10], upper middle-income [n=8], and high-income countries [n=19]), for which data are available, between 1990 and 2011.[31]

Figure 4.1 shows that cigarette prices, expressed in U.S. dollars, are highest in HICs and lowest in low-income countries. Additionally, historical data show that while cigarette prices have increased in HICs, they have remained relatively flat in low-income countries. This reflects both the generally higher tax levels and more frequent tax increases in HICs.[31,32] Furthermore, the differences in cigarette prices have become more pronounced, in both absolute and relative terms, between HICs and the rest of the world since 2000.

Figure 4.1 Median Price of a Pack of Cigarettes, by Country Income Group, 1990–2011



Notes: Using the official exchange rate, the prices of local brands of cigarettes, as collected by the Economist Intelligence Unit, were converted to U.S. dollars (not adjusted for inflation). Countries were discarded from the dataset if more than approximately one-third of the time series data were missing, if the country experienced a serious bout of hyperinflation or introduced a new currency, or if price data were so unstable over time that they were simply not credible. With these countries removed, the subsequent analysis was performed on 40 countries. Data were collected from large urban areas and may not reflect the full range of prices within the country.
Source: Economist Intelligence Unit 2012.[31]

Consumers respond to price changes. It is *changes in* the retail price, not the *level of* the retail price, that drive changes in the consumption of cigarettes. The current price level is the result of price changes from previous years, which would have influenced changes in the consumption of cigarettes in the past; any significant future changes in cigarette consumption will depend on future price changes, holding

other factors constant. A price increase gives consumers an incentive to change their smoking behavior, but if cigarette prices are stable, whether high or low, consumers have no reason to change their consumption, again holding other factors constant.

From an econometric perspective, to estimate the price elasticity of demand for cigarettes in a particular country using time series data, the inflation-adjusted (real) price of cigarettes must change over time. If the price does not change, then the impact that price has on the consumption of cigarettes cannot be determined.

Cigarette Consumption and Prices

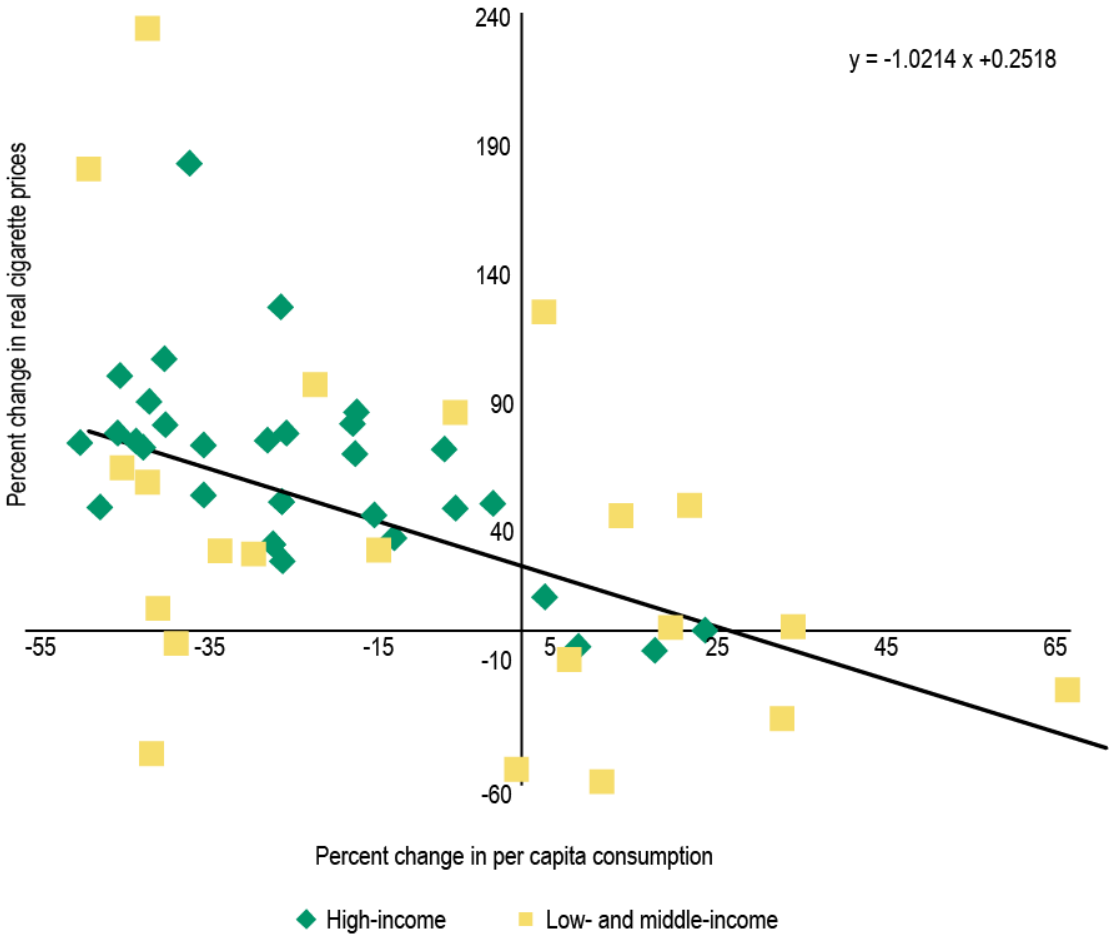
Analyzing trends in cigarette consumption and the real prices of cigarettes can help to determine how successful countries have been at curtailing the consumption of cigarettes. Successful countries are primarily high- and middle-income countries that have implemented strong tobacco control strategies, including significant tax increases. Conversely, countries where the consumption of cigarettes has increased have generally experienced very rapid economic growth but only modest increases or, more often, decreases in the real price of cigarettes. The World Health Organization[33] (WHO) reported that, compared with other tobacco control strategies in the WHO Framework Convention on Tobacco Control (WHO FCTC), countries have made limited progress so far in increasing the price of tobacco products by raising taxes.

Comparative data also show that increases in the price of cigarettes are a particularly powerful tobacco control tool. In a sample of countries for which appropriate data are available (n=52; 29 high-income, 21 middle-income, and 2 low-income countries), the simple correlation coefficient between changes in the real price of cigarettes and changes in per capita consumption of cigarettes for the period 1996–2011 was –0.56 (Figure 4.2).[31]

Cigarette Affordability

Cigarette consumption is sensitive to changes in income. Since 2000, many LMICS have experienced periods of rapid economic growth during which cigarette taxes and prices have not kept up with the growth in income. In many LMICs, the demand for cigarettes increases as the average income increases, but the demand for cigarettes usually increases by a smaller percentage than the percentage change in average income (meaning that demand is relatively inelastic with respect to income). Since 2000, several studies[34,35] have used the concept of cigarette affordability, which refers to the quantity of resources that are required to buy a pack of cigarettes. The term incorporates both the price of cigarettes and the average level of income. With all other factors remaining constant (i.e., income), the higher the price of cigarettes, the less affordable they are. However, in countries where the average per capita income is high, cigarettes may be more affordable than in a country where cigarettes are cheaper but the average level of income is proportionally much lower.

Figure 4.2 Percentage Change in Real Cigarette Prices Versus Percentage Change in Per Capita Consumption of Cigarettes, 1996–2011



Note: Country income group classification based on World Bank Analytical Classifications for 2011.
Sources: Economist Intelligence Unit 2012.[31] ERC Group 2011.[252]

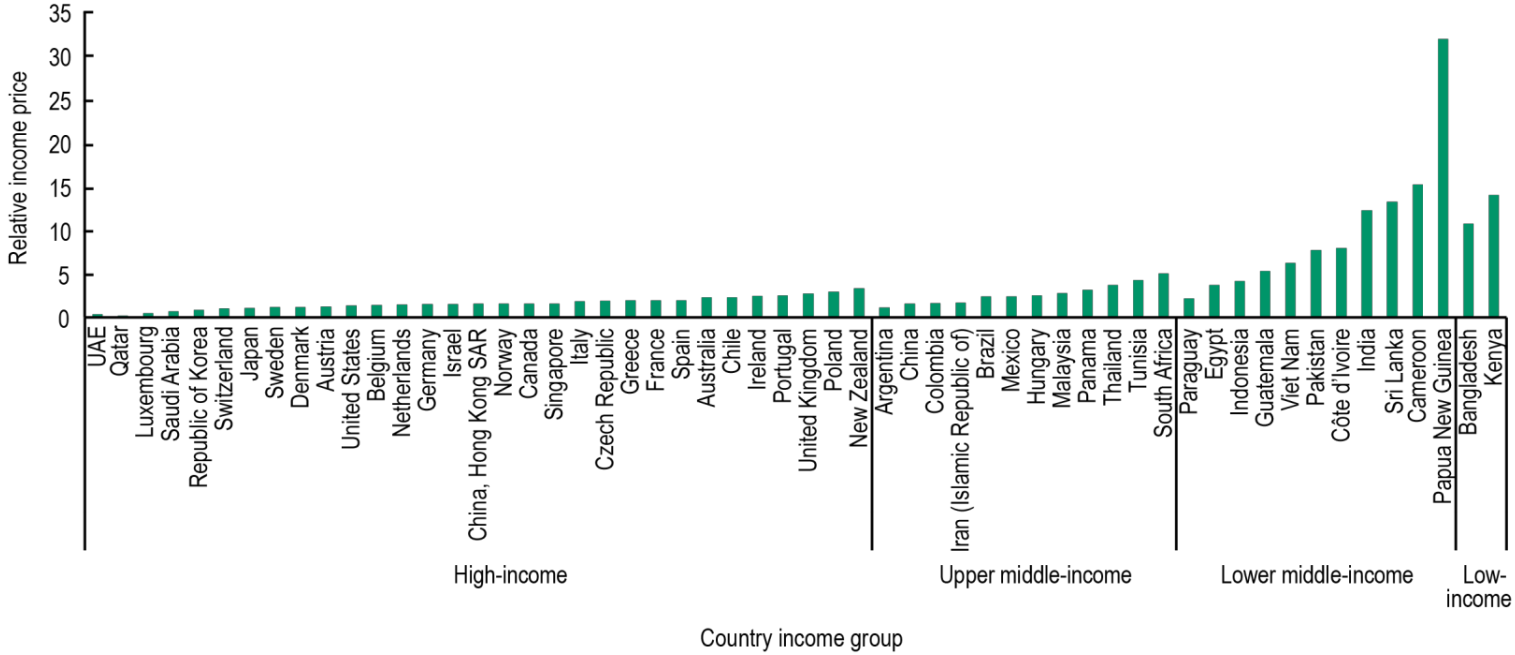
Two metrics are available to measure the affordability of cigarettes: (1) the number of minutes of labor (at a representative or average job) required to buy a pack of cigarettes, and (2) the percentage of per capita gross domestic product (GDP) required to buy 100 packs of cigarettes. The latter measure, also called the relative income price, tends to be used for a large sample of countries but may be most useful when considering the affordability of cigarettes in LMICs.[35] The relative income price increases as cigarettes become less affordable because of an increase in cigarette prices or a decrease in per capita GDP. However, if both cigarette prices and per capita GDP increase, as is often the case, then the affordability of cigarettes depends on the relative magnitudes of these changes. While relative income price is an easily constructed measure of affordability given the ready availability of per capita GDP, cross-country comparisons of affordability may be distorted when there are significant differences in income inequality across countries and when there are significant socioeconomic differences in tobacco use within and across countries. A measure of income that better reflects the income of the tobacco-using population (e.g., average or median income of a tobacco user, or the minutes of work required to purchase a pack of cigarettes by the average tobacco user) would help to address this problem, but is difficult to use in practice given the lack of consistent data across countries.

In their study using data from 1990 to 2006, Blecher and van Walbeek[35] found that, on average, cigarettes were far more affordable in HICs than in LMICs, despite being more expensive in HICs when expressed in a common currency. An updated analysis using more recent data (Figure 4.3) shows the relative income price, categorized by the standard World Bank country income group classification, for a sample of 56 countries. This analysis confirms that cigarettes remain more affordable in HICS than in LMICs. One hundred packs of cigarettes cost more than 2% of per capita GDP in only seven HICs (Australia, Chile, Ireland, Portugal, the United Kingdom, Poland, and New Zealand). In contrast, in both of the low-income countries for which data are available, 100 packs of cigarettes would cost more than 10% of GDP. In the upper and lower middle-income countries reporting data, the percentage of GDP required to purchase 100 packs of cigarettes would range from 0.5% to 31.8%. In general, cigarettes are less affordable as country income decreases.

Cigarette consumption is generally higher in countries where cigarettes are more affordable than in countries where cigarettes are less affordable. Using cross-sectional data, Blecher and van Walbeek[34] showed that differences in the *level* of cigarette affordability can explain, to some extent, differences in per capita consumption of cigarettes between countries. These authors estimated the affordability elasticity of demand, defined as the quantity by which cigarette consumption decreases in response to cigarettes becoming less affordable by 1%, to be –0.53. This elasticity estimate falls in the same range as typical price elasticity estimates, but it emphasizes affordability, which is conceptually quite different from price.

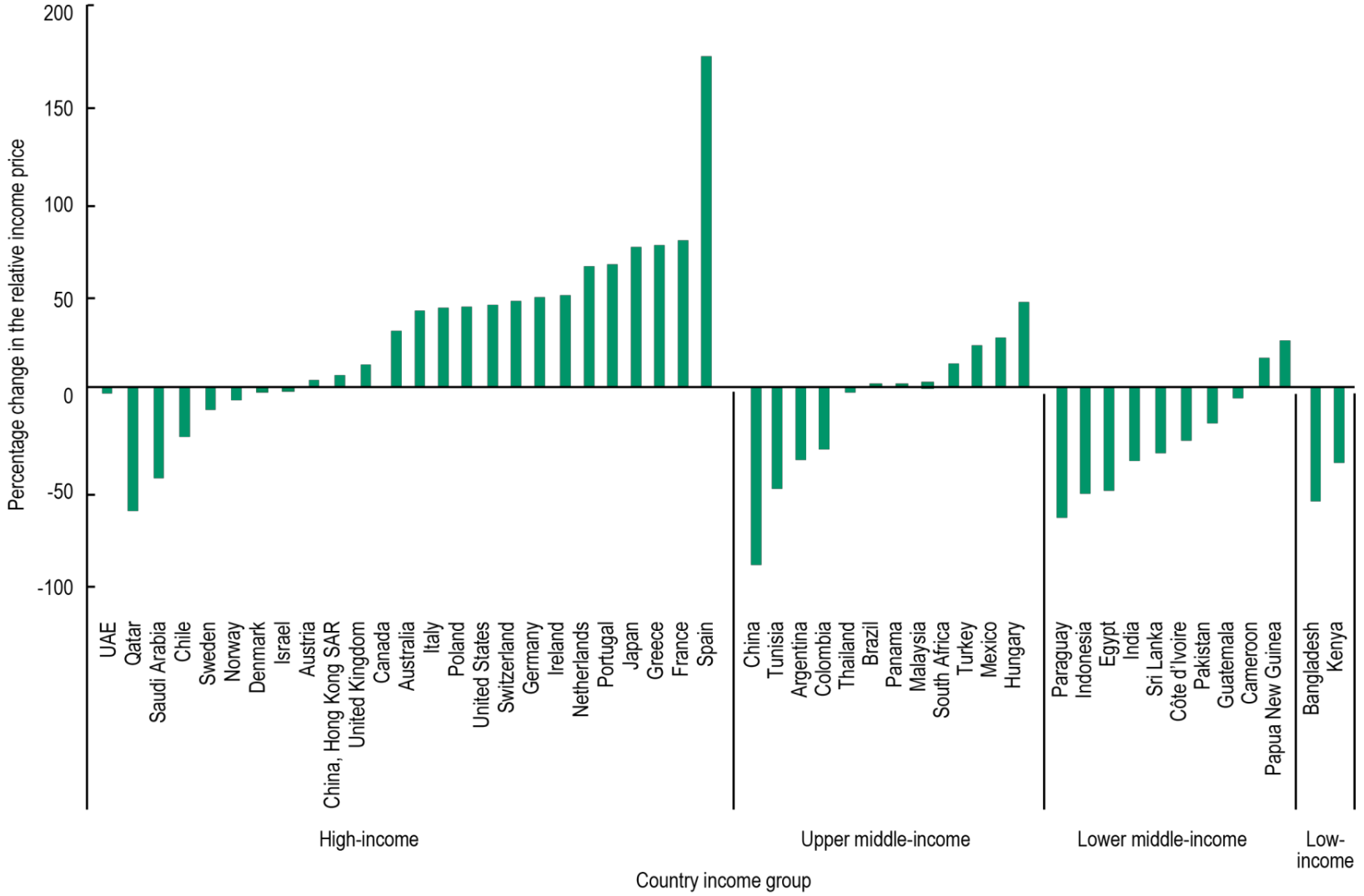
In the same way that changes in prices (rather than the level of prices) are more useful as a tobacco control tool, changes in cigarette affordability (rather than the level of cigarette affordability) are expected to drive changes in cigarette consumption over time. Figure 4.4 shows average annual percentage changes in cigarette affordability from 2000 to 2013 for a sample of 49 countries. An increase in the relative income price implies that cigarettes have become less affordable. As shown in Figure 4.4, between 2000 and 2013, cigarettes became less affordable in 17 of 25 HICs but in only 9 of 24 LMICs. The result is predictable: a strong divergence in cigarette consumption between these two groups of countries. Thus, despite the fact that cigarettes remain, overall, less affordable in LMICs compared with HICs, changes in affordability over time have led to a decrease in consumption of cigarettes in HICs but an increase in the rest of the world.

Figure 4.3 Cigarette Affordability in Selected Countries, by Country Income Group, 2013



Notes: Relative income price is the percentage of annual per capita GDP required to buy 100 packs of cigarettes. Country income group classification based on World Bank Analytical Classifications for 2013. UAE = United Arab Emirates. SAR = Special Administrative Region.
Source: Adapted from Blecher and van Walbeek 2009[35] using data from Economist Intelligence Unit 2015.[31]

Figure 4.4 Percentage Change in Cigarette Affordability, by Country Income Group, 2000–2013



Notes: Relative income price is the percentage of annual per capita GDP required to buy 100 packs of cigarettes. Country income group classification based on World Bank Analytical Classifications for 2013. UAE = United Arab Emirates. SAR = Special Administrative Region.
Source: Economist Intelligence Unit 2015.[31]

Taxation on Cigarettes

Total tax burden is defined as the sum of all taxes—including general sales taxes, such as a value-added tax—expressed as a percentage of the retail price. According to the 1999 World Bank publication *Curbing the Epidemic: Governments and the Economics of Tobacco Control*,[30] the total tax burden on cigarettes is highest in HICs and decreases as a country's income level decreases. Using 1996 data for the sample of countries in this study, the average tax burden was 67% in HICs, 50% in upper middle-income countries, 46% in lower middle-income countries, and 40% in low-income countries.[30] A similar analysis based on 180 countries was performed by WHO[36] in 2014 (Table 4.1) using the World Bank's income categories. Although the choice of descriptive statistics (i.e., unweighted/simple average, weighted average, and median) substantially influences the results, the 2014 WHO data confirm the earlier World Bank findings that the tax burden is higher for HICs and lower for LMICs. In fact, considering unweighted average tax burdens, the picture in 2014 is not different from that in 1996.

Table 4.1 shows the average tax burdens weighted by the number of current adult cigarette smokers, thus giving more weight to countries with more smokers. This weighting results in a significant compression of tax burdens among the four groups of countries, which is what happens if low-income countries with high smoking rates have above-average tax burdens and HICs with low smoking rates have below-average tax burdens.

Table 4.1 also shows the proportion of the total tax burden that is made up of various types of excise tax, which are taxes applied on certain goods consumed within a country. A specific excise tax is a fixed amount levied per given measure of a particular commodity and an *ad valorem* excise tax is a percentage of the value of the commodity, which can be measured in a variety of ways (see chapter 5 for more detailed definitions).

Table 4.1 reveals that as a country's income level increases, the proportion of specific taxes (based on a measure of weight or quantity) in the total excise tax amount generally increases at the expense of the *ad valorem* tax (based on value) component, although some differences are seen when the data are weighted by the number of adult smokers (weighted average). In low-income countries, the bulk of the excise taxes are made up of *ad valorem* taxes, and specific taxes generally account for only a small part of the excise tax. In contrast, in both lower middle-income countries and HICs, the specific tax component accounts for most of the excise tax. Among upper middle-income countries, the *ad valorem* tax accounts for the largest proportion of excise tax when weighted by the number of adult smokers, mainly due to the large number of smokers in China which relies primarily on an *ad valorem* tax.

Most countries also levy a general sales tax or value-added tax (VAT) on cigarettes, as on many other products and services. The base for calculating the sales tax or VAT varies from country to country. Most countries levy the tax on the final retail price exclusive of the VAT, others levy it based on the final retail price. A few other countries with weaker capacity to collect VAT at all levels of the supply chain levy it only at the value of production/import. These other taxes also include import duties, but these are relatively unimportant in most countries.

Table 4.1 Total Tax Burden, by Country Income Group, 2014

Descriptive statistics	Average price, $ PPP*	Specific excise, as a % of price	*Ad valorem* excise, as a % of price	Value-added tax, as a % of price†	Other taxes, as a % of price	Total tax burden, as a % of price
Unweighted average						
Low-income countries	2.32	7.80	14.70	10.40	1.80	34.74
Lower middle-income countries	3.59	27.40	7.60	11.90	1.60	48.55
Upper middle-income countries	4.68	26.90	16.80	11.60	3.10	58.38
High-income countries	6.07	33.80	17.70	13.60	1.30	66.48
Weighted average (by current adult cigarette smokers [2013 estimate])						
Low-income countries	2.03	6.70	25.90	11.80	1.40	45.76
Lower middle-income countries	2.78	35.20	8.70	12.70	0.10	56.64
Upper middle-income countries	2.94	7.90	32.10	13.70	0.60	54.35
High-income countries	5.53	33.80	17.90	12.70	0.30	64.78
Median						
Low-income countries	1.93	0.00	10.21	11.88	0.00	30.86
Lower middle-income countries	2.51	16.00	6.69	11.50	0.00	40.87
Upper middle-income countries	3.87	25.65	0.00	13.04	0.00	58.86
High-income countries	5.66	30.18	8.72	15.97	0.00	72.90

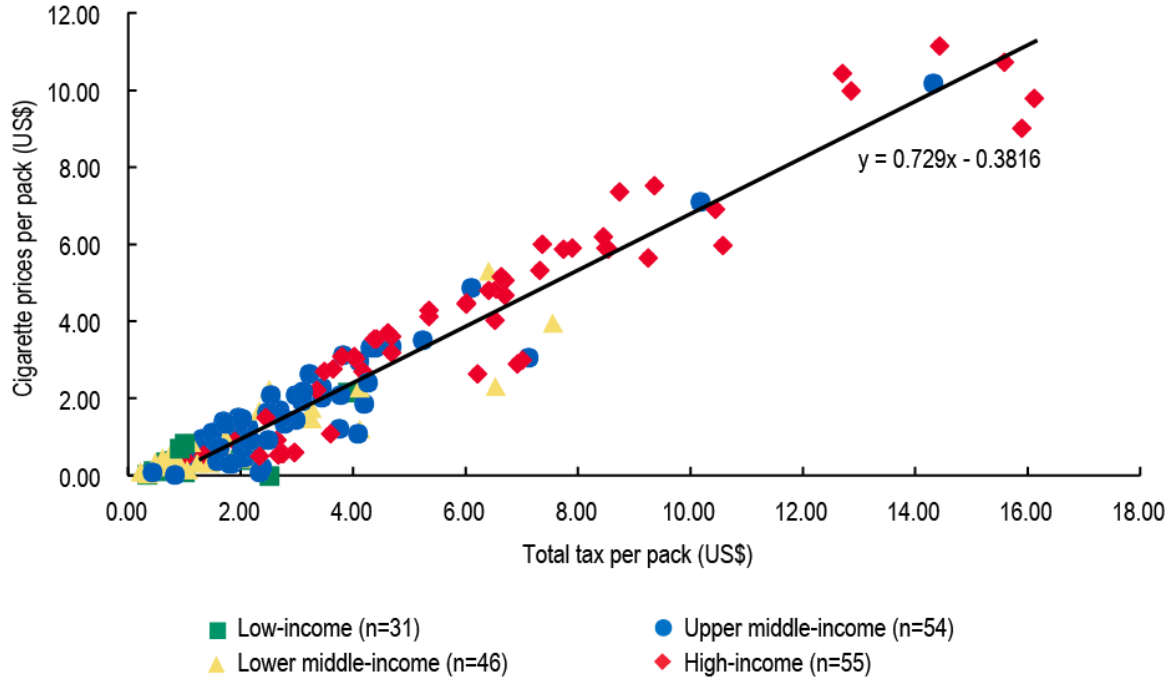
*Average price reflects the price of a 20-cigarette pack of the most sold brand in each country included in the country groupings. PPP = Purchasing Power Parity.
†This column also includes sales taxes, not tabulated separately in this table.
Notes: Low-income countries (n=29), lower middle-income countries (n=45), upper middle-income countries (n=53), and high-income countries (n=53). Country income group classification based on World Bank Analytical Classifications for 2014.
Source: World Health Organization 2015.[36]

Microeconomic theory suggests a positive relationship between tax burden and the price of cigarettes—that is, as the government increases the tax burden, the manufacturer would be expected to pass the tax on to the consumer in the form of a higher retail price. Evidence from 186 observations (31 low-income, 46 lower middle-income, 54 upper middle-income, and 55 high-income countries) broadly supports this view, as shown in Figure 4.5.[36]

The correlation between cigarette price (expressed in U.S. dollars) and tax burden is very high (0.95). However, a closer look at Figure 4.5 suggests that the positive relationship is influenced primarily by highly taxed, high-priced cigarettes in HICs. When examining only LMICs (n=131), the correlation coefficient between price and tax burden drops slightly, to 0.88. For relatively low tax burdens, between 20% and 60% of the retail price, the tax burden percentage is unrelated to the retail price. This suggests that other factors (e.g., input, labor, logistical and distributional costs, and profit margins in the manufacturing, wholesale, and retail sectors) play as important a role in determining the retail price of cigarettes as the excise tax. Moreover, as described in chapter 5, simpler cigarette tax structures, particularly those that emphasize specific taxes and do not involve tier-based taxes, are associated with less variability in the prices smokers pay for cigarettes across brands. Thus, increases in cigarette taxes

in countries with simpler tax structures will likely be more effective in reducing smoking prevalence compared with tax increases in countries that have more complex tax structures.[37,38]

Figure 4.5 Price of a Pack of Cigarettes Versus Total Tax on Cigarettes, by Country Income Group, 2014



Note: Country income group classification based on World Bank Analytical Classifications for 2014.
Source: World Health Organization 2015.[36]

The tax burden clearly affects the price of cigarettes. Figure 4.5 offers a static (cross-sectional) picture of different combinations of the price-to-tax burden for 2014 but not the impact of a *change* in the tax burden on the price in any particular country. Examining the impact of changing the tax burden would require tracking changes in the excise tax and in the price of cigarettes for each country over time. Given the diversity and complexity of some excise tax regimes and changes in these regimes over time, consistent data to investigate the relationship between the excise tax and retail prices for a large sample of countries over a sizable time period are not currently available.

Several studies have investigated the impact of excise tax changes on the retail price of cigarettes.[39–42] These studies have typically focused on the United States. Early studies were inconclusive, but more recent (2010) studies have generally found that increases in the excise tax are mostly, fully, or more than fully passed on to consumers.[43] When cigarette manufacturing firms have significant market power, as they typically do, the strategic interactions between these firms make it more difficult to predict how an increase in the excise tax will impact the retail price. In some cases, the excise tax increase could be the signal for all firms to increase the retail price by the full amount of the excise tax, or even more. In other cases, cigarette manufacturers might not pass on the increased excise tax to consumers in the form of a higher retail price, hoping to gain market share from competitors. However, where cigarette manufacturers are monopolies or near-monopolies, the uncertainty is diminished.

According to Becker and colleagues,[21] the best strategy for a monopolist would be to set the retail price lower than the short-run profit-maximizing position when the business environment is good. However, when the environment is unfavorable to the industry (e.g., when tobacco control legislation is passed or when the excise tax increases consistently), a more appropriate strategy would be to set the retail price much higher in order to maximize short-run profits, given the expected lower future profits. The implication of this strategy is that the monopolist cigarette manufacturer would increase the retail price by more than the actual increase in the tax. As discussed in Box 4.1 below, growing evidence suggests that this strategy is becoming more popular in some countries where government policies are unfavorable toward the tobacco companies.

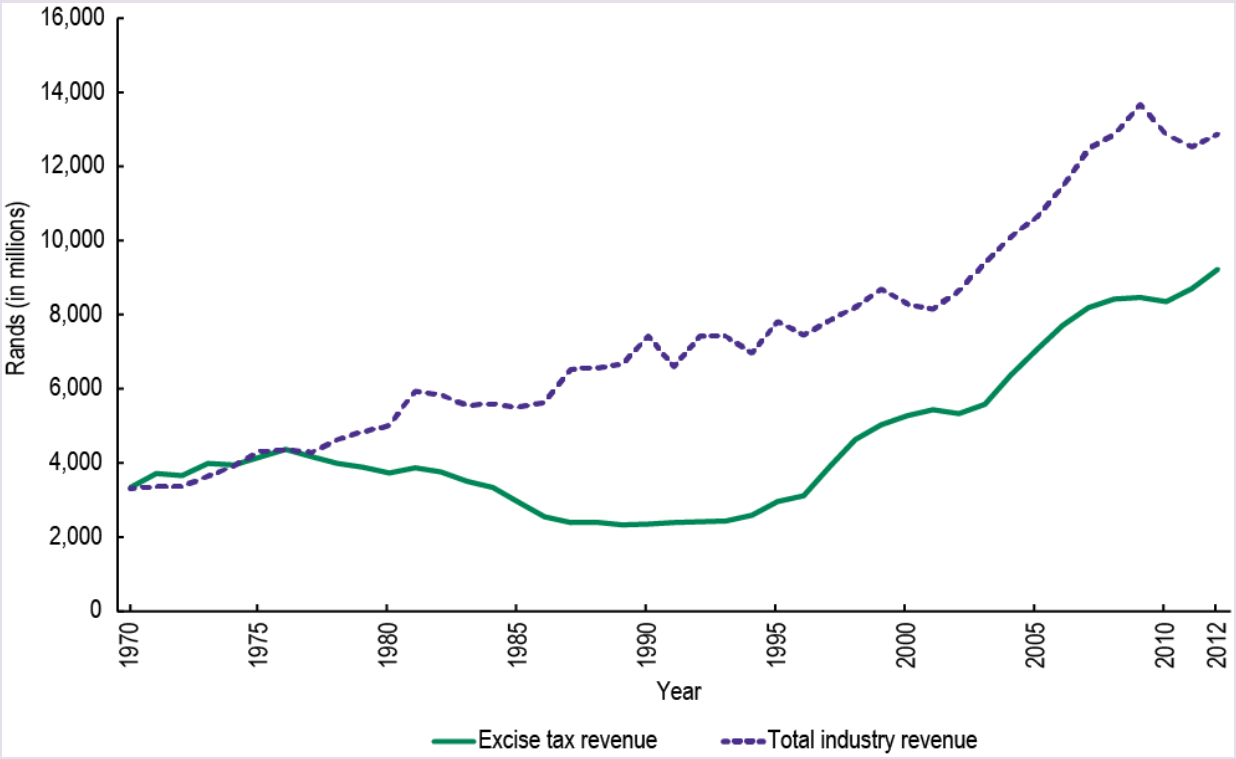
Box 4.1: Examples of Tobacco Industry Responses to Increased Taxes

The response of the tobacco industry is an important variable in the impact of tobacco taxation on both public health outcomes and government revenue. Two countries, South Africa and Jamaica, serve as case studies for the impact of tobacco industry pricing moves in response to changes in taxation.

South Africa levies a specific excise tax on cigarettes. During the 1970s and especially the 1980s, inflation, averaging about 15% annually, eroded the real value of this excise tax. During the mid-1990s, the government moved to raise the excise tax burden on cigarettes from approximately 32% of the retail price to a total tax burden (i.e., excise tax plus VAT) of 50% of the retail price. During this period, the tobacco industry, a near-monopoly in South Africa, initiated retail price increases which brought manufacturers substantial gains in net-of-tax prices (after taxes have been paid).[44] An original analysis by van Walbeek of data from Statistics South Africa and Budget Reviews found that between 1991 and 2000, the real net-of-tax price increased by 88%; this was a substantial change from the 17% decrease in the real net-of-tax price between 1970 and 1991. Between 2000 and 2010 the real net-of-tax price of the most popular price category (the market segment in which the near-monopoly has a particularly strong presence) increased by an additional 86%.

The government tax increase and the industry price increase had a beneficial impact on both government tax revenues and tobacco industry revenues, allowing the industry to make greater profits on fewer cigarette sales. Despite a 42% decrease in legal cigarettes sold, the following figure from van Walbeek's original analysis shows that the industry's real revenues increased by 95% between 1991 and 2012, owing to the relative price inelasticity of cigarettes. Ironically, the industry engineered a greater decrease in cigarette consumption in the short term by raising prices than the government was able to achieve by increasing the excise tax alone.

Excise Tax Revenue and Industry Revenue in South Africa, in Rands, Adjusted for Inflation, 1970–2012



Notes: Currency adjusted for inflation using 2008 rands. Original analysis by van Walbeek.

In contrast, in Jamaica the tobacco industry, rather than the government, captured most of the benefit from price increases implemented in response to a substantial increase in the excise tax. In 2005, the Jamaican Ministry of Health commissioned a report, *The Economics of Tobacco Control in Jamaica: Will the Pursuit of Public Health Place a Fiscal Burden on the Government?*,[45] on the benefits of increasing the excise tax on cigarettes. Given Jamaica's fiscal situation at the time, the primary objective of the increase was to raise government revenues, with decreased cigarette consumption being a secondary objective.

Before 2008, Jamaica had a complex cigarette tax model. Cigarettes were subject to three kinds of taxes: (1) a special consumption tax (SCT), (2) an excise tax, and (3) a general consumption tax (GCT). In 2005, the SCT was levied as a specific tax, but if the net-of-tax value of cigarettes (known as the ex-factory price) exceeded a certain threshold value (expressed in nominal prices), an *ad valorem* tax was levied on the difference between the ex-factory price and the threshold value. The excise tax, a tax earmarked to finance the National Health Fund, was levied at a rate of 23% of the sum of the ex-factory price and the SCT. The GCT was levied at a rate of 15% of the sum of the ex-factory price, the SCT, and the excise tax.[45]

In April 2005, the Minister of Finance announced a 51% increase in the specific component of the SCT. Carreras, the Jamaican subsidiary of British American Tobacco, responded by recommending that the retail price of cigarettes be increased from Jamaican dollars (J$) 180 to J$ 220 because of the increased tax on cigarettes.[45] However, total taxes only increased marginally, because the threshold for implementing the *ad valorem* component of the SCT was also raised, thus reducing the amount of the *ad valorem* component of the tax. Based on the most pessimistic assumption, the tax increased by no more than J$ 6.70 per pack compared with the J$ 40 per pack increase in the recommended retail price. The industry clearly was able to capture most of the revenues from the change in cigarette taxes.[45]

Jamaica's experience following the 2005 tax increase rather dramatically illustrates that a combination of industry market power (Carreras is a monopoly in Jamaica) and a complex tax structure can result in a situation in which the primary purpose of increasing the tax on cigarettes—that is, increasing government revenues—is thwarted by the industry.[46] To address this situation, Jamaica further revised its tax system in 2008, removing the *ad valorem* component of the tax and increasing the specific component to J$ 120 per pack, with several subsequent increases bringing the tax to J$ 240 in 2015.[46]

These examples highlight two important principles: (1) simple excise tax systems are more efficient than complex tax systems, and (2) an industry with significant market power has a strong incentive to increase its net-of-tax price when faced with increases in the specific tax. These principles are discussed further in chapter 5.

Methods of Assessing the Impact of Tax and Price on Use of Tobacco Products

Empirical analyses of the demand for cigarettes and other tobacco products first began to appear in the mid-20th century as economists analyzed the impact of price and income on the demand for a variety of products.[47–49] These early studies relied on aggregate time series data and focused entirely on HICs. For example, Stone[49] used annual time series data from the 1920s and 1930s and estimated that the price elasticities of tobacco demand were –0.24 in the United States and –0.53 in the United Kingdom. Similarly, Koutsoyannis[48] used annual time series data from the 1950s to estimate price elasticities for 14 HICs, which ranged from insignificant in several countries to –0.95 in Austria.

As evidence of the adverse health consequences of tobacco use accumulated and grew stronger in the 1950s and 1960s, an increasing number of economists began to focus analyses on tobacco use alone, rather than as one of many consumer products. Many of the early studies examined the impact of information shocks (e.g., the 1964 Surgeon General's report[50]), tobacco company advertising, restrictions on tobacco advertising, and price.[51–56] Analyses of tobacco use became increasingly sophisticated during the next few decades as data on tobacco use, prices, and tobacco control policies became more widely available, econometric methods improved, and high-speed computing technology became easily accessible. In addition to the continued analysis of time series data, researchers began to analyze pooled cross-sectional time series data (e.g., data over time for U.S. states) as well as data from a variety of individual and household surveys.

By the end of the 20th century, a substantial body of evidence demonstrated that higher taxes and prices led to reductions in overall tobacco use and in the prevalence and intensity of use, with greater impact on key subpopulations (e.g., young people and those earning low incomes). A few of these studies focused on LMICs,[57] but most examined HICs, particularly the United States.[58] Chaloupka and colleagues[59] provided a comprehensive review of global evidence available up to the year 2000, concluding that price elasticity of cigarette demand in HICs centered on –0.4. Based on the limited evidence available at the time, the authors estimated that demand was about twice as responsive to price in LMICs.

Economic research on the impact of tax and price on tobacco use has expanded greatly since 2000. Many of these more recent studies focus on LMICs, mainly because of the changing patterns of tobacco use globally and the growing health and economic burdens that tobacco use imposes on these countries. The rapid growth of this research has been driven by the increasing availability of high-quality data on tobacco use, the growing cadre of well-trained economists, and the availability of funding to support

such research in LMICs. At the same time, the body of research from HICs has also grown and become stronger because of continued improvements in time series and microeconometric methods, the availability of more extensive and better integrated data, and the increased feasibility of complex econometric analyses of large data made possible by advances in computing technology.

Findings from this increasingly sophisticated and rapidly growing literature strengthen the conclusions reached earlier—that is, that higher taxes and prices for tobacco products lead to significant reductions in tobacco use. Tobacco use has declined because more adult users have quit, fewer former users have restarted, potential users have been deterred from beginning to use, and those who continue to use have decreased their consumption. Reductions also stem from other changes in tobacco use behaviors, including product and brand choices and aspects of purchasing behavior. A more extensive review of this research, including comprehensive tables summarizing the numerous studies based on aggregate and survey data, as well as studies of key subpopulations (young people and low-socioeconomic-status populations), is available in the International Agency for Research on Cancer (IARC) handbook *The Effectiveness of Tax and Price Policies for Tobacco Control*.[2]

Econometric studies of the impact of tax and price on tobacco use employ two primary measures of tobacco use: (1) macro-level aggregate measures of consumption, such as country-level data on tobacco sales (this literature developed earlier, growing rapidly before the 1990s); and (2) household or individual-level data taken from surveys such as national surveys of drug use or health risk behavior. Economic studies using survey data have come to dominate the literature in the past two decades. Most analyses of aggregate data are time series analyses for a particular country or geographic area (e.g., state, province, region, or city), but many studies pool time series data from multiple areas. These analyses use data from a single cross-sectional survey, or pooled data from multiple cross-sectional surveys, or longitudinal data from repeated surveys of the same individuals or households over time. As briefly described below, each type of data has its own strengths but is also subject to limitations that pose challenges to estimating the demand for tobacco. However, the rapidly growing literature comprised of studies that use diverse data and methods from an increasing number of countries has produced strong and consistent evidence that higher taxes and prices reduce tobacco use. A more thorough discussion on methodological and related issues is available in *Methods for Evaluating Tobacco Control Policies*[60] and in *Global Efforts to Combat Smoking*.[61]

Analysis of Aggregate Data

Aggregated data on tobacco consumption are frequently obtained from government agencies through publications and other circulated materials, and are typically based on tax-paid sales or derived from production and trade statistics (production plus imports minus exports). Such data are most often available annually but can be available on a quarterly, monthly, or more frequent basis (e.g., scanner-based retail sales data, which are available in a growing number of countries and obtained from stores selling tobacco products). Using aggregated data, the price elasticity of demand is estimated by measuring the change in an aggregate measure of tobacco consumption (e.g., cigarette sales) in response to a 1% increase in the price of tobacco.

Econometric analyses of aggregate data generally include measures of real price and income as key independent variables, and many of these analyses control for a variety of other factors, such as tobacco companies' marketing expenditures, indicators of key tobacco control policies, prices of other tobacco and/or nontobacco products, various population characteristics, and other potentially relevant determinants of demand.

Time series data are used to study the impact of price on behavior over time. However, researchers face a variety of challenges when using time series data to estimate the demand for tobacco:

1. Key explanatory variables, such as price and income, can be highly correlated over time, making it difficult to obtain precise estimates of the independent impact of each on demand.
2. Other important determinants of demand may be difficult to measure (e.g., attitudes and norms regarding tobacco) and may be correlated with determinants for which data are available (e.g., price and tobacco control policies); omitting these difficult-to-measure variables from the demand equation can result in biased estimates for the variables of interest.
3. Using official statistics on tax-paid sales or production and trade-based measures as proxies for actual consumption may result in measurement error in the dependent variable when opportunities for tax avoidance and evasion exist. To the extent that these opportunities are not modeled and are correlated with price, this can result in upwardly biased estimates of price elasticity. Additionally, using proxies can result in measurement errors due to timing issues as these proxies precede actual consumption, with the relative error larger for data reflecting shorter periods (e.g., monthly data rather than annual data). For example, wholesalers, cigarette smokers, or retailers may stock up on cigarettes in anticipation of a tax increase, consuming or selling these cigarettes weeks or months later.
4. Observed consumption and prices result from the interaction of demand for and supply of tobacco products; failing to account for this simultaneity can bias the resulting estimates of price elasticity.

Time series methods have advanced significantly since about 1990.[2] For example, newer methods have addressed the fact that variables used in time series analyses are often following long-term trends (i.e., nonstationarity), which could result in spurious associations. However, these more sophisticated methods are complex and data-intensive, and relatively few time series analyses of tobacco demand have applied such techniques. This is particularly true for time series studies of LMICs that rely on annual data over a relatively short time period.

Relatively few significant methodological advances have occurred with respect to the analysis of pooled cross-sectional time series data. Most of these analyses have pooled data for subnational areas from the same country or region (e.g., U.S. states, Canadian provinces, or European countries) where comparable data are available on a regular basis. In recent years, comparable data have become more regularly available for an increasing number of countries, so a few such analyses have used pooled data at the country level. The most significant advance in the analysis of pooled cross-sectional time series data has been the inclusion of time- and geographic-fixed effects. Time-fixed effects control for time-varying factors that affect all locations. Geographic-fixed effects capture time-invariant and place-specific factors that are not accounted for by other variables included in the models. To the extent that these unmeasured factors are correlated with included variables, the inclusion of fixed effects in estimated models will reduce or eliminate biases from potentially omitted variables.[2] However, including fixed

effects can often make it difficult to obtain precise estimates for price and other variables of interest, especially when there is little within-location variation in these measures over time.

Analysis of Survey Data

While aggregate data are useful in understanding the overall impact of tobacco taxes and prices on tobacco use, survey data can help to explain how tobacco use is affected by changes in taxes and prices. Researchers use individual- and household-level survey data to disentangle the effects of price on decisions to consume from the impact of price on the intensity of consumption (conditional demand); that is, they distinguish between prevalence and intensity of use. With these data, researchers can assess how various subpopulations—defined by age, gender, socioeconomic status, race/ethnicity, or other characteristics—respond to changes in taxes on and prices of tobacco products. Additionally, individual-level data may be used to study the impact of price on a range of behavioral changes, including tobacco use initiation, cessation, and product switching.

Individual- and household-level data are generally collected in large cross-sectional surveys that are representative at the national or subnational level. In some countries, surveys are conducted regularly so that data from multiple waves can be pooled in analyses of tobacco demand. Less often, these data are collected at regular intervals from the same cohort of respondents, allowing researchers to conduct longitudinal analyses that can better assess the causal role of taxes, prices, and other influences on patterns of tobacco use.

Some surveys collect limited information on tobacco use as part of a larger effort (e.g., household expenditure surveys or health-focused surveys). Other surveys collect detailed information on tobacco-related knowledge, attitudes, beliefs, and use (e.g., the Tobacco Use Supplement to the Current Population Survey[62]). Beginning in 1998, global tobacco surveillance efforts have systematically collected comparable, detailed data on tobacco use (the cross-sectional Global Adult Tobacco Survey [GATS][63] and Global Youth Tobacco Survey [GYTS],[64] and the longitudinal International Tobacco Control Policy Evaluation [ITC] Project[65]), allowing researchers to pool data across countries in analyses that assess the impact of national tobacco control efforts on tobacco use.

Survey-based analyses of tobacco demand overcome some of the challenges that researchers face when working with highly aggregated data. For example, the high correlations between key determinants of demand often encountered with aggregate data (e.g., between price and income at the country level) will generally be much lower in individual-level survey data, making it easier to obtain more precise estimates of the independent effects of these factors on tobacco use. Additionally, survey data are less subject to the simultaneity biases in aggregate data that result from supply and demand jointly determining price and consumption, given that any one individual's tobacco use is too small to influence price. Survey-based measures of consumption include both licit and illicit consumption, unlike aggregate sales data that reflect licit, tax-paid sales only.

Researchers who use survey data to conduct analyses of demand face some of the same challenges that arise in aggregate data analyses, as well as challenges that are unique to survey data. Key determinants of demand, most notably exposure to tobacco company marketing efforts and underlying attitudes and norms regarding tobacco, are either not available at disaggregated levels that allow researchers to link these data to surveys based on respondents' locations, or are collected as part of the survey itself, which makes it difficult to sort out the causal relationships between these potentially endogenous variables and

demand (e.g., smokers are more likely than nonsmokers to be aware of cigarette marketing). Biases can result from the extent to which these and other key determinants of demand (e.g., sentiment toward tobacco) are omitted from the analysis but correlated with included measures (e.g., tobacco control measures).

Similar biases can result from the measure of price used in demand analyses that use survey data.[60] Prices of tobacco products that are matched to surveys based on location may not accurately reflect the prices that tobacco users encounter in that location, particularly when there are opportunities for tax avoidance and tax evasion, or when these prices do not fully reflect the price-reducing marketing activities of tobacco companies (e.g., discount coupons, two-for-one offers), which can lead to estimated price elasticities biased toward zero. The use of self-reported prices collected as part of a survey can create an endogeneity bias, because the price that a given user pays can be related to his or her tobacco use. For example, compared with light smokers, heavy smokers may be more likely to buy cigarettes by the carton, smoke less expensive brands, buy at discount outlets, engage in tax avoidance, or take advantage of price-reducing promotions. Researchers have attempted to overcome this potential endogeneity by developing average measures of price from the prices reported by individuals residing in the same geographic area, or by using instrumental variables and two-stage least-squares methods.

In addition, measurement errors that result from reporting biases may be present in the dependent variables, particularly with respect to tobacco consumption, which is often under-reported.[60] Because of the inability to address problems with under-reporting, researchers typically assume that the proportion of under-reporting is the same at different consumption levels; if this is not the case, however, resulting estimates will be biased.

Since the early 1980s, an increasing number of studies have used survey data to analyze the demand for tobacco. This is in large part because significant gains in computing power have made such analyses possible, and because high-quality survey data have become available for an increasing number of countries.

Evidence on the Impact of Tax and Price on Tobacco Use

Aggregate Demand Findings

In the 1970s, as awareness of the adverse health consequences of tobacco use began to grow, economists, statisticians, and other researchers in the United States and United Kingdom began to focus on studying tobacco demand. For example, in a series of papers extending one another's work, Sumner,[53] Atkinson and Skegg,[66] McGuinness and Cowling,[67] and others analyzed the demand for cigarettes in the United Kingdom. These studies estimated price and income elasticities, as well as how demand was affected by the 1962 release of the Royal College of Physicians report[68] on the health consequences of smoking and cigarette advertising. Price elasticity estimates from these studies varied widely, from –0.13 to –1.05, depending on the time period analyzed, type of data employed, and methods used. U.S. studies published between 1972 and 1980 by Hamilton,[51] Warner,[54] Fujii,[69] and others also focused on cigarette demand, using time series data to estimate price and income elasticities as well as the effects on consumption caused by other events, such as the 1964 Surgeon General's report[50] and other "health scares," the 1971 ban on tobacco advertising in broadcasts, and other factors. Price elasticity estimates from these early U.S. studies[51,54,69] were more consistent than those from the early studies in the United Kingdom. The price elasticities in these three studies fell in a narrower range, from –0.37 to –0.92, with most clustering around –0.5.[2]

During the 1980s and early 1990s, similar studies began to emerge from other HICs, including West Germany,[70] Australia,[71] Austria,[72] Finland,[73] Greece,[74] and New Zealand.[75,76] Meanwhile, in the United Kingdom researchers continued to update and extend earlier analyses.[77,78] These studies produced a range of price elasticity estimates that varied depending on country, time period, methods, and models. But the range of these estimates continued to narrow, with most falling between –0.2 and –0.6. In the United States, in addition to continued analysis of national time series data,[79–81] economists began to take advantage of the considerable differences in taxes and prices across states in analyses that used pooled cross-sectional time series data.[82,83] With few exceptions, estimated price elasticities from this wave of studies fell into the same –0.2 to –0.6 range.

Fewer studies have examined the impact of prices on the aggregate demand for other tobacco products, generally confirming that the use of these products is also responsive to changes in their prices. For example, the Pricing Policies and Control of Tobacco in Europe project estimated price elasticities for a variety of tobacco products—including pipe tobacco, roll-your-own tobacco, and snus—in 11 European countries where sufficient data were available. These price elasticities were in the same range as these countries' estimated price elasticities for cigarettes.[84] In contrast, recent studies of e-cigarette demand based on aggregate sales data have produced price elasticity estimates suggesting that the demand for the products is more responsive to price than cigarette demand is.[85,86] Using quarterly sales data from U.S. markets covering 2009 through 2012, Huang and colleagues[85] estimated price elasticities centered on –1.2 for disposable e-cigarettes and –1.9 for reusable e-cigarettes. Similarly, using sales data from 2011 through 2014 for six European Union (EU) countries, Stoklosa and colleagues[86] estimated that the price elasticity of e-cigarette demand was –0.82 based on static models, and up to –1.15 in the long run based on dynamic models.

A variety of methodologies were improved during this wave of research, particularly in U.S. studies. For example, several studies accounted for the interactions of supply and demand; however, estimated price elasticities from these studies tended to be quite similar to those that ignored such simultaneity.[87,88] Other studies began to model addiction more explicitly, first using a myopic addiction framework and eventually the rational addiction framework. These studies found clear evidence of intertemporal dependence between cigarette smoking and estimates of higher long-run than short-run price elasticities.[21,88,89]

Several studies that used state-level data from the United States explicitly modeled the potential for cross-border shopping and other tax avoidance and evasion tactics. These models reduced the bias often produced when using state-level data to estimate price elasticities. The resulting estimates showed the importance of interstate tax and price differentials in explaining differences in tax-paid sales; the resulting elasticity estimates were consistent with those based on national time series data, which are not subject to the same problems.[83,91] Other studies included a variety of other tobacco control measures in their analyses, including restrictions on smoking in public places and workplaces,[92] restrictions on advertising,[93,94] and tobacco control program efforts.[95,96]

As these analyses grew increasingly diverse and sophisticated, estimated price elasticities became more and more consistent. A general consensus emerged by the end of the 1990s, based largely on these aggregate demand analyses, that the short-run price elasticity of cigarette demand in HICs was approximately –0.4, with long-run elasticity about twice as high. The short run is considered the first 1 to 2 years following a tax increase; the long run is considered the period after which consumers fully adjust to the changes.

The first published study of tobacco demand in an LMIC appeared in 1990; Chapman and Richardson[57] analyzed tobacco demand in Papua New Guinea using annual time series data from 1973 to 1986. They estimated the tax elasticity of cigarettes as –0.71 and of non-cigarette tobacco as –0.50, well above price elasticity estimates from HICs. After the Chapman and Richardson study, several studies were produced in the 1990s for other LMICs, including Brazil,[97] China,[98,99] Poland,[100] South Africa,[101–103] Turkey,[104] and Zimbabwe.[105] These studies used a variety of methods and approaches; some accounted for addiction using myopic or rational addiction models.[97,101,104] All studies used annual time series data, some covering as few as 12 years.[97]

These early studies of LMICs produced a wide range of price elasticity estimates; short-run elasticities ranged from –0.11 to –0.99, and long-run elasticities ranged from –0.37 to –1.52. In general, and consistent with economic theory, most of the price elasticity estimates from this early small set of studies using aggregate data from LMICs suggested that cigarette demand in these countries was less inelastic than in HICs. By the late 1990s, a consensus had emerged that demand was about twice as sensitive to price in LMICs as in HICs.[30]

Many other aggregate demand studies were conducted in the 2000s using data from LMICs. These include studies from Argentina,[106] Bangladesh,[107,108] Bolivia,[109] Brazil,[110] Chile,[111] China,[112,113] Egypt,[114] Estonia,[115] Indonesia,[108,116] Malaysia,[117] Maldives,[108] Mexico,[118] Morocco,[119] Myanmar,[108] Nepal,[108] South Africa,[120] Sri Lanka,[108] Thailand,[108] Turkey,[121,122] Ukraine,[123] and Uruguay.[124]

Price elasticity estimates from these studies in LMICs varied widely. Short-run elasticity estimates ranged from insignificant to –2.18, and some long-run elasticity estimates were several times larger.[2] Despite this wide range, most of the estimates fell between –0.2 and –0.8, indicating that cigarette demand in LMICs is at least as responsive and often more responsive to price than in HICs. Studies from countries where at least some cigarettes were relatively affordable (e.g., Ukraine and, in recent years, China) tended to produce more price-inelastic estimates. However, studies in countries where incomes were relatively low tended to produce less price-inelastic estimates.

A small but growing number of studies published since 1990 have pooled aggregate data from a number of countries. Many of these studies focused largely on assessing the impact of bans on advertising by tobacco companies and other marketing practices, but they also estimated price elasticities. Three of these studies pooled at least two decades' worth of data from countries in the Organisation for Economic Co-operation and Development.[93,125,126] Estimates of price elasticities from these studies ranged from –0.20 to –0.55. Blecher[127] extended these analyses to include 51 low-, middle-, and high-income countries using annual data from 1990 to 2003. The estimates produced by this study were more inelastic, ranging from –0.09 to –0.13.

In summary, the number of studies based on aggregate measures of tobacco use in HICs is growing. These studies are becoming increasingly sophisticated over time, and the resulting estimates of price elasticity are remarkably consistent. Regarding the short-run price elasticities for cigarette demand, most estimates have clustered around –0.4, with the majority ranging from –0.2 to –0.6. Early studies of tobacco use in LMICs produced wide estimates of price elasticity, with most suggesting that cigarette demand in LMICs is much more responsive to price than cigarette demand in HICs. The rapid expansion of research in LMICs in recent years indicates that the range of price elasticity estimates has narrowed somewhat, with the majority of short-run price elasticity estimates falling between –0.2 and –0.8, with many clustering around –0.5. In all countries, studies that model the addictive nature of tobacco use

conclude that the long-run price elasticity of demand is greater than that estimated for the short run. Price elasticity estimates tend to be more inelastic in countries where low-priced, relatively affordable cigarettes are widely available.

Findings From Survey-Based Studies of Adult Tobacco Use

The first studies using survey-based data were published in the early 1980s by Lewit and colleagues for the United States.[128,129] A rich body of survey-based literature exists for the United States due to variation in cigarette taxes and prices subnationally (i.e., across states) and over time (more than four decades).

Lewit and Coate[129] were the first to assess the impact of price on cigarette smoking among adults using survey data, which were taken from the 1976 wave of the U.S. National Health Interview Survey (NHIS) and augmented with state-level cigarette prices. This study used a two-step approach, first estimating the effect of price on smoking prevalence and then estimating the effect of price on cigarette consumption among those who smoked. The estimated overall price elasticity of cigarette demand was –0.42, which is consistent with estimates from previous studies based on aggregate data. The study found that price influenced smoking largely by affecting smoking prevalence (elasticity of –0.26) and concluded that higher prices would also reduce cigarette consumption among those who continued to smoke (elasticity of –0.10).

During the next 10 years several additional survey-based studies of demand in adults were completed in the United States, including a few studies that modeled the addictive nature of smoking and studies that looked at taxes and demand for smokeless tobacco products.[20,130–133] In the 2000s, survey-based studies of the demand for cigarettes among adults used increasingly large samples obtained by pooling datasets from multiple waves of various nationally representative surveys.[134] For example, in constructing their sample of more than 355,000 adults, Farrelly and colleagues[135] pooled multiple waves of data from the NHIS conducted between 1976 and 1993. Using two-part methods, they estimated overall price elasticity as –0.28, for which the impact of price was split about evenly between its effects on smoking prevalence (–0.13) and conditional demand (–0.15).

Starting in the late 1990s, similar studies began to emerge from HICs other than the United States. The first were conducted in Canada and Australia,[136] which have subnational prices that vary similarly to those of the United States, followed by Italy,[137] Republic of Korea,[138] and Spain.[139–141] For example, to estimate the price elasticity of cigarette demand in Canada, Gruber and colleagues[142] used household expenditure data from eight waves of the Canadian Survey of Family Expenditure, conducted from 1982 to 1998, finding an overall price elasticity of –0.45.

The number of survey-based studies of the demand for tobacco increased from the late 1990s through the 2000s. New research continued in the United States and in other HICs for which previous studies had been done, and research also started to emerge from a few other HICs. In general, the findings from these studies were consistent with those from other HICs, and with the estimates that were obtained for these countries in studies based on aggregate data. Most of this research produced overall price elasticity estimates between –0.2 and –0.6, finding that price influenced both smoking prevalence and conditional demand. Estimates for the relative impact on prevalence and conditional demand varied, with some studies finding a greater impact on prevalence and others finding a greater impact on conditional demand. Two of these studies modeled addiction[140,141] and estimated that long-run price elasticities were

greater than short-run elasticities, which is consistent with theory and other empirical evidence. A Community Preventive Services Task Force (U.S.) review,[143] based on 116 studies from the United States and other HICs, concluded that "an intervention that increases the unit price for tobacco products by 20% would reduce overall consumption of tobacco products by 10.4%, prevalence of adult tobacco use by 3.6%, and initiation of tobacco use by young people by 8.6%."[143,p.1] The overall median price elasticity estimates were –0.37 for adults and –0.74 for youth.

The first survey-based study of adult cigarette demand in LMICs was produced in China in 1997 by Mao and Xiang.[99] These researchers used cross-sectional data on adults in China's Sichuan province, augmented with data on cigarette prices collected from local retailers. As with the early aggregate demand studies, Mao and Xiang found that cigarette demand in China was relatively responsive to price, with a larger impact on prevalence (elasticity of –0.89) than on conditional demand (elasticity of –0.18).

Survey-based studies of tobacco demand in LMICs increased rapidly, in part because of support for this type of research from such international organizations as the World Bank and WHO. Given the relative availability of different types of survey data, studies of tobacco demand in LMICs are more commonly based on measures of tobacco use constructed from household expenditure surveys than from representative surveys of adults. Using household-level data limits researchers' ability to assess the impact of price on prevalence of tobacco use because researchers cannot evaluate the effects on each household member's decision to use. This limitation likely accounts for the very small prevalence elasticities that result from these studies. However, household-level data are more useful for understanding the impact of price on tobacco consumption in households that consume.

Studies have used several methods to obtain price data. Many have used measures of price derived from self-reported expenditures and consumption or obtained from respondents as part of a survey. Other studies have used data collected from local tobacco vendors or obtained from archival sources. To reduce the previously noted bias in price elasticity estimates that can result from using price measures derived from self-reported data, several studies have averaged prices across respondents in the same geographic area and constructed a market-level price measure (e.g., Bishop et al. 2007,[144] Mao et al. 2008[145]). Others have used the Hausman test[146] or other methods to examine the endogeneity of price. Although successfully performing these tests requires instruments that may not be available, many of the studies that have used this approach have concluded that prices can be treated as exogenous (e.g., Karki et al. 2003,[147] Kyaing 2003[148]).

Estimates of price elasticity from survey-based studies of tobacco demand in LMICs vary considerably, from those that find little impact of price on either prevalence or conditional demand for cigarette smoking (e.g., in China and the Russian Federation),[149] to those that find that tobacco use is highly responsive to price (e.g., in Myanmar).[148] Some of the differences likely result from the price measure used in the study. Studies that treat self-reported prices as exogenous are more likely to estimate greater elasticity. Studies that use locally collected prices for selected brands may introduce measurement errors based on the choice of brands and the retailers from whom prices are obtained. This type of price measure may bias elasticity estimates toward zero, as Bishop and colleagues[144] suggested was the case with the price measure used by Lance and colleagues[149] in their analysis for China.

As discussed previously, it is likely that part of the difference in price elasticity can be explained by the relative affordability of cigarettes. For example, the highly price-inelastic estimates for cigarette demand among Russian men[149,150] have been attributed to the widespread availability of the very inexpensive and

highly affordable brands they smoke.[151] Similarly, rapidly rising incomes in China that have far outpaced increases in cigarette prices can help explain the increasingly price-inelastic estimates obtained in studies of cigarette demand in China such as the 2008 study by Hu and colleagues.[152] Additionally, because of the wide range of prices across brands in the Chinese market, Chinese smokers may be more likely to switch to cheaper cigarette brands in response to price increases, thereby diluting the impact of tax policies on smoking prevalence.[153,154]

From 2000 to 2014, numerous survey-based studies were conducted to assess the impact of price on the use of tobacco by adults in LMICs, including Bangladesh,[155] Bulgaria,[156] China,[144,145,149] Estonia,[115] Egypt,[157] India,[158] Indonesia,[159] Jordan,[160] Mexico,[161] Myanmar,[148,162] Nepal,[147] Poland,[163] the Russian Federation,[149,150] South Africa,[164,165] Sri Lanka,[166] Thailand,[167] Turkey,[121,168] Ukraine,[169] and Viet Nam.[170]

Price elasticity estimates from these studies vary considerably. Many, particularly those based on household expenditure surveys, found very little impact of price on smoking prevalence.[121,144,149,150,161] Other studies concluded that prevalence is quite responsive to price—for example, Kyaing's[148] estimate of –1.28 for Myanmar and Van Kinh and colleagues'[170] estimate of –0.94 for men in Viet Nam. Similar variability exists in the estimates of the price elasticity of conditional demand, with some finding little impact,[145,149,150] and others concluding that consumption among those who use tobacco is relatively responsive to price—for example, John's[158] estimates of the price elasticity of conditional demand for bidis (–0.91) and tobacco leaf (–0.87) in India. In general, the estimates for overall price elasticity vary, and most range from –0.2 to –0.8—that is, the same range that encompasses most of the estimates obtained for overall demand from studies in LMICs based on aggregate data.

Using GATS cross-country data from approximately 200,000 participants, Kostova and colleagues[171] estimated a total price elasticity of cigarette demand in LMICs at approximately −0.53. Higher prices were associated with lower demand across countries in terms of both smoking prevalence and daily number of cigarettes smoked among smokers, even after controlling for a number of country characteristics. Thus, while patterns of tobacco use may differ across countries, these results suggest that the relationship between price and smoking prevalence holds across different cultural and policy environments.

Taxes/Prices and Cessation

A small number of studies, nearly all from HICs, have looked at the impact of taxes and prices on smoking cessation. Several studies constructed respondents' smoking histories using data from cross-sectional surveys that asked about past cigarette use; these data were then matched to price data from each respondent's location. This approach can introduce measurement errors in the dependent variable (due to errors in recall about the timing of cessation) and in the price variable (due to potential mismatching of prices for individuals who changed locations between cessation and the time of the survey). Douglas[172] was the first to follow this approach, applying ordered probit, split-sample duration methods to data from the 1987 U.S. NHIS in a rational addiction framework. This study found that (a) the price elasticity of smoking duration was about –1.0, implying that a 10% permanent price increase would reduce the length of time an individual smoked by about 10%, and (b) the probability of quitting in response to price increases rose with the duration of smoking.

Since 2000, a few studies using cross-sectional data with retrospective information to examine the impact of price on smoking cessation have been conducted in the United Kingdom,[173] Spain,[174] France,[175] and the United States.[61,176] These studies produce similar evidence that higher cigarette prices increase the likelihood of smoking cessation.

Only a few studies have used longitudinal data to examine the impact of taxes and prices on cessation, but these findings provide similar evidence that higher prices increase the likelihood of smoking cessation.[177,178] Tauras and Chaloupka[179] used longitudinal data from the Monitoring the Future cohorts with baseline surveys from 1976 to 1993 and biennial follow-ups through 1995; they estimated cessation elasticities between survey waves of 0.34 and 1.00 for women and 0.27 and 1.30 for men in the mostly young adult sample, implying that a 10% increase in price reduced the likelihood that a smoker was smoking 2 years later by between 3.4% and 10% for female smokers and between 2.7% and 13% for male smokers. Additionally, Hyland and colleagues,[180] using data from the first two waves of the ITC Survey for the United States, United Kingdom, Canada, and Australia, found that smokers who purchased cigarettes from low-tax or untaxed sources were less likely to make a quit attempt or to have successfully quit between waves of data collection. Further analyses, using three waves of ITC data from the United States and Canada found that smokers living in areas with higher cigarette prices and taxes are significantly more motivated to quit; the study also found suggestive evidence that further price increases over time increase quit motivation and the likelihood of actual quitting.[181]

To date, few studies have looked at the impact of prices on cessation of tobacco use in LMICs. A recent review using GATS data from 14 countries, primarily LMICs, examined the association between the probability of being a recent quitter and several tobacco control policy factors, including exposure to warning labels, worksite smoking bans, anti-smoking media messaging, tobacco marketing, and current cigarette and bidi prices.[182] After accounting for country-specific attributes in pooled analyses, they found that higher cigarette prices were associated with a higher probability of quit attempts, and higher bidi prices were associated with higher probabilities of both quitting and quit attempts in South-East Asian countries where bidi use is common. The strength of the impact of these policy factors on cessation varied across countries and policies.

Ross and colleagues[183] analyzed the impact of changes in cigarette excise taxes on smoking cessation rates with data from three neighboring Eastern European countries (the Russian Federation, Poland, and Ukraine) during the 1990s and 2000s. They estimated that a 10% increase in cigarette taxes increased the probability of smoking cessation among smokers by 1.6% to 2.3%.

Differences by Gender

A few studies of cigarette demand have examined the impact of taxes and prices on tobacco use in relation to gender. In some countries, men and women may respond differently to price because of differences in life stages or gender-related characteristics. For example, smoking among women often increases as women enter the labor force in greater numbers and begin to earn their own incomes. As a result, cigarettes become more affordable to them, and gender differences in response to price may become less pronounced.[184] Alternatively, to the extent that women are more weight conscious than men and may see smoking as a weight control mechanism, women could be less sensitive to price than men.[185]

Research estimating gender differences in the price elasticity of adult tobacco use in HICs has produced mixed evidence.[135,186] Some studies have found that men are more responsive to price than women. Chaloupka[187] estimated that the long-run price elasticity of cigarette demand for men centered around –0.60, while demand among women was unresponsive to cigarette prices. Other studies found the opposite: Aristei and Pieroni[137] estimated conditional demand elasticities of –0.13 for Italian men and –0.65 for Italian women. Still other studies—for example, in France[175] and Spain[174]—found little difference by gender.

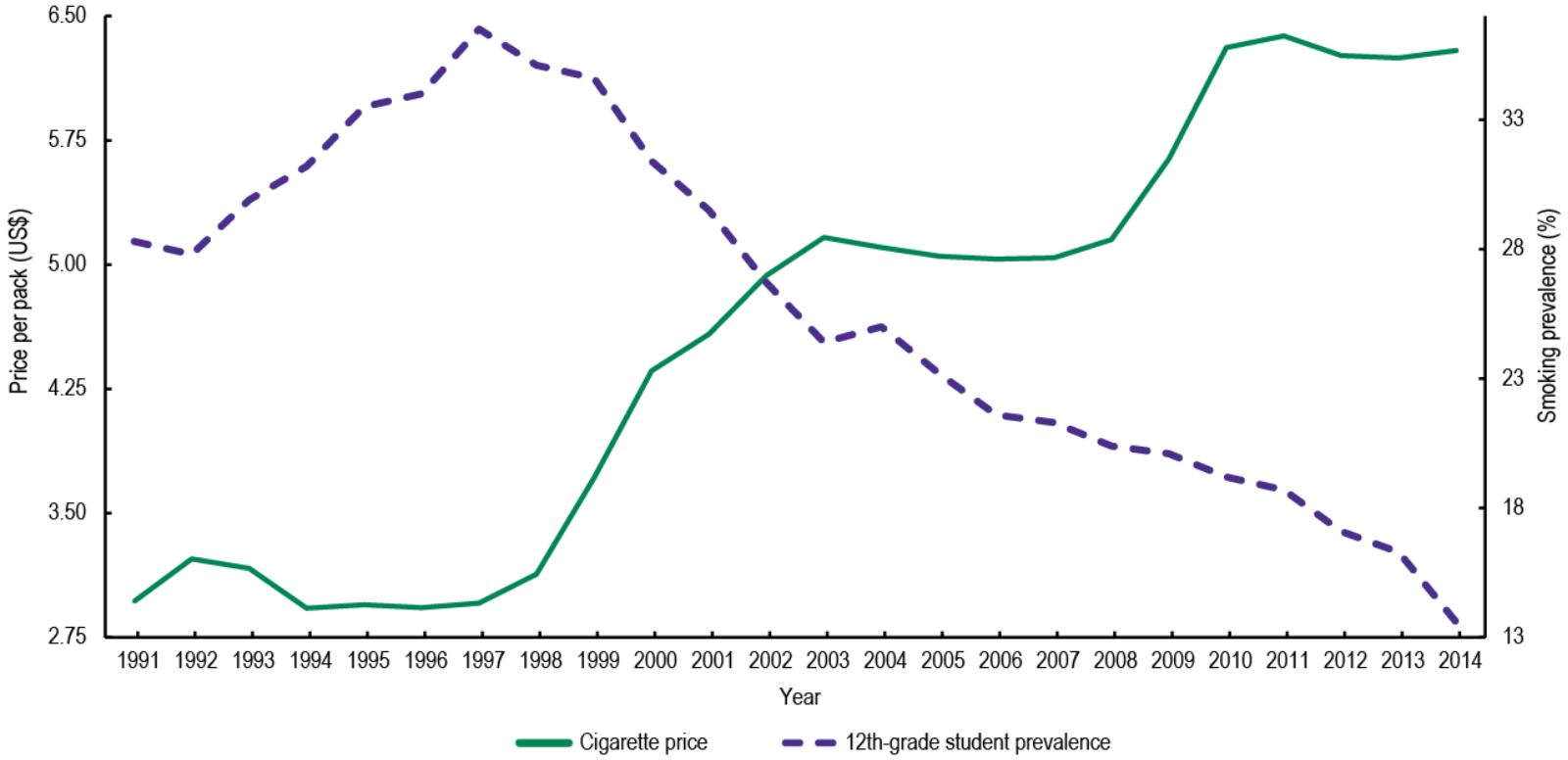
Almost no demand studies from LMICs have examined gender differences in the price elasticity of tobacco use, in part because research in these countries relies greatly on household expenditure survey data and thus is unable to examine data separately for men and women. The few existing analyses have not yielded a clear pattern. For example, Ogloblin and Brock[150] found that smoking prevalence among Russian women was much more responsive to price than smoking prevalence among Russian men (elasticities of –0.63 and –0.08, respectively). Ross and colleagues[151] attributed this finding to differences in brand choices by gender, because men tend to smoke inexpensive local brands, and women are most likely to view smoking as a luxury and tend to smoke expensive foreign brands.

Differences by Age Group

Economic theory suggests several reasons why young people are likely to be more responsive than adults to changes in tobacco product prices.[128,188,189] Young tobacco users are likely to spend a greater share of their limited disposable income on tobacco products and therefore may be more sensitive to price than adult tobacco users. Compared with adults, youth are more influenced by the behavior of their peers. Thus, changes in tobacco use by some youth as a result of changes in prices will lead to changes in tobacco use by other young people. Furthermore, because of their relatively shorter time consuming tobacco products, young people may be less addicted to tobacco than adults, suggesting that youth will respond more quickly to changes in price. Similarly, young people are generally more present-oriented than adults, implying that they will respond more to changes in the immediate cost of tobacco use (e.g., prices) than to changes in long-term costs (e.g., health consequences).

Since 1990, an extensive evidence base has accumulated on the effects of taxes and prices on tobacco use among youth. Much of the data comes from HICs, but the availability of data from the GYTS has led to comparable studies in LMICs.[190] Much of the research on youth demand for tobacco products has been conducted in the United States because of the considerable variation in taxes and prices between different states and the availability of survey data on youth tobacco use. In addition to variations in state and local taxes, the tobacco industry twice induced substantial changes in prices in the 1990s. In April 1993, Philip Morris initiated “Marlboro Friday,” cutting the price of cigarettes by approximately 25% in response to competition from generic brand cigarettes. Later that month, other tobacco companies followed suit, cutting the price of their premium cigarettes. In late 1998, tobacco companies significantly increased prices in response to the adoption of the Master Settlement Agreement (MSA).[58] As suggested by Figure 4.6, cigarette tax and price changes have significantly influenced youth smoking in the United States.

Figure 4.6 Inflation-Adjusted Cigarette Prices and Prevalence of Youth Smoking in the United States, 1991–2014



Note: Currency adjusted for inflation using a 2014 base.
Sources: Johnston et al. 2016.[253] Orzechowski and Walker 2014.[254]

Lewit and colleagues[128] were the first to assess the impact of cigarette prices on smoking by U.S. youth. Using data from the nationally representative 1966–1970 National Health and Nutrition Examination Survey (Cycle III), this study estimated an overall price elasticity of –1.44. The strongest impact of price was seen on prevalence, for which the price elasticity was estimated to be –1.20; the price elasticity for consumption among young smokers was –0.25. These estimates were more elastic than those found by Lewit and Coate[129] in a study of adult cigarette demand.

Since the early 1990s, many studies based on U.S. cross-sectional data have confirmed Lewit and colleagues' 1981 conclusion[191] that youth smoking is more responsive to price than adult smoking. For example, using data from the 1992–1994 Monitoring the Future surveys, Chaloupka and Grossman[192] estimated an overall price elasticity of –1.31 for youth smoking. In a later study with similar findings, Lewit and colleagues[191] examined the impact of cigarette prices on youth smoking prevalence and intentions to smoke. Data for this study came from cross-sectional surveys of 9th-grade students in 1990 and 1992 from the 22 U.S. and Canadian sites in the Community Intervention Trial for Smoking Cessation. This study estimated that the price elasticity of youth smoking prevalence was –0.87, and the price elasticity of intentions to smoke by nonsmoking youth was –0.95. These results indicate that youth are somewhat more sensitive to price than adults.

Similarly, Gruber and Zinman[193] found consistent evidence that youth smoking responds to changes in cigarette prices, particularly among older youth. Using data from a variety of U.S. surveys and estimates from fixed-effects models for high school seniors, the study estimated a prevalence elasticity of –0.67, which is three to four times higher than comparable estimates for adults. The study also concluded that the decline in the price of cigarettes between 1991 and 1997 explained 26% of the rise in smoking among high school seniors over this period. Likewise, Tauras and colleagues,[194] using data from the 1997 National Longitudinal Surveys of Youth baseline and annual follow-up data through 2001, found the overall price elasticity of youth smoking to be –0.83, about double the consensus elasticity estimate for adult cigarette demand.

Other studies of cigarette demand among U.S. youth have produced similar findings,[195] and studies of other tobacco use by U.S. youth have found that use of smokeless tobacco by youth is also responsive to price.[196,197] Because of the very low prevalence of smokeless tobacco use among girls, these studies have focused on use of smokeless products by boys. In one study using data from the 1992–1994 Monitoring the Future surveys, Chaloupka and colleagues[196] estimated prevalence elasticities of –0.35 to –0.52 for smokeless tobacco use among 8th-, 10th-, and 12th-grade boys. In another study, using data from the Youth Risk Behavior Surveys of 1995 through 2001, Tauras and colleagues[197] estimated tax elasticities that ranged from –0.12 to –0.20 (for prevalence of smokeless tobacco use) and from –0.04 to –0.08 (for intensity of smokeless tobacco use) among high school boys. Price elasticities were larger than tax elasticities because smokeless tobacco taxes account for a modest share of prices.

Several studies conducted in the United States during the 1990s and 2000s assessed the impact of price on smoking behavior by age group. In general, studies found that cigarette demand becomes more price-inelastic among older age groups.[135,198] Canadian studies of youth cigarette demand have reached similar conclusions.[199] Youth smoking prevalence in Canada had been falling steadily in the early 1990s, but 1994 tax cuts led to a significant rise in the prevalence of youth smoking, and subsequent price increases led to reductions in prevalence.[200]

Several U.S. studies have investigated the differential impact of price on youth at different stages of smoking uptake.[201,202] After finding that cigarette demand was more price sensitive among older adolescents than younger adolescents, Gruber and Zinman[193] concluded that price has a greater impact on regular smoking than on early experimentation with smoking. Similarly, Ross and colleagues,[203] using a nationally representative survey of high school students in 1996, found that price had the greatest impact on progression to later stages of uptake. The authors suggest that smokers at earlier stages (trying, experimentation) are smoking few cigarettes and are likely to rely on social sources for those cigarettes. As they progress toward regular smoking, they begin to buy their own cigarettes, become more aware of prices, and consequently become more sensitive to price. Similarly, Slater and colleagues[204] found that price-reducing promotions for cigarettes had little impact on early stages of uptake but were strongly associated with progression beyond experimentation and into more regular and established smoking.

However, the evidence for a relationship between price and youth smoking initiation is mixed.[2] Several studies have used retrospective data to assess price and initiation in various countries, including Australia,[205] France,[175,206] Spain,[174] Germany,[207] the United States,[172,208] and the United Kingdom.[173] These findings may be limited due to measurement problems inherent in using retrospective data and because of lack of variation in price over many years. A recent review cited methodological limitations in studies of the impact of cigarette prices on smoking onset.[209]

A few U.S.-based studies have used longitudinal data to assess smoking among youth as they move from adolescence to adulthood. Some earlier studies yielded mixed findings,[210,211] possibly because few changes in cigarette taxes occurred during the 1980s. Later studies using data from the 1990s did find that price had an impact on initiation. For example, as part of the Monitoring the Future project, Tauras and colleagues[212] followed several cohorts of 8th-grade and 10th-grade students throughout the 1990s, a decade of substantial U.S. cigarette price changes (the "Marlboro Friday" price reductions and the 1998 post-MSA price increases) and state and federal tax increases. These researchers found that cigarette prices significantly influenced smoking initiation. Price may impact youth differently by gender.

As Cawley and colleagues[185,213] conclude, smoking initiation among adolescent girls is significantly influenced by weight-related factors (e.g., self-described overweight, body mass index, reports of trying to lose weight), while smoking initiation among adolescent boys is significantly affected by cigarette prices, with neither factor being significant for the opposite gender.[185,213] For boys, Cawley and colleagues[185] found that price had a greater impact on the initiation of more regular smoking, estimating elasticities of –0.86 for any smoking initiation, and –1.49 for initiation of frequent smoking. However, for girls, Cawley and colleagues[213] found a price elasticity of initiation of –0.24 compared to –1.2 for boys. These findings suggest that gender-specific differences in the impact of price may account for the mixed findings about price and initiation from previous studies.

There are a variety of mechanisms through which price might have a greater impact on youth smoking than on smoking by adults. For example, higher cigarette prices may indirectly influence youth smoking by reducing parental modeling of smoking and by reducing cigarette availability to youth who might sneak cigarettes from their parents.[188] A few other studies conducted in the United States during the 2000s explored some of the factors that may explain why youth smoking would be more responsive to price than adult smoking. Powell and colleagues[214] examined the role that peer influence plays in responsiveness to price, using data from the 1996 Study of Smoking and Tobacco Use Among Young People. In controlling for peer influence, the study estimated a price elasticity for youth smoking

prevalence of –0.32, compared with a price elasticity of –0.50 found by models that do not account for peer influences. The difference—an elasticity of –0.18—represents the indirect effect of price that works through peers, or the "social multiplier" effect, suggesting that peer influences account for more than one-third of the overall impact of price on the prevalence of youth smoking.[214]

In another analysis of these data, Ross and colleagues[215] looked at other mechanisms through which changes in prices could influence youth smoking. In response to survey questions about their anticipated reaction to alternative price increases, young people indicated that higher prices would make them less likely to smoke in the future and would lead to reductions in cigarette consumption among those who continued to smoke, with larger effects for larger price increases. In addition, 60% of future smokers indicated that they would be less likely to share cigarettes with their friends if prices increased. Other studies have found that while higher prices significantly reduce smoking among buyers, they have less impact on borrowers (those who get cigarettes from friends), possibly because price has more impact on youth at later stages of the smoking uptake process, when they are more likely to be purchasing their own cigarettes.[215,216]

As of 2015, relatively little research has been conducted on the differential impact of taxes and prices by age in LMICs, in large part because of the lack of good data on youth tobacco use and tobacco product taxes and prices. Early studies used household expenditure survey data to examine differences in price elasticity by age. More recent studies are based on data from the GYTS.

Van Walbeek[44] compared trends in smoking prevalence by age in South Africa, using data from the national, repeated cross-sectional All Media and Products Survey for 1993–2003, a period during which the inflation-adjusted price of cigarettes more than doubled. This price increase was due largely to a series of tax increases and coincided with significant reductions in smoking prevalence among all age groups, but the largest reduction occurred among people ages 16–24 years. In another analysis using data from GYTS surveys conducted in 1999 and 2002 in South Africa, van Walbeek[43] found a significant drop in the prevalence of youth smoking (from 23% in 1999 to 18.5% in 2002), and an even larger drop in the prevalence of frequent youth smoking (from 10.1% in 1999 to 5.8% in 2002). These findings are consistent with evidence from the United States that price impacts regular youth smoking more than it does youth experimentation.[193,216] However, van Walbeek's analysis controlled for other determinants of demand, making it difficult to quantify how much of the declines in prevalence can be attributed to the increases in cigarette taxes and prices.

Other studies, which used household data, have generally found that younger smokers are more responsive to price than older smokers, and that demand becomes less elastic with age. Such findings have been reported from Ukraine,[169] Thailand,[167] Nepal,[147] Myanmar,[148] and Viet Nam.[217]

Several studies have used data from the GYTS to estimate the impact of price on tobacco use among youth. For some countries the surveys include questions on cigarette prices, relying on the respondents' own self-reports for the information. Self-reported price information can have an endogeneity bias, as discussed earlier, meaning that heavier smokers are more likely to seek out less expensive cigarettes, which could account for part of the estimated effect of price on smokers' cigarette consumption. For this reason, economic analyses of GYTS data have generally used self-reported prices to produce aggregated measures of price, usually at the school level. Ross[218] was the first to conduct an economic analysis of GYTS data, using data from 1999 for Kiev, Ukraine. Estimated price elasticities for smoking prevalence in this study ranged from –0.29 to –0.51, but estimated price elasticities for conditional cigarette demand

were considerably higher, ranging from –1.42 to –1.83. Ross[219] used data from the 1999 GYTS to conduct a similar economic analysis of tobacco use by youth in Moscow. Using a school-level measure of price, prevalence elasticities ranged from –0.47 to –0.51, and conditional demand elasticities ranged from –0.32 to –0.69. With an average elasticity of –1.15, these estimates are well above the demand elasticities found by the limited number of studies on adult smoking in the Russian Federation.[149,150]

Joseph and Chaloupka[220] used GYTS data to estimate the price elasticity of demand for cigarettes, bidis, and gutka among youth in India. Focusing on data collected in 26 of 28 states and 2 of 7 union territories between 2000 and 2004, they found that bidis have the highest price elasticity (–2.70), followed by gutka (–0.58) and cigarettes (–0.40).[220] The authors also found that girls were more responsive to price increases than boys, possibly because of tighter constraints on their spending.

At least two studies have used pooled data from multiple waves of the GYTS from many countries, matched to prices from the Economist Intelligence Unit's World Cost of Living Survey by country and year, to estimate the impact of cigarette prices on youth smoking. Kostova and colleagues,[221] using data from 20 countries, found an estimated prevalence elasticity of –0.63 and a conditional demand elasticity of –1.2. Nikaj and Chaloupka,[222] using data from 38 countries, estimated a total price elasticity of –1.5 for the entire sample, including some HICs, and –2.2 when they limited their sample to LMICs only, suggesting that youth in poorer countries are more sensitive to cigarette price changes than youth globally.

Tax, Price, and Tobacco Use: Other Key Findings

Many studies based on both aggregate and survey data have assessed the impact of tobacco taxes and prices on a variety of other outcomes. For example, several studies have considered the impact of relative prices on product and brand choices, individuals' tax avoidance, and other aspects of purchasing behavior. Some studies have looked at the role of tax and price differentials in larger scale tax evasion. Other studies have examined the impact of tobacco taxes and prices on: (a) health-related outcomes, from exposure to SHS to death and disease caused by tobacco use, (b) other substance use, such as alcohol consumption and marijuana smoking, (c) other household spending, particularly in poor households, and (d) employment. Several studies have assessed the impact of higher taxes on the revenues that governments receive from those taxes.

This section briefly reviews findings from studies that look at the impact of tobacco taxes and prices on substitution among tobacco products, other substance use, and health outcomes. Other chapters of this monograph explore other outcomes in more detail: revenues in chapter 5, tax avoidance and tax evasion in chapter 14, employment impact in chapter 15, and impacts on household spending in chapter 16. Chapter 16 also addresses differences in price elasticity by socioeconomic status.

Relative Prices and Substitution Among Tobacco Products

Several studies from HICs have examined the impact of changes in the relative prices of tobacco products on substitution among these products. In general, these studies have concluded that increases in the price of one tobacco product relative to the prices of other products will reduce the use of products that are now more expensive and lead to an increase in use of products whose relative prices have fallen. Evidence from LMICs is mixed, likely reflecting cultural factors associated with the use of different products. The small number of studies that have examined how changes in prices influence brand choice have nearly all come from HICs. Generally, these studies have concluded that changes in the relative

prices of different brands lead smokers to substitute with brands whose relative prices have fallen, and that overall increases in taxes and prices lead to other forms of compensation among continuing smokers.

In an analysis of aggregate demand for cigarettes, cigars, and pipe tobacco in Finland, Pekurinen[73] found that an increase in the price of one product, holding other prices constant, results in some substitution with the other two products. Similarly, in analyses of adult cigarette and smokeless tobacco use based on U.S. survey data, Ohsfeldt and colleagues[131–133] consistently found that higher cigarette taxes led some adult smokers to substitute with smokeless tobacco products, but found little evidence that higher taxes on smokeless tobacco products led to substitution with cigarettes. In contrast, Tauras and colleagues[197] found that higher cigarette prices led to reductions in use of both cigarettes and smokeless tobacco only among high school boys in the United States. Taurus and colleagues analyzed an adolescent population that was in its early stages of uptake and experimentation with multiple tobacco products; this may help explain why their findings differ from those of Ohsfeldt and colleagues. Early studies have produced mixed results of the impact of cigarette and other tobacco product prices on the demand for electronic nicotine delivery systems (ENDS) (battery-powered devices designed to heat a liquid, which typically contains nicotine, into an aerosol for inhalation by the user). The mixed evidence for substitution between ENDS and other tobacco products is likely due to the rapid evolution of the ENDS market during the periods covered by these studies.[85,86]

Mixed evidence also results from the few studies that have estimated cross-price effects in LMICs. For example, Chapman and Richardson[57] analyzed aggregate data from Papua New Guinea and concluded that changes in the relative taxes on cigarettes and non-cigarette tobacco result in significant substitution between the two. A study in Viet Nam by Laxminarayan and Deololikar[217] produced similar findings. Using household survey data, this study found evidence of substitution between cigarettes and rustic tobacco, with higher cigarette prices leading to increased use of rustic tobacco, but not the reverse. In contrast, John's[158] analysis of household survey data on tobacco use in India found little evidence that changes in relative prices result in substitution between cigarettes, bidis, and leaf tobacco. This study's positive but largely insignificant cross-price elasticity estimates suggest that these products are complements in India.

A few studies have examined how changes in relative prices affect substitution among brands. For example, Tauras and colleagues,[223] analyzing scanner-based cigarette sales data, found that changes in the relative prices of premium, discount, and deep discount cigarette brands in the United States accounted for much of the observed changes in the market shares for the three price tiers. Similarly, White and colleagues[153] found that changes in the relative prices of cigarettes among brands in different price tiers led Chinese smokers to switch brands, with the greatest impact on smokers of less expensive brands.

A few studies have found that higher taxes lead to compensating behaviors among some continuing smokers that may reduce the public health impact of higher taxes. For example, two studies conducted in the United States concluded that higher taxes and prices lead some smokers to switch to longer cigarettes and brands that are higher in (machine-measured) tar and nicotine in an effort to maintain nicotine levels even as they reduce their daily consumption.[224,225]

Tobacco Product Prices and Other Substance Use

A few studies have examined the impact of tobacco product taxes and prices on the use of other substances, including alcohol and marijuana (cannabis). In general, these studies have found evidence of complementarity between tobacco use and other substances, with higher prices for one substance leading to reductions in consumption of both substances. However, some studies find evidence of substitution, with higher prices for one substance leading consumers to substitute use of another.

Jones[226] analyzed aggregate expenditure data for tobacco and four categories of alcoholic beverages in the United Kingdom and found that tobacco is a complement for each category. Bask and Melkersson[227] reached the same conclusion based on their analysis of aggregate sales data in Sweden, as did Jimenez and Labeaga[228] in their analysis of household expenditure survey data in Spain. Cameron and Williams[136] and Zhao and Harris,[229] in analyses of individual-level survey data from the Australian National Drug Strategy Household Surveys, had similar results—namely, that higher tobacco and alcohol prices reduce consumption of both tobacco and alcohol. Guindon and colleagues,[230] using household expenditure survey data from India, found some suggestive evidence of substitutability between cigarettes, bidis, and a locally made liquor among urban households.

Evidence of complementarity is mixed when examining U.S. data on adults. Goel and Morey[231] concluded that alcohol and cigarettes are substitutes for one another, based on an analysis of pooled cross-sectional time series data on state-level sales. Decker and Schwartz[232] analyzed individual-level adult survey data from the Behavioral Risk Factor Surveillance System and found mixed results: Higher alcohol prices were associated with reduced smoking (indicating complementarity), but higher cigarette prices were associated with increased drinking (suggesting substitutability). Picone and colleagues'[233] analysis of longitudinal data from the first six waves of the Health and Retirement Survey found that stronger smoke-free policies reduce drinking, but that higher cigarette prices lead to increased alcohol consumption, and higher alcohol prices increase cigarette consumption for both men and women.

Studies of U.S. youth have also produced mixed evidence. Pacula[234] used data from the 1983 and 1984 waves of the 1979 National Longitudinal Survey of Youth to model the uptake of tobacco, alcohol, and marijuana use among young people. This study found that higher past cigarette prices lead to increased current alcohol consumption, suggesting that cigarettes and alcohol are economic substitutes. In contrast, Dee[235] analyzed teen smoking and drinking using state-level aggregated data from the 1977–1992 Monitoring the Future surveys of high school seniors. This researcher concluded that cigarettes and alcohol are economic complements, with stronger alcohol control policies reducing the prevalence of youth smoking, and higher cigarette taxes reducing the prevalence of youth drinking. Markowitz and Tauras[236] used data from the 1997 National Longitudinal Survey of Youth and its annual follow-up surveys through 2001 to examine the relationships between youth smoking and drinking and the consumption of other goods. This study found mixed evidence for relationships between youth smoking, drinking, and drug use, with alcohol and marijuana complements for smoking, but smoking substituting for alcohol and marijuana.

A few studies from Australia and the United States have considered the relationships between cigarette taxes and prices and marijuana use. These studies have consistently found that cigarette and marijuana smoking are complements. For example, in analyses of survey data from Australia, Cameron and Williams[136] and Zhao and Harris[229] found that a higher cigarette price reduces both cigarette and marijuana smoking. Chaloupka and colleagues[237] reached the same conclusion in an analysis of data on

U.S. youth from the Monitoring the Future surveys. This study found that higher cigarette prices are associated with reduced frequency of marijuana use, and that there was a negative, but not significant, association between cigarette prices and the prevalence of youth marijuana use. Similarly, Farrelly and colleagues[238] analyzed data from the U.S. National Household Surveys on Drug Abuse for youth ages 12–20 years and found that higher cigarette taxes reduce the intensity of youth marijuana use. Some evidence from their study indicates that higher cigarette taxes also lower the probability that young males will use marijuana.

Pacula's[234,239] analyses of data from the 1979 National Longitudinal Survey of Youth further supported conclusions that cigarettes and marijuana are economic complements for young people in the United States. In models based on the 1984 data that examined contemporaneous associations, these studies reported that youth marijuana use was lower in states with higher cigarette taxes, but these estimates were not statistically significant.[239] In a further analysis that considered the onset of addiction and used the 1983 and 1984 data, Pacula[234] found that higher past and current cigarette prices significantly reduced current youth marijuana use. Similarly, an analysis by Markowitz and Tauras[236] of the 1997 National Longitudinal Survey of Youth produced generally significant negative estimates for the effect of higher fines for marijuana use on the prevalence of youth smoking.

Tobacco Product Prices and Health-Related Outcomes

A few studies have directly assessed the impact of tobacco taxes and prices on the health consequences of tobacco use. Not surprisingly, these studies find that higher tobacco taxes and prices would reduce the incidence of disease and mortality caused by tobacco use. This research, based entirely on U.S. data, is briefly reviewed below.

Moore[240] examined the impact of cigarette taxes on death rates from diseases attributable to tobacco use, using pooled cross-sectional time series data for U.S. states from 1954 to 1988. This study estimated that a 10% increase in cigarette taxes would reduce the number of premature deaths caused by smoking in the United States by 6,000 per year.

Many studies have found that higher cigarette taxes and prices significantly reduce the prevalence of smoking among pregnant women.[241–243] Because of the serious adverse health consequences of smoking during pregnancy, these findings imply that tax- and price-induced reductions in maternal smoking would significantly improve birth outcomes. For example, Evans and Ringel[242] estimated that a US$ 1.10 tax increase would reduce smoking prevalence among pregnant women by 32% and, as a result, would reduce the probability of giving birth to a low birth weight baby by 5%.

To examine the impact of cigarette taxes on exposure to secondhand smoke, Adda and Cornaglia[244] analyzed data from the U.S. National Health and Nutrition Examination Survey (the 1988–1994 and 1999–2006 waves) on cotinine levels in body fluids. These researchers found that higher cigarette taxes are associated with reduced cotinine levels in nonsmokers, especially children, and conclude that excise taxes are an effective way to reduce nonsmokers' SHS exposure. In another study, Markowitz[245] analyzed annual state-level data on the number of sudden infant death syndrome cases from 1973 through 2003. Estimated cigarette price elasticities of deaths from sudden infant death syndrome ranged from –0.69 to –0.76, suggesting that increases in cigarette taxes would have a significantly positive impact on infant health.

Finally, a few studies have found some evidence that higher cigarette taxes have contributed to higher obesity rates in the United States, but this evidence is inconsistent.[246–248]

Using Price Elasticity Estimates to Project the Future Impact of Tobacco Tax Increases

The price elasticity estimates described in this section have been used to develop projections of the public health and fiscal impacts of tobacco tax increases. For example, in the United States, the American Cancer Society's Cancer Action Network (ACS-CAN)[249] has used estimates of the price elasticities of cigarette demand, adult prevalence, and youth prevalence, along with other information, to project the effect of a US$ 1.00-per-pack increase in each state's cigarette tax on the number of adults who would quit smoking, the number of youth who would not initiate smoking, tax-paid cigarette sales and cigarette excise tax revenues, the health care costs of treating various consequences of smoking, and state Medicaid spending on health care to treat the diseases caused by smoking. This study estimated that a US$ 1.00 increase in the cigarette tax of every U.S. state would induce 1.4 million adults to quit, deter 1.69 million youth from starting to smoke, avert 1.32 million smoking-related deaths, and save more than US$ 645 million in health care costs over 5 years.

Similarly, country-specific and regional or global estimates of various cigarette price elasticities were used to estimate the public health and revenue impact of tax increases in China, India, Mexico, Turkey, and several other countries for a series of reports by the Bloomberg Global Initiative to Reduce Tobacco Use.[250]

These and other projections generally start with the overall price elasticity of cigarette demand, typically obtained from econometric estimates based on tax-paid cigarette sales data, and assume that the tax increase being modeled will be fully passed on to consumers in the price paid for cigarettes. For example, if a state's average cigarette price is US$ 5.00 per pack, the current state tax is US$ 1.00 per pack, and 1 million tax-paid packs of cigarettes are sold in the state (generating US$ 1 million in tax revenues), a simple projection of the sales and revenue impact of a US$ 1.00 tax increase, assuming an overall elasticity of –0.4, would have prices rising by 20% (from US$ 5.00 to US$ 6.00 per pack), sales falling by 8% (to 920,000 packs), and cigarette excise tax revenues rising by 84% (from US$ 1 million to US$ 1.84 million).[249]

Many projections allow for increased tax avoidance and evasion in response to a tax increase and employ a less inelastic estimate of elasticity. For example, the ACS-CAN[249] projection used an elasticity of –1.0 for tax-paid cigarette sales, allowing for considerable tax avoidance and evasion in response to a given state's tax increase. In the example above, this would lead to a 20% reduction in sales and a 60% increase in revenues. It is also important to use both adult and youth prevalence elasticities in projecting the public health impact of a cigarette tax increase because youth and adults are not equally price sensitive.

Similarly, adult and youth prevalence elasticities are used in projecting the public health impact of a cigarette tax increase. Given the available estimates, many of these projections assume that the impact on adult prevalence is half of the overall elasticity and that youth uptake of tobacco use is two to three times as responsive to price. When projecting the impact on youth, these projection models often assume that young people will take up smoking at the same rate as adults or young adults have. Continuing the example above, if the state has one million adults and adult smoking prevalence is 20% (200,000 adult smokers), the US$ 1.00 tax increase will reduce the prevalence of adult smoking by 4%, or induce

8,000 adult smokers to quit smoking. If there are 500,000 young people in the state, and it is assumed that they will take up smoking at the same rate as adults have and youth smoking is twice as sensitive to price, then the US$ 1.00 tax increase maintained over time in real terms will prevent 8,000 young people from taking up smoking.

These simple projection models also may model the impact of a tax increase on deaths caused by smoking. These models make some basic assumptions about the fraction of lifelong smokers who will die prematurely from a disease caused by smoking (a typical assumption is 50%, based on the epidemiological evidence) and the fraction of quitters who, by quitting, will avoid a premature death caused by smoking (often assumed to be around 70%, again based on the epidemiological evidence). In the example above, the reduction in deaths among adult smokers would be 2,800 (4,000 of the quitters would have died from a disease caused by smoking, and 70% of these would have avoided a premature death by quitting), and the reduction in deaths among young people prevented from taking up smoking would be 4,000 (half as many as those who would have otherwise taken up smoking and died prematurely as a result).

A study published in 2016 modeled the global cigarette market, using 2014 data for 181 countries, to quantify the impact of raising the cigarette excise tax in each country by PPP$ 1 per pack (roughly US$ 0.80 per pack).[251] The study found that such a tax increase would increase the amount of cigarette excise revenue generated throughout the world by 47% from PPP$ 402 billion (US$ 328 billion) to PPP$ 593 billion (US$ 470 billion), producing an extra PPP$ 190 billion (US$ 141 billion) in revenue. Using the 2014 data, the prevalence rate of daily adult cigarette smoking worldwide would decrease from 14.1% (740 million smokers) to 12.9% (674 million smokers), for a relative decrease of 9%, or 66 million fewer smokers globally. The expected number of smoking-attributable deaths from among the world's adult population would decrease by 15 million, reflecting a decline of about 6% in smoking-related mortality among this cohort.[251]

While relatively simple, these types of projections have proven to be very helpful in illustrating the public health and revenue benefits of tobacco tax increases. More sophisticated models incorporate more detailed epidemiologic, economic, and other evidence and produce more refined, but similar, projections.

Summary

Failures in the markets for tobacco products, including consumers' imperfect information about the health harms of tobacco use and the health and financial impacts of tobacco use, provide an economic rationale for governments to reduce tobacco use through economic interventions such as higher taxes on tobacco products and other tobacco control policies. Excise taxes on tobacco products are the most direct policy for influencing cigarette and other tobacco product prices. The total tax burden on tobacco products is defined as the sum of all taxes on the product expressed as a percentage of the retail price, and there is a close correlation between the tax burden on tobacco and the price of tobacco products, particularly in countries with a high tax burden. In general, the total tax burden on cigarettes is highest in HICs.

The retail price of cigarettes is a key determinant of cigarette consumption, and changes in the retail price induce changes in consumption. Tobacco consumption is also sensitive to changes in consumer income—the more affordable a product, the more likely it is to be purchased. As with price, consumers

respond to changes in affordability. The affordability of cigarettes can be measured by either the number of minutes of labor required to purchase a pack of cigarettes or the percentage of per capita gross domestic product required to purchase 100 packs of cigarettes. In general, studies find that although cigarette taxes and prices tend to be highest in HICs and lowest in LMICs, cigarettes tend to be more affordable in HICs than in lower income countries. Since the 1990s, however, cigarettes have become relatively less affordable in HICs and relatively more affordable in LMICs, which has contributed to decreased consumption in HICs but increased consumption in LMICs.

Econometric studies of the impact of tax and price on tobacco use employ two primary measures of tobacco use: (1) macro-level aggregate measures of consumption, such as country-level data on tobacco sales (this literature developed earlier, growing rapidly before the 1990s); and (2) household or individual-level data taken from surveys, such as national surveys of drug use or health risk behavior. Over time, a substantial body of evidence has accumulated that demonstrates that higher taxes and prices lead to reductions in overall tobacco use and in the prevalence and intensity of use, with greater impact on key subpopulations (e.g., young people and people with low incomes). Additionally, studies have assessed the impact of tax and price on specific outcomes, such as prevalence of tobacco use, smoking cessation, initiation of smoking by youth, cross-price elasticity, and health outcomes.

Changes in tobacco consumption induced by changes in the excise tax and retail price are reflected in the price elasticity of demand: the responsiveness of consumption to increased price. Much of the recent evidence indicates that demand for tobacco products in LMICs is at least as responsive to price as demand in HICs, and likely more responsive. In HICs, most estimates of elasticities of demand range from –0.2 to –0.6, clustering around –0.4. In LMICs, elasticity estimates range from –0.2 to –0.8, clustering around –0.5. Thus, in HICs a 10% increase in the price of cigarettes may be expected to decrease tobacco consumption by 4%, while in LMICs a 10% increase in price may be expected to decrease consumption by 5%.

An extensive and increasingly sophisticated body of research clearly demonstrates that higher tobacco product taxes and prices lead to reductions in tobacco use by motivating current users to quit, preventing young people from taking up tobacco use, and reducing the frequency and intensity of consumption among those who continue to use tobacco. In addition, research generally shows that vulnerable populations, most notably young people and lower income populations, are more responsive to tax and price increases than older people and higher income populations. Finally, a small but growing literature demonstrates that the reductions in tobacco use that result from higher taxes and prices reduce the morbidity and mortality caused by tobacco use.

Research Needs

Much is known about the impact of taxes and prices on tobacco use, particularly in HICs, but further research could be useful. Reliable estimates of overall price elasticities of demand for tobacco products and estimates of the effects of price on prevalence, initiation, and cessation are not available for many LMICs. Relatively little is known about how price elasticity changes over time, at different levels of tax and price, or for larger and smaller price changes. Although cigarettes are the predominant form of tobacco used around the world, other tobacco products (smokeless tobacco, waterpipe tobacco, bidis, and others) are commonly used in some countries. However, few studies have assessed the price elasticity of demand for tobacco products other than cigarettes, and even fewer have estimated cross-price elasticities; where applicable, these studies will be very useful. Although a small but increasing

number of studies have emphasized the importance of affordability of tobacco products, more research is needed to understand how changes in affordability affect tobacco use.

Conclusions

1. A substantial body of research, which has accumulated over many decades and from many countries, shows that significantly increasing the excise tax and price of tobacco products is the single most consistently effective tool for reducing tobacco use.
2. Significant increases in tobacco taxes and prices reduce tobacco use by leading some current users to quit, preventing potential users from initiating use, and reducing consumption among current users.
3. Tobacco use by young people is generally more responsive to changes in taxes and prices of tobacco products than tobacco use by older people.
4. Demand for tobacco products is at least as responsive and often more responsive to price in low- and middle-income countries as it is in high-income countries.

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