Chapter 9
Health and economic impact of tobacco taxation

Introduction

According to evidence from around the world, raising the tax on tobacco products is a highly effective control policy instrument to improve population health and reduce smoking-related health risks (Jha & Chaloupka, 1999). A tax increase leads to an increase in cigarette prices, which in turn will cause some smokers to quit smoking or not to initiate or relapse to the smoking habit, while others may continue smoking but will smoke less. The act of quitting smoking itself and less secondhand smoke (SHS) exposure will reduce premature deaths and improve the health of the population, thereby reducing healthcare costs.

On the other hand, the cigarette industry is concerned with the possible negative impact on employment resulting from a reduction in cigarette consumption. Tobacco farming also may be affected by a loss in earnings. In addition to smuggling and the regressive effect on low-income smokers, these are key concerns that many governments or tobacco industries have used to argue against an increase in tobacco taxes.

Some officials also are concerned that with an increase in the tobacco tax, the demand for cigarette consumption will decrease, and with it government cigarette tax revenue. However, empirical studies (Chaloupka *et al.*, 2000) have shown that since the demand for cigarettes is inelastic (that is, the percentage of reduction in cigarette consumption is less than the percentage of increasing price), governments will in fact realize increased cigarette tax revenue as a result of an increase in the tobacco tax. Some governments allocate part of the additional tax revenue to tobacco control activities or tobacco-related medical care. Fiscal experts may argue against such an earmarked tax. There are other potential effects of tobacco taxation on the consumer price index.

This chapter reviews and summarizes the population health and economic impact of tobacco taxation from past published literature and empirical evidence. The overall conceptual framework for the impact analysis on this topic is displayed in Figure 9.1.

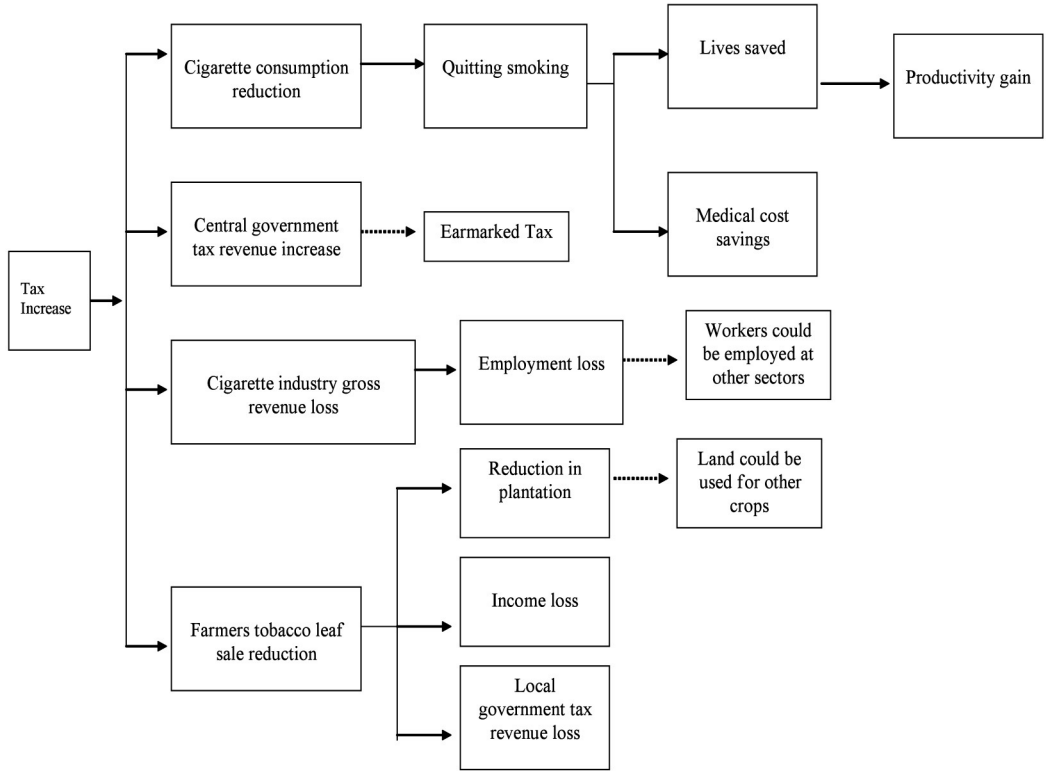
This review is organized as follows. The first section reviews the impact of tobacco taxation on population health, healthcare cost savings, and productivity gain. This is followed by a presentation of the impact of tobacco taxation on industry employment and tobacco farming. The next section summarizes the impact of tobacco taxation on government revenue, followed by a discussion of the pros and cons of earmarked tobacco taxation. The finally section reviews the impact of tobacco taxation increases on inflation and the consumer price index.

Impact on population health and healthcare cost savings

Direct impact of smoking on population health

Smoking is a major cause of premature death and morbidity. Smoking has been directly linked to cancer, cardiovascular disease and respiratory disease, among others (US. Department of Health and Human Services, 2000). A vast literature exists on the relationship between smoking and mortality (Peto *et al.*, 1992; Peto *et al.*, 1994; Peto, 1994). These studies estimate about 4 million deaths per year worldwide attributable to smoking. Half of these deaths are in low- and middle-income countries. By 2030, the annual death toll could reach 10 million if no tobacco control measures are taken. More recently, a country-specific study for China (Gu *et al.*, 2009) estimated that in 2005 a total of 673 000 deaths were attributable to smoking. The

Figure 9.1. The overall conceptual framework for the population health and economic impact of tobacco taxation



Adapted from Hu T-w, Mao Z, Shi J, Chen W. Tobacco Taxation and Its Potential Impact in China. Paris, France: The International Union Against Tuberculosis and Lung Disease, 2008, page 26.

leading causes were cancer (268000 deaths), cardiovascular disease (146 200 deaths) and respiratory disease (66 800 deaths).

Studies have also been conducted for the USA (Burns *et al.*, 1997), India (Gupta *et al.*, 2005; Jha *et al.*, 2008) and Germany (Neubauer *et al.*, 2006) that have provided a quantitative relationship between the length of smoking, smoking cessation, and benefits of quitting smoking for mortality. The risk of death declines with the length of time since an individual quits smoking, with the reductions in relative risk on heart disease and stroke more immediate than the effects on respiratory disease and cancer. Studies indicate that a large portion of heart disease deaths of those aged 40–64 are due to smoking, suggesting a reduction in economic productivity due to lost work years.

Increasing tobacco taxes can reduce smoking-attributable mortality and morbidity. The impact of tobacco taxation on the reduction of mortality depends on (1) the magnitude of the price increase resulting from a tobacco tax increase, (2) the magnitude of the price elasticity (the negative relationship between price and consumption), which includes smoking behaviour (quitting or initiating) in relation to the price increase, and (3) the relationship between mortality and quitting smoking. For example, if the price elasticity of demand for cigarettes is −0.5, a 10% price increase will reduce consumption by 5% (Chaloupka & Warner, 1999). Empirical literature indicates that about one third to one half of the 5% reduction in cigarette consumption is the result of people quitting or not initiating smoking (US Department of Health and Human Services, 2000).

The literature suggests that about one quarter to one half of those who quit smoking will avoid a smoking-related premature death (Jha & Chaloupka, 1999; Shafey *et al.*, 2009). The same analytical methods have been used in several studies supported by the International Union Against Tuberculosis and Lung Disease (Barber *et al.*, 2008; Hu *et al.*, 2008; John *et al.*, 2009a; Ross *et al.*, 2008). In China, it was estimated that an increase in the excise tax of 1 RMB (US$0.15) per pack could save

one million lives if the price elasticity of demand is −0.15; 3.4 million lives could be saved if the price elasticity of the demand for cigarettes is −0.50 (Hu *et al.*, 2008). The India study indicates that with a price elasticity of demand for cigarettes of −0.34, a 75% price increase would save 2.7 million smokers lives (John *et al.*, 2009a). In the Russian Federation, with a price elasticity of the demand for cigarettes at −0.10, a 70% price increase would mean that 2.7 million tobacco-related deaths could be averted (Ross *et al.*, 2008). A study in another major cigarette smoking country, Indonesia (Barber *et al.*, 2008) indicates that with a price elasticity of −0.29 and an increase in the tax rate from 37% to 70% of the sales price, 2.5 million deaths could be averted. All of these estimated lives saved are only for those people who are already smoking before the tax increase. These examples show the impressive population health ramifications of raising the tobacco tax.

Several studies have empirically examined the direct relationship taxes/price and deaths. A study (Moore, 1996) used a national data for the USA to examine the effects of tobacco excise tax on changes of mortality. Controlling for state, year, socioeconomic variables and alcohol tax, he found that variations in tobacco taxes between 1954 and 1988 were inversely related to smoking-related mortality. He concluded that a 10% increase in the tobacco tax would save over 6000 lives a year. A study for Switzerland (Yamasaki *et al.*, 2005) using time series data between 1965 and 1994 found that taxes on tobacco were inversely related to the male standardized suicide rate. They concluded that a policy designed to reduce tobacco consumption has the benefit of reducing suicides, particularly for men.

Kaplan *et al.* (2001) generalized the analysis of health impacts to consider overall health benefits. They simulated the impact of a US$0.50 per pack cigarette tax increase in California. Assuming a price elasticity of −0.40, it would result in about 8389 quality-adjusted life years (QALYs) saved during the first year. Higher taxes would produce even greater health benefits in the long-term. Table 9.1 summarizes the impact of tobacco taxation on lives saved.

Table 9.1. Impact of tobacco taxation on lives saved

References	Country	Amount of tax	Assumptions	Lives saved
Asia				
Levy *et al.* (2006)	Viet Nam	From 36% to 72% of price	−0.3 to −0.6 by age	5921 lives per year after 20 years, 9490 lives per year after 30 years
Hu *et al.* (2008)	China	Additional 1 RMB (US$0.15 or from 40% to 51% of retail price)	Price elasticity −0.15 −0.50	1 million lives of current smokers 3.4 million lives of current smokers
Barber *et al.* (2008)	Indonesia	Raised from current level to 70% of retail price	−0.29	2.5 million lives of current smokers
John *et al.* (2009a)	India	Raised from current level to 75% of retail price	−0.34	2.7 million lives of current smokers
Europe				
Levy *et al.* (2008b)	Albania	Increase in price from 125 lek to 250 lek	−0.2 to −0.4 by age	462 lives saved per year after 20 years
Ross *et al.* (2008)	Russian Federation	Raised from current level to 70% of retail price	−0.10	2.7 million lives of current smokers
North America				
Moore (1996)	USA	10% tax increase	N/A	6000 lives per year
Kaplan *et al.* (2001)	USA (California)	Raised US$ 0.50 per pack	−0.40	8389 QALYs first year
Levy *et al.* (2008c)	USA (Kentucky)	Tax increase from 0.30 to $2.00	−0.1 to −0.4 by age	401 lives per year after 20 years
South America				
Ferrante *et al.* (2007)	Argentina	From 68% of price to 85% of price	−0.1 to −0.6 by age	5283 lives per year after 20 years, 7851 lives per year after 30 years
World				
Ranson *et al.* (2000)	Worldwide	10% tax increase		10 million lives of current smokers

Several studies have examined the impact of tobacco taxation on disease-specific mortality, such as heart disease or stroke, based on a pre-post tobacco control intervention programme. Studies for California statistically have identified a clear association between taxation and mortality. In 1989, California increased tobacco taxation and earmarked part of the revenue for a tobacco control programme. Lightwood & Glantz (1997), using data collected between 1980 and 1995, by comparing the pre- and post-tobacco control programme (1989–1995), showed via a regression model that the California tobacco control programme was able to reduce deaths by about 13 000 per year by preventing cardiovascular and stroke deaths. Another study (Fichtenberg & Glantz, 2000) compared per-capita cigarette consumption and the death rate from heart disease for California to that of the other 49 US states. Regression results indicated that between 1989 and 1992, California had 33 000 fewer deaths from heart disease than would have been expected if California had had no tobacco control programme. One major limitation of these studies is that tobacco control programmes in California include not only taxation, but also non-price tobacco control programmes. Although it is difficult to sort out the net effect of tobacco taxation from other tobacco control programmes that were also implemented, tobacco taxation is the key feature of the California tobacco control programme, and thus much of the effect of tobacco control in California can be attributed to taxes.

The effects of taxes and tobacco control in California have also been estimated using the SimSmoke tobacco control simulation model (Levy *et al.*, 2007a). Based on that model, the number of premature deaths avoided increases to over 5223 in the year 2010 alone. Over the years 1989 to 2010, the model estimates that about 55 444 lives were saved as a result of tobacco control policies in the state of California. Further, the model shows that about 60% of the deaths avoided can be attributed to cigarette price increases. For Arizona (Levy *et al.*, 2007b), which like California had mounted a major tobacco campaign, the SimSmoke model shows that price increases lead to 60% of the premature deaths avoided.

The SimSmoke model has also been applied to several nations. While the Arizona and California models applied price elasticities based on studies for the USA, the models for other nations use elasticity estimates based on studies conducted for the respective nation. A SimSmoke model for Thailand (Levy *et al.*, 2008a) estimates that between 1991 (shortly after tobacco control policies began) and 2026 about 320 000 premature deaths would be avoided due to tobacco control, of which approximately 60% would be again due to price increases. The Thailand estimate uses a relatively conservative estimate of the relative mortality risks of smoking. If relative risks increase to those for the USA, the number of premature deaths avoided could rise to about 540 000 by the year 2026. Price increases also played an important role in Korea's reduction in smoking prevalence (Levy *et al.*, 2010).

The SimSmoke model has been used to project the lives saved from imposing a hypothetical tax increase, and shows how the number of lives saved generally increases steadily per year. For example, using the SimSmoke model for Viet Nam, Levy *et al.* (2006) show that with the tax increasing from 36% of price to 72% of price, 5921 lives would be saved per year after 20 years and 9490 lives would be saved per year after 30 years. Despite a smaller population and using lower price elasticities, Ferrante *et al.* (2007) show that increasing the tax as a percentage of price from 68% to 85% in Argentina would yield 5283 lives saved per year after 20 years and 7851 lives saved per year. Based on studies of relative risk, a smaller total mortality relative risk was used for Viet Nam (1.35, based on studies for China) than Argentina (2.1, based on studies for the USA).

The SimSmoke models show that the effects of a price increase on mortality are small at first but grow over time, because 1) the reduction in the relative mortality risks increases with the time since quitting, 2) the effects on reduced initiation are delayed until about age 40 when deaths due to tobacco begin to appear, and 3) the effects of a price increase grow over time because its effects on initiation and cessation continue into the future, and because the larger effects of price on youth (see previous chapters on the higher price elasticity for youth) spread over time through to the population (Levy *et al.*, 2000).

In general, studies indicate that reductions in smoking rates due to increased taxes lead to a reduction in premature deaths due to smoking, including deaths during the ages of 40–64 when smokers would otherwise be working. Because the risks of death decrease with the years since quitting and the effects occur largely after the age of 40, the full effects of a tax increase will extend far into the future. Two limitations should be noted on previous work. First, studies for low-income nations, such as China, use relative risks of smoking much lower than those for high-income nations, such as the USA. The relative risks of smoking

may be expected to increase in these low-income nations as the duration and intensity of smoking increase, thus suggesting that future deaths due to smoking may be understated. In addition, while some studies have distinguished the relative risks of cigarettes from bidis (Jha *et al.*, 2008), none of the studies of tax effects consider the effects on health of smokeless tobacco both alone and synergistically when used with smoked tobacco.

Impact of smoking on health cost savings

As shown in Figure 9.1, one of the immediate impacts of raising the tobacco tax is that some smokers quit smoking. Quitting smoking reduces the incidence of smoking-related illness, thus saving healthcare costs. The potential impact of health cost savings can be documented by numerous studies of the cost of smoking around the world.

There are two approaches to estimating the cost of smoking: one is based on the incidence rate, and the other is based on the prevalence rate. The incidence-based approach estimates the lifetime cost of smoking (Hodgson, 1992; Manning *et al.*, 1989) while the prevalence-based studies estimate the cost of smoking in a given year for the USA (Bartlett *et al.*, 1994; Miller *et al.*, 1998; Miller *et al.*, 1999), for Viet Nam (Ross *et al.*, 2007), for China (Sung *et al.*, 2006) and for India (John *et al.*, 2009b). The incidence approach requires extensive sources and numerous lifetime epidemiological and economic assumptions. Thus, most cost of smoking studies are estimated by the prevalence-based approach.

The key assumption used in the prevalence approach is to estimate the smoking-attributable fraction (SAF) for comparing the healthcare cost of current smokers, former smokers and never smokers, mainly for three disease categories: cancer, vascular disease and respiratory diseases. Using healthcare expenditures surveys and associating with these disease categories, the SAF is calculated by disease category and relevant socio-demographic distinctions (rural/urban, gender, age). The estimated SAF is then multiplied by each cost estimate of interest to obtain smoking attributable cost. For example, the product of SAF and total inpatient hospitalization expenditure is smoking-attributable hospitalization costs; the product of SAF and total morbidity cost is smoking-attributable morbidity costs. Most cost-of-smoking estimates for the United States (Rice *et al.*, 1986), China (Jin *et al.*, 1995; Sung *et al.*, 2006), Viet Nam (Ross *et al.*, 2007), and India (John *et al.*, 2009b) have used this SAF method.

An alternative method of cost estimation is to use a regression model comparing the overall healthcare expenditures between smokers (former and current) and never smokers, as employed in studies for the United States (Bartlett *et al.*, 1994; Miller *et al.*, 1998; Miller *et al.*, 1999). This method requires extensive data to compare various smoking states as well as a set of socio-demographic variables.

The magnitude of smoking costs is influenced by method of estimation, cost data source, assumption of SAF, and time period of the study. Even for the same country and the same year, costs could vary by these factors. For instance, the estimated cost of smoking in the United States for 1993 varied between $53.4 billion (Miller *et al.*, 1999) and $72.7 billion (Miller *et al.*, 1998); in China, the direct medical cost of smoking was US$0.8 billion in 1989 (Jin *et al.*, 1995) and US$5.0 billion in 2000 (Sung *et al.*, 2006). Using a similar method, the medical cost of smoking in India was $907 million in 2004 (John *et al.*, 2009b). Comparing each country's healthcare cost of smoking to their respective total healthcare expenditures, the United States spends about 5% to 7% of its total healthcare costs for smoking-related costs, while China and Germany spend about 3% of their total healthcare costs in this area.

One approach for assessing the impact of tobacco taxation on healthcare cost savings is to first estimate the amount of healthcare services (inpatient, outpatient, medication) prevented or averted due to quitting smoking, and then to estimate the unit cost of these healthcare services. The relationship between tobacco taxation and healthcare cost savings can be seen in a Chinese study (Hu *et al.*, 2008). With a tax increase of one RMB (US$0.15) per pack (tax rate at retail price from 40% to 51%) and a price elasticity of −0.15, 4.1 million smokers in China would quit. According to a cost-of-smoking analysis (Sung *et al.*, 2006), per-smoker medical costs attributable to smoking were about US$25.4 in China in the year 2000. Thus, 4.1 million fewer smokers would result in savings of US$100 million in medical care costs. Table 9.2 summarizes studies of the impact of taxation on healthcare cost savings.

A Netherland study (Barendregt *et al.*, 1997) compared healthcare costs among smokers and nonsmokers to estimate the effect of smoking cessation on healthcare costs over time. They found that the healthcare costs for smokers at any given age are as much as 40% higher than those for nonsmokers, but only in the short run. In the long run, the study compared the healthcare costs incurred by smokers and lifetime

Table 9.2. Impact of tobacco taxation on healthcare cost savings

References	Country	Amount of tax increase	Assumptions	Healthcare cost savings
Asia				
Hu *et al*. (2008)	China	1 RMB (US$ 0.15)	Price elasticity = −0.15	US$ 100 million
Europe				
Reed (2010)	United Kingdom	5% tax increase	Price elasticity = −0.35	£ 10.2 billion
North America				
Ahmad (2005)	USA (California)	20% tax increase	–	US$12 billion for 75 years paid
Lightwood *et al*. (2008)	USA (California)	US$ 0.050 increase per pack	Price elasticity = −0.30 – −0.70	US$ 86 billion (95% CI = 28, 151 billion) between 1989–2004

healthcare cost incurred by non-smokers; with the additional years gained, the total lifetime healthcare costs for non-smokers are higher than smokers. If these costs are converted into present value (with a discount rate of 3% to 5%), smoking cessation would not lead to increased healthcare cost.

The California 1989 tobacco control legislation has had a significant impact in reducing heart disease and lung cancer. Between 1989 and 1995, in California the cost savings from fewer cardiovascular hospitalizations and other medical services resulted in US$390 million in savings of 1997 direct medical costs (Lightwood & Glantz, 1997). A recent study on the effect of the California tobacco control programme on personal healthcare expenditures (Lightwood *et al*., 2008) showed that between 1989 and 2004, the California programme was associated with $86 billion in reduced medical spending. It should be noted again that this estimated healthcare cost savings is attributable not only to the increase in the tobacco tax but also to other non-price tobacco control programmes implemented in California during this same period.

A California simulation study (Ahmad, 2005) projected the impact of a tobacco tax increase over a 75-year period. The study found that a 20% cigarette tax increase would increase tax revenue by almost $10 billion, and smoking-related medical costs would decrease by $188 billion during the period. The smoking prevalence level was projected to decrease from 17% to 12% over the 75-year period. Indeed, current California smoking prevalence rate is almost approaching this target due to active tobacco control programmes implemented in California.

While some studies have examined the healthcare costs of smoking for countries other than the USA (see Table 9.2), more research is needed on these costs, since these costs are likely to vary from country to country. In addition, the specific effects of a tax increase have only been estimated for California in the USA. A potentially important healthcare costs savings from higher tobacco taxes is through reduced maternal smoking and reduced secondhand smoke. These effects of taxes are discussed below.

Cost-effectiveness analyses

Several cost–effectiveness studies have been conducted to consider how the benefits of a tax compare to its costs. Ranson *et al.* (2000) used 1995 data and estimated that if the inflation-adjusted price of cigarettes were raised by 10% worldwide through tax increases, 42 million smokers would be induced to quit. This price increase would prevent a minimum of 10 million tobacco-related deaths. In comparison, non-profit measures, such as a comprehensive ban on advertising, bans on smoking in public places, prominent warning labels, and mass information programmes would prevent about 5 million deaths. Thus it is highly cost-effective to initiate an increase in tobacco tax. A study of the United Kingdom prepared for Action on Smoking and Health (Reed, 2010) provided an economic analysis of the impact of increasing tobacco tax on net benefits to the United Kingdom economy as a whole. Assuming −0.35 as prevalence elasticity, they estimate that an increase of 5% in tobacco prices would cause 190 000 smokers to quit smoking, a total cost savings of 10.2 billion in 2010

prices. These cost savings consist of £1.97 billion for National Health Services, £1.36 billion for reduced absenteeism, £1.15 billion for output from extra working life, and £5.74 billion for values of extra life years.

A cost–effectiveness study of tobacco tax increase from a healthcare perspective was published in the Netherlands (van Baal *et al.*, 2007). It was concluded that a tobacco tax increase is a cost-effective intervention for public health, even when considering additional medical costs from life years gained.

In a recent study to estimate the health efficacies and financial costs of strategies to reduce salt intake and control tobacco use (Asaria *et al.*, 2007), the authors used the WHO Comparative Risk Assessment project to estimate the effects of successful implementation of price tobacco control and non-price control strategies. With the assumption of price elasticities ranging between −0.40 and −1.20 for 23 low-income and middle-income countries, an increased real price of cigarettes to reduce smoking prevalence by 10% in combination with mid-range estimates of non-price interventions would reduce the smoking prevalence rate by 20%, and 2.19 million deaths from cardiovascular disease would be averted, as well as 2.12 million from respiratory disease, and 1.20 million from cancer, for a total of 5.5 million deaths averted. The cost of implementation of this tobacco control programme would range from US$.04 to US$.032 per person for the countries analysed. As the authors point out, implementation costs associated with an increase in tobacco taxes would be largely if not completely offset by the generated tax revenues.

Either from a conceptual model or empirical analysis, evidence shows that increasing the tobacco tax will improve health, prevent tobacco-related illness, and thus save on healthcare costs. Cost savings in health care is thus an added benefit from implementation of tobacco taxation policy.

Secondary effects of a tax increase

While most of the literature on health effects focuses on the direct effects of smoking on the smoker, some studies examine the relationship between cigarette taxes and the health of others or its relationship to other unhealthy life styles.

Not directly estimated in the above reviewed studies is the effect of tobacco tax increases on deaths due to SHS. Substantial evidence now exists that SHS increases the risks associated with heart disease, stroke, respiratory disease, lung cancer and sudden infant death syndrome (SIDS) (US Department of Health and Human Services, 2006). As tobacco tax increases cause smokers to quit, exposure to SHS is likely to decrease in the home and at work, thereby reducing the mortality risks associated with secondhand smoke and thereby saving lives.

A recent study examined the effect of taxes and smoke-free air laws on SHS (Adda & Cornaglia, 2010). They used the nationally representative sample from the US National Health and Nutrition Examination Survey from 1988–1994 and from 1999–2002, and quantified the relationship between the concentration of cotinine in body fluids of non-smokers over time. They found that tobacco excise taxes have a significant effect on SHS exposure. A 10% increase in the state excise tax reduced the cotinine concentration in nonsmokers by about 3.6% for children 8–12 years of age. The effect was particularly large for children who are exposed to their parents' smoke. Thus, excise tobacco taxes may have an important health effect through reducing the exposures of children living in families where at least one parent smokes.

Prenatal smoking and postnatal SHS exposure have been identified as a strong risk factor for SIDS, a leading cause of infant mortality. A US study by Markowitz (2008) found higher cigarette prices/taxes and smoke-free air laws are associated with reduced cases of SIDS.

Besides the effects of passive smoking, maternal smoking has been associated with low-birth-weight babies, which leads to substantial added costs over the life of the individual, as well as other health risks to the child (Adams & Young, 1999; US Department of Health and Human Services, 2004). A growing literature examines the relationship of cigarette taxes to birth outcomes. Using the US Natality Detail File data from 1989–1992, Evans and Ringel (1999) estimated that the maternal smoking rate falls by 5% for a 10% increase in cigarette prices. In addition, among those women who quit smoking in response to a tax increase, average birth weights rose by approximately 400 g. In their follow-up study, Ringel and Evans (2001) provide more detailed information about the impact of a tobacco tax on the propensity of pregnant women to smoke, and found that a 10% increase in cigarette price would reduce maternal smoking rate by 7%. Colman *et al.* (2003) examined the effect of cigarette excise taxes on smoking before, during and after pregnancy, and found a statistical association between taxes and prenatal smoking through both quitting and relapse during and after pregnancy. The price elasticity of prenatal quitting and postpartum relapse was close to one in absolute

value. Finally, Lien and Evans (2005) estimated the impact of large cigarette tax hikes in four US states on maternal smoking and infant birth weight. Smoking during pregnancy doubled the chance that an infant was born with a low birth weight.

Several studies have examined the interrelationship between tobacco prices and other unhealthy lifestyles. To date, studies have considered the effect on alcohol, marijuana use and obesity.

Most econometric analyses addressing tobacco and alcohol use are based on estimating demand functions and calculating cross-price effects from estimated price coefficients. Some studies rely on aggregate data at regional or national level. Using aggregate quarterly expenditure data for the United Kingdom over the period 1964–1983, Jones (1989) estimated budget shares equations which included four categories of alcoholic beverages and tobacco. He found tobacco to be a complement to all four categories of alcohol. Goel and Morey (1995) used a pooled set of data organized by year and state on US cigarette and liquor consumption for the period 1959–1982, and found the two goods to be substitutes. However, the cross-price effects differed markedly: from +0.33 for liquor to +0.10 for cigarettes, suggesting that there may be some asymmetry in the number of people who smoke and drink liquor and those who only smoke or only drink liquor. Bask and Melkersson (2004) modelled the demand for alcohol and cigarettes as two separate equations and then as a simultaneous system, taking into account habit formation. They used aggregate annual time series on sales volumes for the period 1955–1999 in Sweden, and found that alcohol and cigarettes are complements in consumption.

Several other studies have used survey data at the level of individual consumers. Jimenez and Labeaga (1994) estimated demand equations in a demand system using individual expenditures taken from the Spanish Family Expenditure Survey (SFES). The resulting cross-price elasticity of tobacco with respect to alcohol price averaged −0.8, suggesting complementarity between the two commodities. Decker and Schwartz (2000) considered two separate demand equations for alcohol and cigarettes where each included the price of both goods among other factors. The overall cross-price elasticity of alcohol with respect to cigarettes was +0.50, suggesting that the two goods are substitutes, while that of cigarettes with respect to the price of alcohol was −0.14. Fanelli and Mazzocchi (2004) developed a dynamic modelling approach, which is consistent with the rational addiction theory and with the hypothesis of adjustment costs. A strong complementarity between alcohol and tobacco consumption was found. Picone *et al.* (2004) examined the increases in the costs and barriers to smoking in the USA to study the relationships between smoking and drinking behaviours. They found that past consumption of cigarettes was positively related to current alcohol consumption, that increasing the cost of smoking (through the introduction of smoking bans) was associated with reduced alcohol consumption, and, finally, that higher cigarette prices were associated with increased alcohol consumption (suggesting a substitute effect).

Several studies of the adult population considered the use of marijuana along with tobacco and alcohol. Cameron and Williams (2001) showed that decisions of participation in tobacco, alcohol and marijuana are closely related, with marijuana being a substitute for alcohol and a complement of tobacco, and alcohol and tobacco being complements. Zhao and Harris (2004) investigated marijuana, alcohol and tobacco consumption using micro-unit data from the Australian National Drug Strategy Household Surveys. Consistent with findings of complementarity, the results indicate a positive relationship across all three substances, with the correlation between marijuana and tobacco use being the highest.

Studies have also focused specifically on the relationships between cigarette taxes and prices and other substance use among youth. Chaloupka *et al.* (1999) found that higher cigarette prices were associated with a reduced frequency of youth marijuana use. Farrelly *et al.* (2001) reached similar conclusions, finding that higher cigarette taxes reduced the probability that young males would use marijuana as well as the intensity of youth marijuana use. Pacula (1998a, 1998b) provides additional support, finding that youth marijuana use was lower in US states with higher cigarette taxes, although her estimates were not statistically significant. Extending this work to allow for habit formation, Pacula found that higher past and current cigarette prices significantly reduced current youth marijuana use, but that higher past cigarette prices were associated with greater current alcohol use, suggesting that cigarettes and alcohol are economic substitutes for youth. In contrast, based on an analysis of teen smoking and drinking using state-level data, Dee (1999) concluded that stronger alcohol control policies reducing youth smoking prevalence and higher cigarette taxes reduced the prevalence of youth drinking. Finally, using longitudinal data, Markowitz and Tauras (2006) found

negative (though generally non-significant) effects of beer prices on youth smoking prevalence, and their proxy for marijuana prices generally indicated negative and significant effects on youth smoking prevalence, consistent with most of the rest of the literature implying that cigarettes, marijuana and alcohol are economic complements (i.e. used together) for youth.

Most of the studies find negative cross-price effects and therefore conclude that alcohol and tobacco are complements. Two notable exceptions, however, are Goel and Morey (1995) and Decker and Schwartz (2000).

Studies have also examined impact of tobacco taxes on obesity, since quitting smoking may be associated with an increase in appetite. Using US deaths between 1984–1999, Chou *et al.* (2004) found a positive effect of cigarette prices on body weight. Since tobacco taxes are associated with higher cigarette prices, this study suggests that quitting smoking would lead to weight gain. However, a follow-up study (Gruber & Frakes, 2006) used the same data set and found no evidence that reduced smoking leads to weight gain. Chou *et al.* (2004) used the cigarette price as the key variable in the model, while Gruber and Frakes (2006) used the cigarette tax as a key variable, suggesting that the results are sensitive to model specification. Future research is needed to address the issue between tobacco taxation and the effect of smoking cessation on weight gain.

Impact on earmarked tobacco tax revenue

Pros and cons of earmarking tobacco tax revenue

As discussed in Chapter 2, an earmarked tax is defined as the amount of tax revenue designated for spending on specific government or public services (Buchanan, 1963). In other words, earmarking calls for a simultaneous choice both on the level of taxation and expenditures on an item-by-item basis.

Earmarking of tax revenue has been adopted by countries worldwide and has a long history. Justification is often based on the benefit principle. For example, gasoline or automobile tax proceeds are used for highway financing, property tax revenue is used by the local government for residential services and local public school education, and social security taxes are used for retirement income. Here, the benefits to the smokers in light of the effects of secondhand smoke can be considered a justification for earmarking.

Earmarking the tobacco tax for health-related activities is often justified not only on the benefit principle but also as a "users' fee" or a "sin tax." It is argued that the tobacco tax covers the external costs of smoking (Manning *et al.*, 1989; Manning *et al.*, 1991) and discourages smokers from using cigarettes, thus leading to a reduction in tobacco-related healthcare costs and secondhand smoke exposure, by reducing the morbidity and mortality associated with cigarette smoking. Since the 1980s, countries such as Australia, Canada, New Zealand, Finland, Egypt, Thailand, and some states in the United States (California, Massachusetts, Oregon and others) have designated part of their tobacco tax revenue to finance tobacco control activities, health promotion, disease prevention, and healthcare insurance.

Some public finance experts have argued that earmarking may not be a good tax budgeting procedure because it introduces rigidities and does not permit proper allocation of general revenue among competing uses. Earmarking may be an arbitrary fiscal policy that does not lead to an optimal social welfare budget allocation principle (Musgrave & Musgrave, 1980). Furthermore, relying on a particular type of tax revenue may generate uncertainty for future tax revenue streams. However, researchers in the tobacco control field have shown that since earmarked tobacco taxes are used to fund health promotion and disease prevention programmes, this practice is consistent with the "benefit principle" of taxation and can reduce the welfare losses resulting in higher tobacco taxes (Hu *et al.*, 1998). Furthermore, given that many publicly provided health insurance programmes target lower-income populations, this type of earmarking is consistent with the objective of a tax and transfer system.

Examples of an earmarked tobacco tax and its impact on tobacco control

In the 1980s, earmarking tobacco taxes was adopted in Australia and New Zealand via the "Vic-Health" model that used tobacco tax revenue to fund sports and artistic events previously funded by the tobacco industry. Also, some of the tax revenue was dedicated to help tobacco farmers and those employed in the tobacco industry to move to other crops and industries.

Perhaps the first most comprehensive earmarked tobacco tax revenue programme was initiated in California. The California Tobacco Tax and Health Promotion Act was passed in 1988 by a popular vote. The cigarette tax was raised from 10 cents per pack to 35 cents per pack. The goal was to achieve a 75% reduction in the smoking prevalence rate by the year 2000. The Act

created the Tobacco Product Suntax Fund, which allocated the revenue into six accounts (Bal *et al.*, 1990):

(1) 20% of the funds for health and anti-smoking media campaigns;

(2) 35% for indigenous hospital services;

(3) 10% for indigenous physician services;

(4) 5% for research on tobacco-related diseases;

(5) 5% for the environment; and

(6) 25% for the government general account.

The basic philosophy behind this earmarked tobacco tax is that population-based tobacco control programmes offered through media, schools, websites and public areas will both reduce smoking prevalence and protect nonsmokers. Between 1989 and 1995, about US$1.5 billion in revenue was appropriated for these earmarked accounts.

Between 1990 and 1993, the State of California spent $26 million on a state-wide media campaign designed to change tobacco-related attitudes and behaviours of the adult population. To evaluate the possible impact of this earmarked media campaign together with the impact of the additional tobacco tax on cigarette consumption, Hu *et al.* (1995) employed a time-series regression model. They found that during the study period, cigarette sales were reduced by 819 million packs attributable to the state tax increase, and by 232 million packs attributable to the anti-smoking media campaign. This study suggests that earmarking the tobacco tax for a non-price tobacco control programme (i.e. anti-smoking campaign, bans on advertising and promotion of tobacco products, health-warning labels, and others) had an additional impact on tobacco consumption. Levy *et al.* (2007 a, 2007b) found that the media campaigns funded by the earmarked taxes played an important role in reducing smoking rates in the states of Arizona and California. A national study (Chaloupka & Grossman, 1996) further confirmed that the states that have earmarked a portion of their tobacco tax revenue for anti-smoking campaigns have all experienced a significant impact on both reducing the probability that a youth will initiate smoking and on reducing cigarette consumption among young smokers.

Besides the United States, Thailand is another example of success with earmarking. In 2001, the Thailand government passed the Health Promotion Foundation Act, which allocates 2% of the total national tobacco tax revenue (about US$93 million per year) to establish the Thai Health Promotion Foundation. This Foundation serves as a key organization working on public health issues, including tobacco control programmes. Levy and collaborators show the importance of these programmes in Thailand (Levy *et al.*, 2008a). The Thai Health Promotion Foundation not only been actively working with the Thai government and parliament to enact tobacco control legislation and conduct tobacco control policy research, but it has also provided tobacco control technical assistance to neighbouring countries, such as Viet Nam, Cambodia, and the Lao People's Democratic Republic.

Taiwan, China also was inspired by the California Tobacco Tax and Health Promotion Act in passing the Tobacco and Alcohol Tax Act in 1999 and implementing it in 2002. This act specified that about 70% of the additional tobacco tax revenue would go towards the national health insurance, 10% to anti-smoking activities, 10% to health promotion and disease prevention, and 10% to social welfare programmes. A follow-up public opinion analysis regarding the earmarked cigarette tax in Taiwan, China (Tsai *et al.*, 2003) indicated that more than half of respondents were in favour of earmarking tobacco taxes for health programmes; this was especially true among nonsmokers with higher income and higher education.

A World Bank report on financing healthcare services in China (Saxenian & McGreevey, 1996) noted that, since China is the world's largest cigarette consumption country and a large portion of its rural low-income population lacks health insurance coverage, raising the tobacco tax in China could double health benefits. A 10% increase in the cigarette tax would reduce cigarette consumption by 5%, and the increased 5% in government revenue could have been used for one third of China's poorest 100 million uninsured population. While the World Bank in general does not support the practice of earmarked taxes, the World Bank Report noted that, in the case of tobacco taxation, the benefits of earmarking tax revenue for health and tobacco control exceed its cost with respect to fiscal rigidities.

Several studies have examined the impact of tobacco control programme expenditures on reducing prevalence of smoking. For the USA, Farrelly *et al.* (2003) analysed the impact of funds used in those states from 1981 and through 2000 on per-capita consumption. Controlling for the effect of price and other factors, they found that campaigns meeting the CDC-recommended minimum per-capita expenditures reduced per-capita cigarette consumption by 8.5%, with ranges depending on the model specification between 3.4% and 21%. Tauras *et al.* (2005) examined the relationship between state-level tobacco control expenditures and youth smoking prevalence and

quantity smoked using 1991 through 2000 national representative youth survey. They found that real per-capita expenditures on tobacco control had a negative and significant impact on youth smoking prevalence and on the average number of cigarette smoked by smokers (Tauras *et al.*, 2005). A similar conclusion was reached by another US study (Farrelly *et al.*, 2008) for reducing adult smoking prevalence. The effect of state tobacco control programme expenditures, if all states had invested at the CDC-recommended minimum ($9.19) or optimum ($22.18) levels from 1995 to 2003, would be relative declines in prevalence of 5.4% and 17.4%, respectively, and translate into an estimated 2.2 million to 7.1 million fewer adult smokers in the United States (these numbers were calculated using 25% discount for expenditures). Thus, these studies provide confirmation of the potential benefits from earmarking revenues from taxes to tobacco control programmes.

Thus, the earmarking of taxes to tobacco control has been used to further reduce smoking rates beyond the effects of a tax and to pay for the healthcare costs associated with smoking. As described in earlier sections in this chapter, the reduction in smoking rates from funding non-price programmes can also further reduce healthcare expenditures for smokers and non-smokers. In particular, funding for cessation treatment programmes and media campaigns can help those quit who have not been induced by the tax to quit, and those smokers thereby avoid the higher personal expenditures associated with the tax. The promotions and enforcement of smoke-free air laws can help to reduce secondhand smoke exposure and thereby the effects on non-smokers. Generally, studies find that comprehensive strategy of smoke-free air laws, media campaigns, cessation treatment programmes, and advertising restrictions can most effectively reduce smoking and the harms associated with smoking (US Department of Health and Human Services, 2000). Chapter 3, however, discusses some of the complexities involved in the implementation of earmarked taxes.

Impact on government revenue

As discussed in Chapter 2, two major purposes of tobacco taxation are (1) to generate government tax revenue and (2) to reduce smoking to promote public health. As discussed in an earlier section of this chapter, research evidence shows that raising the tobacco tax improves population health and reduces healthcare costs. This section will address the impact of tobacco taxation on government revenue.

When tobacco taxes are increased, the tax is generally shifted to consumers (see Chapter 3) through an increase in retail prices. Consumers reduce their cigarette purchases as price increases. It has been shown in previous chapters that the percentage change in the demand for cigarettes is negatively related to the percentage change in price (i.e. price elasticity of demand). Therefore, the tobacco tax is a very important policy measure for tobacco control.

Taxing tobacco products is considered an efficient tax for the following reasons: (1) the demand for cigarettes is less elastic (somewhere between −0.20 to −0.80; see Chapter 4) such that a significant amount of government revenue can be generated through a small percentage reduction in cigarette consumption, and (2) the administrative cost of tax collection is relatively low compared to other tax bases, such as income tax or property tax.

Tobacco tax revenue and price elasticity of the demand for cigarettes

The magnitude of tobacco tax revenue that a government can generate largely depends on (1) the level of taxation (either a percent of the price or absolute amount of tax per pack) and (2) the price elasticity of the demand for cigarettes. The more inelastic the demand, the more government revenue can be generated. When the amount of additional tax increases with an inelastic demand, the proportional reduction in cigarettes purchased by the consumer is smaller than the proportional increase in taxes generated. In a simple example provided by Sunley (2009), if the price elasticity of demand is −0.6, a 10% increase in price would reduce the percentage of consumption by 6%; however, the tax revenue would increase by 25%. As the price elasticity of demand increases in absolute value, consumption is reduced and the smaller the increase in government revenue.

Many examples can be found from around the world of how raising the tobacco tax has led to an increase in government revenue and, at the same time, a reduction in cigarette consumption. For instance, in 1998 California (USA) passed a law (Proposition 99) to increase the tobacco tax beginning in 1989 by US$0.25 (20% of price) per pack of cigarettes. Between 1989 and 1992, the per-capita annual sales of cigarettes in California dropped by about 10.8 packs, while the state tobacco tax revenue increased by $2.0 billion. The estimated tax elasticity with respect to reduction of cigarette sales was about −0.60, i.e.

a 10% increase in tax resulted in a 6% reduction in cigarette sales (Sung *et al.*, 2005). To further achieve the goal of reducing the smoking prevalence rate in California, in 1999 the state increased the cigarette tax by an additional $0.50 per pack and at the same time the industry increased the price another $0.45 following the Master Settlement Agreement (MSA). From 1999–2002, this additional increase in price resulted in a further reduction of annual per-capita cigarette sales by 9.6 packs. At the same time, the state cigarette tax revenue increased by an additional $2.1 billion during the four-year period. The impact of this tax increase on cigarette consumption was −0.40 in the short run and −0.48 in the long run (Sheu *et al.*, 2004; Sung *et al.*, 2005). Again, this example shows that higher taxes will generate more government revenue and reduce cigarette consumption.

For the United States as a whole, tax increases have led to revenue increases. Giovino *et al.* (2009) shows the pattern of average state taxes rates as adjusted for inflation relative to average state tax revenues. In a graphical display they show that as average state taxes have increased, tax revenues have increased and the tax revenues declined as average state taxes went down (corresponding to figure 37 in page 69 in the above cited report). The large price increases following the MSA and other tobacco control policies implemented during the 1990s and early 2000s have somewhat dampened the magnitude of the effect of tax increases on tax revenues, because these policies have reduced smoking rates independent of the state tax increases. Nevertheless, tax revenues still increased over that time period. In addition, data in the report by Giovino and colleagues (2009) show that in each state that experienced a tax increase showed an increase in tax revenues, with the exception of New Jersey, where a small increase in tax was accompanied with a stronger smoke-free air law that reduced smoking rates.

During a similar time period, the South African government initiated a tobacco tax increase as a means of tobacco control. The government gradually raised the tobacco tax rate (Van Walbeek, 2002). Other examples from around the world of how an increase in the tobacco tax rate is associated with an increase in government revenue include the United Kingdom (Townsend, 1998) and Thailand (World Health Organization, 2009).

Additional studies have been funded by the International Union Against Tuberculosis and Lung Disease to estimate the impact of a tobacco tax increase on government revenue for major smoking countries such as China, India, Indonesia, and the Russian Federation, who have yet to implement tobacco taxation as a measure to control tobacco use. The China study (Hu *et al.*, 2008) used a demand model to estimate the effect change tax on the quantity demand. The study found that an increase of one RMB (or US$0.15), an increase from a tax rate 40% of retail price to 51% of retail price per pack of cigarettes, would raise US$31.2 billion in tax revenue at a price elasticity of −0.15 or an additional US$28.7 billion in tax revenue at a price elasticity of −0.50. If the tax rate increased to 68% of the retail price, even at a low price elasticity of −0.15, the government would gain an additional US$54.5 billion in tax revenue. In Indonesia, at a price elasticity of −0.29, a tax rate increase from 37% to 70% of the sale price would garner the government an additional US$8.3 billion in revenue, even though the number of smokers would be reduced by 7.3 million (Barber *et al.*, 2008). In India, with a tax rate increase from 38% to 50%, the Indian government would gain Rs.11 billion, and consumption of cigarettes would be reduced by 8 billion sticks (John *et al.*, 2009a). Finally, the Russian study also indicated that a tax of 70% of the retail price of cigarettes would increase tax revenue by US$5.98 billion at a price elasticity of −0.10 (Ross *et al.*, 2008).

In sum, all of the post-tax implementation examples and simulation studies uniformly show that the tobacco tax is an effective policy instrument to raise government revenue. Several qualifications should be mentioned. First, other tobacco control policies that reduce smoking rates may offset some of the effects of the tax increase, as they reduce smoking rates independent of the tax increase. Second, tax revenues will fluctuate with the general state of the economy, e.g. a recession may lead to temporary reductions in the quantity of cigarettes sold independent of the tax. Third, with additional life years gained attributable to tobacco tax, government may need to incur additional pension funds. Fourth, cross-border shopping and smuggling may offset some of the increase or in exceptional cases reduce tax revenues, as discussed in Chapter 8. Finally, at some point, even in the absence of the factors described above, tax increases may reduce tax revenues when there are so few smokers left.

Impact of a tax increase on overall employment

One of the arguments that has been raised against increasing tobacco taxes is that the reduction in tobacco consumed either through quitting

or reducing the quantity smoked will translate into a reduction in employment, or more generally a shrinking economy. The impact has been estimated as a reduction in the gross number of tobacco-related jobs in tobacco industry-sponsored reports (Agro-Economic Services Ltd & Tabacosmos Ltd, 1987; Arthur Andersen Economic Consulting, 1993; PEIDA, 1991; Price Waterhouse, 1992; Tobacco Merchant Association, 1995). These effects are compounded as multipliers are applied to the tobacco-related job losses to account for the reverberations in other parts of the economy from lost consumer expenditures (Jacobs *et al.*, 2000). In addition, tobacco industry-sponsored studies overestimate the number of tobacco-related jobs, since many jobs are part-time and seasonal, and few farms grow only tobacco.

The estimates from the tobacco-sponsored studies present only part of the picture. They should not be interpreted, as has been suggested, as the number of people who would be unemployed if the tobacco industry is reduced. Unlike tobacco industry-sponsored studies, economic-based studies consider the employment impact of shifting consumer spending from tobacco products to other goods and services for a nation or a region. In a dynamic economy, resources—including workers—are constantly shifting between industries due to changes in prices. Thus, economic studies estimate the contribution of the tobacco industry to net employment, the change in employment in a nation or a region after considering the redistribution of the same resources to alternative uses.

The effect on net employment

In general, as tobacco consumption in a country is reduced, e.g. due to taxes, resources for the most part will transfer to other industries. As consumers spend less on tobacco, they spend more on other goods or increase their savings. The increased spending in other goods and service directly creates new jobs in the economy. Likewise, additional tax revenues generated from raising tobacco product taxes do not disappear from the economy, but are redirected into other uses by the government, creating employment and other benefits in those sectors. In general, reallocation generates alternative business opportunities in other sectors of an economy, along with the associated employment and income that counteract the loss in the tobacco sectors.

Studies taking into account the change in production and spending patterns have assumed that money not spent on tobacco is spent on other goods and services according to consumers' existing (average) expenditure patterns, or, if the data is available, they have considered how expenditures are modified by those of smokers who have recently quit (which may further vary depending on whether the individual quit or cut back the quantity smoked). For those who became former smokers, Buck *et al.* (1995) found that the marginal increase in income in the short term was spent more on luxury items, recreational goods, transport, communication and educational services (Buck *et al.*, 1995).

Instead of spending the money saved from not purchasing cigarettes, some portion of the additional money in Indonesia (Barber *et al.*, 2008) and in China (Hu *et al.*, 2008) could be saved. This would mean a reduction in consumption, but would also mean lower interest rates which would translate into an increase in investment and thus future growth.

A higher cigarette tax may also be associated with changes in the government sector. If the tax change is not too large, revenue from taxes will probably increase at least in the short run, because demand is inelastic. While more money will be drawn out of the economy by the government, the increased revenue may be used to replace other taxes that would otherwise be raised. Alternatively, government could pay off the national debt (which would reduce the interest rate, but probably also reduce consumption) or increase government expenditure (which could generate additional employment). As taxes increase and with sufficient time for adjustment, tax revenues will eventually decline. Commonly, studies of the employment effects assume that government will then react either by decreasing government expenditure, which would result in government job losses, or by increasing taxes from other goods and services. However, some increase in taxes would occur naturally as consumer expenditure is switched from tobacco to other goods and more taxes are collected on these items. Thus, even a long-run demise of the tobacco industry would cause a governmental revenue shortfall only if the tobacco tax revenue were not replaced with an equal-yield alternative revenue source.

Empirical studies on the effect on overall employment of reduced tobacco use

Most studies that have attempted to investigate the impact of falling tobacco consumption on employment were done between 10 and 15 years ago, and have been reviewed by Jacobs *et al.* (2000). Since then, studies have been conducted for China, Indonesia and Bulgaria and have been added to the paper. Table 9.3 summarizes the results of the empirical studies.

Table 9.3. Studies of the effect on employment of a fall in cigarette consumption

Country (reference)	Assumptions	Finding
Net exporters		
Canada (Allen 1993 as cited in Jacobs *et al.*, 2000)	Domestic cigarette sales are 0 in 1989, $ switched to "average" expenditure patterns	Little change in jobs
Canada (Irvine & Sims, 1997)	20% decline in tobacco product expenditure Expenditure allocated by average expenditure pattern. Government spending reduced.	Net loss of 6120 jobs (< −0.1% employment)
Indonesia (Ahsan & Wiyono, 2007)	Tax increases of 25, 50 and 100% from 26% of price allocated by average expenditure pattern. Government spending reduced	Net gain in jobs of 281 135 (0.3% of employment), 140 567 and 84 340 for a 100%, 50% and 30% increase in the cigarette tax
United Kingdom (Buck *et al.*, 1995)	Tobacco sales fall by 40%, switch to "recent stopper" expenditure patterns	Net gains of 155 542 jobs (+0.5%)
United States (Warner *et al.*, 1996)	Eliminate all domestic consumption, switch to "average" expenditure patterns	Net job gains of 47 in first year, and 133 000 over 8 years (0%)
Zimbabwe (van der Merwe, 1998b)	All domestic production and consumption eliminated, agriculture shifts to alternative crops, expenditures shift to average input-output pattern	Net loss of 88 000 jobs in first year, agriculture production shifts restore about half (−12.4%)
Balanced tobacco economies		
Bulgaria (Petkova *et al.*, 2001)	10% consumption fall, expenditures shift to average input-output pattern	Net loss of 5567 jobs (−0.02% employment)
China (Hu *et al.*, 2008)	A linear production relationship between production volume and employment loss a price elasticity of −0.15 and −0.5 An additional US$0.15 (1 RMB) per pack tax increase	With elasticity of −0.15, loss of 1656 jobs (<0.01% of jobs). At a price elasticity of −0.5, loss of 5 49 jobs
Scotland (McNicoll & Boyle, 1992)	Eliminate all domestic consumption in 1989, switch to "average" expenditure patterns	Net gain of 7869 jobs (+0.3% employment).
South Africa (van der Merwe & Abedian, 1999)	Eliminate all domestic consumption, switch to "recent stopper" expenditure patterns	Net gain of 50 236 jobs (+0.4% employment)
Net Importers		
Bangladesh (van der Merwe, 1998a)	Eliminate all domestic consumption and all domestic production of cigarettes and bidis in 1994, switch to "average" expenditure patterns	Net gain of 1 098 919 (+2.0%) jobs.
United States; Michigan State (Warner & Fulton, 1994)	Eliminate all domestic consumption in 1992, switch to "average" expenditure patterns	Net gain of 7100 jobs over time (+0.1% employment)

Most of the studies have compared the actual level of employment in their different economies with the predicted level of employment when tobacco expenditure is reduced. All studies have assumed that consumers who stop smoking reallocate their tobacco expenditure to other goods and services in the economy. Falling employment in the tobacco industry will thus be offset by increases in employment in other industries, depending on how labour intensive these other industries are relative to the tobacco industry. This is the first logical underpinning of all the research on this topic.

To simulate the change in employment from a reduction or elimination of tobacco consumption, the amount of expenditure released from tobacco spending distributed according to an assumed expenditure pattern is then applied to either a static input-output model or a dynamic regional econometric model. Both types of models contain the interdependencies or relationships between industry sectors or subsectors in the economy and can be used to simulate the impact of an external policy change on outputs and employment of each sector of the economy. The static approach usually compares two alternative situations in a given year, one with and one without (or with reduced) tobacco expenditure taking place. The dynamic model allows one to simulate trade flows and feedback effects over time.

McNicoll and Boyle (1992) estimated the impact on the Scottish economy of a reduction in spending on cigarettes in Glasgow in 1989 using a static input-output model. Their results indicated a net gain of nearly 8000 jobs (+0.1% of employment) if everyone in Glasgow had stopped smoking in 1989 (McNicoll & Boyle, 1992; Jacobs *et al.*, 2000). A study by Buck *et al.* (1995) used a static model of the United Kingdom comparing the economy with one where 40% of tobacco expenditure was switched to other forms of spending. Where other studies had all assumed that consumers would spend their money according to average consumption expenditure patterns, this study considered four patterns of changed consumer spending: (1) average consumers (the usual assumption), (2) all nonsmokers, (3) all former smokers, and (4) recent stoppers (the more realistic case). All categories showed net increases in jobs, except if released expenditure followed nonsmokers' spending patterns, which was considered unrealistic. If ex-smokers spent freed money like recent stoppers, a net increase of 115 688 full-time equivalent jobs was predicted for the UK (+0.5% of employment).

Static input-output models were conducted for four low- and middle-income nations. For South Africa, van der Merwe and Abedian (1999) found a net gain of 50 236 jobs (+0.4% employment) in 1995 with tobacco elimination, using expenditures of recent quitters, and assuming the same government spending. For Bangladesh, van der Merwe (1998a) found a net gain of 1 098 919 jobs (+2.0% employment) in 1994 with domestic consumption expenditure and all tobacco production for tobacco products and bidis in 1994 eliminated, and with previous average expenditures and no change in government spending by other taxes. For the tobacco-growing nation of Zimbabwe, van der Merwe (1998b) calculated 87 798 jobs lost in 1980 (−12.4% employment) and 47 463 jobs when all domestic consumption expenditure is eliminated and farming moves to alternative agriculture. For Bulgaria, Petkova *et al.* (2001) found that a 10% decrease in consumption with an expenditures shift to average input-output pattern yielded a net loss of 5567 jobs (−0.02% of employment).

A recent study by Ahsan and Wiyono (2007) for Indonesia used price elasticities to examine tax effects. They found that new jobs would increase by 281 135 (0.3% of employment), 140 567 and 84 340 for a 26% (100%), 13% (50%) or 8% (25%) increase in the cigarette price (tax), respectively (Ahsan & Wiyono, 2007). Other non-tobacco crops showed the largest gain. In Indonesia, 13% of expenditures are for tobacco in households with at least one smoker.

To estimate the potential impact of cigarette tax increase on cigarette industry employment in China, a linear production relationship between production volume and employment loss was used (Hu *et al.*, 2008) to show that under a price elasticity of −0.15 and with an additional US$0.15 (1 RMB) per pack tax increase, only 1656 individuals would be unemployed. At a price elasticity of −0.5, with the same amount of tax increase, approximately 5549 individuals would lose their jobs, as compared to the loss of 59 000 employees due to company merging in 2006. The amount of employment loss from an increase in taxes would be minimal. Furthermore, the effect of the reduction in cigarette consumption would lead the cigarette industry to diversify into other products.

In contrast to the static models, Warner and Fulton (1994) developed a dynamic regional economic model to examine falling consumption in the state of Michigan, a non-tobacco-producing state. They examined two scenarios: a complete and instantaneous cessation of tobacco expenditure, and a more realistic

gradual acceleration in the rate of decline in tobacco consumption. Their results indicate that Michigan would experience a net gain of 5600 jobs in 1992, and 1500 more jobs (+0.1% employment) by the year 2005. The Michigan study was extended to include the entire US to assess whether declining tobacco product sales significantly reduced employment across all tobacco-producing and non-tobacco-producing states from 1993 to the year 2000 (Warner *et al.*, 1996). The results showed that the tobacco-producing region would have lost jobs, but collectively all other regions would have gained enough employment to completely offset the losses. Eliminating all tobacco spending was predicted to result in a net gain of 133 000 jobs (~0.0% of employment) in the US economy by the year 2000, while a gradual decline in tobacco consumption would result in a net gain of 19 719 jobs.

A study for Canada (Allen, 1993) argued that, first, with consumption dropping slowly, those jobs that were lost would mostly be met by attrition. Second, technological changes caused many of the job losses in the industry, and third, the most potent cause of falling consumption was increased excise taxes and the government revenues that were raised through these taxes were spent to maintain public services, which created many new jobs. However, Irvine and Sims (1997) conducted a static analysis for a 20% decline in tobacco expenditure, and found a net loss of 6120 jobs (<0.1% of employment) in Canada. However, they assumed government spending was reduced, and Jacobs *et al.* (2000) note that Canada is a tobacco-growing region.

Economic studies generally conclude that reducing tobacco consumption has a small positive effect on the total output and employment of the national economy, except in countries and some states that are heavily dependent on tobacco production. A reduction in smoking does lead to job losses in those sectors immediately associated with tobacco product production, such as tobacco manufacturing and farming, and supplier sectors indirectly associated with tobacco such as the fertilizer and paper industries. But these losses are generally outweighed by increases in employment in all other industries. For any country or region, the estimated net change of employment depends on the specific assumptions used in the studies (e.g., the reactions by government and assumed spending patterns of those who reduce consumption) and the structure of the domestic economy.

The effects of a tax increase on employment will also depend on whether a country is a net importer or exporter of tobacco. In particular, worldwide demand for tobacco products has been declining in most regions of the world and is likely to continue to decline as rapidly, and more rapidly if tobacco control is successful. Therefore, the value of investments made in these industries is likely to decline in those exporting countries regardless of tax increases in the country in which they are located.

Two other savings may be realized by economies that reduce tobacco consumption—the savings from reduced medical costs (some of which will be offset by higher medical costs as the individual lives longer) and productivity gains. For example, the annual economic cost associated with reduced productivity for the United States as a results of deaths due to smoking and secondhand smoke exposure was estimated to be approximately US$96.8 billion (US$64.2 billion for males and US$32.6 billion for females) from 2000–2004 (Centers for Disease Control and Prevention, 2008). These costs did not include other potentially important costs, such as the value of lost work time from smoking-related disability, absenteeism, excess work breaks, and secondhand smoke-related disease morbidity and mortality (Centers for Disease Control and Prevention, 2005). Nevertheless, there are costs associated with the transition from the current tobacco economy to a smaller or tobacco-free economy.

Transition costs

As suggested by Warner (2000), an economic presence of tobacco does not imply an economic dependence. The extent and speed at which resources are shifted from the tobacco industry to other industries will depend on the opportunity cost of resources used in the production of tobacco and tobacco products. For example, agricultural resources, such as land and capital, currently used in tobacco leaf production can be used for other agricultural purposes, and tobacco farmers can produce other crops or engage in other economic activities if tobacco leaf production ceases. Similarly for the resources used in tobacco product manufacturing, wholesaling, and retailing.

The transition costs of switching resources in response to a tax increase will depend on the extent to which resources currently involved in tobacco-related industries are specific to those industries. Many of the jobs involve tobacco in a limited way (e.g. retailers who sell tobacco products, jobs in the heavy industry sector where farming equipment is produced), and are not dependent on tobacco. Primarily jobs in tobacco

farming (which are often part-time and for which other crops besides tobacco are grown), tobacco leaf drying and warehousing (which generally involves few jobs) and tobacco product manufacturing are partially dependent on tobacco. Labour and land currently used for tobacco leaf production are sometimes considerably more productive in tobacco than in other uses, since tobacco grows well on some lands where most other crops do not. The ability to transfer skills and experience specific to tobacco growing to other crops may also be incomplete. Similarly, the equipment, technology and labour skills used to produce tobacco products may have limited value when released from tobacco product manufacturing.

While there may be some costs due to dislocation, these costs will be lessened if the reduction in demand for tobacco is gradual, as is typically the case. Tobacco farmers and manufacturers can adjust by not replacing equipment as it depreciates, not hiring additional workers, and making the land available for other purposes. In addition, for a country that imports tobacco, these effects will be minimal, and for a country that exports tobacco, the exported shares will depend on the tobacco control efforts of other countries. Furthermore, independent of tobacco control policy-induced changes in domestic tobacco use, employment in tobacco dependent sectors has been falling over time as farming techniques and manufacturing process have improved (Capehart, 2000; Van Liemt, 2001).

Various studies for the United States (e.g. Chase Econometrics, 1985; Price Waterhouse, 1992; Sumner & Alston, 1985; Brown, 1998) have concluded that increased cigarette taxes would reduce demand for tobacco, and reduce the incomes of tobacco farmers. For example, Price Waterhouse (1992) estimated that increases in the federal tax on cigarettes from 24 to 48 cents per pack in the United States would lead to a loss of farm revenues by US$50 million and farm jobs by 8140. In contrast, Sumner and Alston (1985) and Brown (1998) claimed that the impact of tobacco measures such as increasing cigarette taxes on farmers' revenues would depend on the response by the federal government to the lower demand for tobacco due to the governmental intervention in tobacco farming. They concluded that adoption of a policy to fix the tobacco quota while allowing the support price to fall would lead to a loss of revenue for quota owners and no change in revenue for the tobacco farmers who rent quotas for growing tobacco, while adopting the converse policy would lead to a revenue gain for the quota owner and a revenue loss for the quota renter.

While reducing cigarette consumption can create economic hardship for those whose livelihood depends on tobacco, programmes can be implemented to reduce these hardships. In high-income nations, efforts have been made to diversify the economic activities for tobacco farmers and reduce their dependence on tobacco farming. In the United States, the efforts have had limited success. Although the high return from growing tobacco has generally limited the impact of efforts to encourage the production of alternatives, many tobacco-growing households are already quite diversified. For example, in the United States, some flue-cured tobacco farms also grow soybeans, corn, cotton and wheat (Jacobs *et al.*, 2000). In Canada, the Tobacco Diversification Plan provided tobacco farmers with incentives to stop growing tobacco and to develop alternatives in the 1980s (Pan American Health Organization, 1992). Many farmers have ceased tobacco production through this programme, but many participants acknowledge that they would have quit tobacco farming without the programme. In addition, 24% of the participants continue to work in tobacco farming as employees, rather than as entrepreneurs (Pan American Health Organization, 1992). Tobacco farmers are unlikely to reduce their tobacco production as long as tobacco remains more profitable than the other crops.

Several studies have evaluated the alternative crops for tobacco in developing counties. Those crops include cassava in Brazil, sugar cane in Kenya and chillies, soybeans, cotton and mustard in India (Jacobs *et al.*, 2000). A study on potential crops in Bangladesh has found that several vegetable species could be more profitable than tobacco (Naher & Efroymson, 2007). Rose blooms have been identified as profitable alternatives to tobacco in Zimbabwe (Maravanyika, 1998). Yach (1996) reported that more than fifty alternative crops and land use have been identified.

Crop diversification programmes and retraining for workers in tobacco product manufacturing could be funded by some of the new revenues that result from the tax increase. In Turkey, for example, the government-sponsored alternative crop programme was implemented in anticipation of privatization of the country's monopoly (Yurekli *et al.* 2010). For Brazil, a World Bank report (Vargas & Campos, 2005) found that diversification strategies, especially those part of broader rural development programmes, were successful despite considerable barriers.

Impact of tobacco tax increases on inflation and the consumer price index

Consumer price indices reflect the average prices paid by the typical consumer in a country. The percentage increase in the consumer price index measures the inflation rate, which directly affects domestic interest rates and foreign exchange rates. These rates are key economic indicators for most countries and often a key determinant of monetary policy. In many countries, changes in wages, social security benefits, and other payments are tied to a price index to keep pace with inflation. In addition, some countries link taxes to price indices in order reflect current prices.

An argument made against raising cigarette taxes is that tobacco taxes have an inflationary impact, especially in countries where wages are indexed to inflation or where government policy is to keep inflation low. The effect of tobacco product tax increases on inflation depends on the percentage of the tobacco price increase due to the tax, and the weight that tobacco prices are given in computing a price index. For example, if taxes account for 50% of tobacco product prices, a doubling of the tax (100% increase) will increase prices by 50%. If the weight given to tobacco products in the price index is 3%, the index will rise by 1.5% in response to the tax increase.

For estimating the impact of cigarette expenditures on the consumer price index, the total percentage of tobacco expenditures from the entire population (smoking and non-smoking) is used. Indonesia and China households with smokers spend about 6% to 12.4% of their total household expenditures on tobacco (Barber *et al.*, 2008; Hu *et al.*, 2008). However, slightly more than 1% of all household expenditure (smoking and non-smoking) in China is for cigarettes (Djibuti *et al.*, 2007). The US cigarette expenditures are less than 1% (Busch *et al.*, 2004) and in the Russian Federation tobacco accounts for between 1 and 3% of household expenditures (Djibuti *et al.*, 2007).

Thus, tobacco is likely to play a small role in the price index. Furthermore, since the weights used to compute price indices in many countries change infrequently, the inflationary impact of tobacco product tax increases will be overstated as consumption of these products falls in response to tax increases.

While cigarette tax increases are not likely to have a major impact on the price index, some governments have excluded tobacco from the index. The European Union, for example, has recommended that its member countries exclude tobacco products (Baille, 1998). France since 1992 and Belgium since 1994 have excluded tobacco products from the price index used for adjusting wages (Guindon *et al.*, 2002). Since 1991, Luxembourg has excluded tobacco products, hard liquor, and other certain other products from its consumer price index because they are considered unnecessary or inappropriate. To date, however, most countries include tobacco products in their most widely-used indices—especially those used for indexing wages, pension payments and other outlays. Excluding tobacco products from price indices would increase the public health impact of tobacco tax increases by providing less of a cushion for users whose wages or benefit payments are indexed (Alchin, 1995).

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