How Effective are Taxes in Reducing Tobacco Consumption?

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INTRODUCTION

Governments have long taxed cigarettes and other tobacco products. Tobacco taxes have been thought to satisfy the Ramsey Rule that states that consumption taxes should be applied to goods with relatively inelastic demands so that welfare losses associated with taxation will be minimized. More recently, many countries have increased tobacco taxes to reduce tobacco use. These tax increases are partly based on efficiency grounds - the idea that tobacco users should bear the full costs of their consumption - and assume that there are social costs associated with use; thus, the tax is a "users' fee." Related to this is the use of tobacco taxes as a public health policy. The effectiveness of taxes for each these purposes depends on information concerning the impact of tobacco taxes on tobacco use. This chapter reviews this evidence.

THE IMPACT OF TOBACCO TAXES AND PRICES ON DEMAND

A fundamental principle of economics is that of the downward sloping demand curve. Many have argued that tobacco use is an exception to this law and that addictive consumption was not conducive to standard economic analysis (e.g. Elster, 1979; Winston, 1980). However, substantial economic research clearly demonstrates that the demands for cigarettes and other tobacco products respond to changes in prices and other factors. Conceptually, economists use a broad definition of price that includes not only monetary price, but also the time and other costs associated with using a product. This chapter focuses on the impact of the prices of tobacco products (which can be increased by raising taxes) on the demands for these products (see Chaloupka and Warner, forthcoming, for a discussion of the impact of other factors on demand).

Conventional Studies of Demand

Many studies have examined the effects of taxes and prices on cigarette demand using standard economic models of demand and diverse econometric methods applied to data from numerous, mostly developed, countries. Many have used aggregate time-series data for a single geographical unit, while others have employed pooled cross-sectional time series data; still others have used individual level data taken from surveys. Most of the price elasticity estimates for overall cigarette demand from recent studies fall within the relatively narrow range from -0.3 to -0.5.

A few recent studies have focused on developing countries (e.g. Xu, Hu and Keeler, 1998; van der Merwe, 1998). Warner (1990) argued that demand in these countries is likely to be more responsive to price than demand in affluent countries given the low incomes and relatively low cigarette consumption in poorer countries. The estimated price elasticities from these studies, about double those from developed countries, are consistent with this argument.

A growing number of studies have used data on individuals taken from large-scale surveys, producing estimated price elasticities comparable to those based on aggregate data. Because of their use of individual-level data, these studies can separately estimate the effect of price on smoking prevalence and conditional cigarette demand (e.g. Lewit and Coate, 1982; Mullahy,

1985; Wasserman, et al., 1991; Chaloupka and Grossman, 1996; Farrelly, et al., 1998; Evans and Farrelly, 1998). In general, these studies conclude that about half of the effect of price on overall demand is on smoking prevalence, with the remainder on consumption by continuing smokers. For example, Wasserman et al. (1991) estimated a prevalence elasticity for US adults in 1985 of -0.17 and a conditional demand elasticity of -0.09.

Evidence from the relatively new field of behavioral economics is consistent with the findings from econometric studies. These studies examine the impact of price on the self-administration of addictive substances in a laboratory setting, where price is defined as the effort required to receive one dose of a drug. One advantage of this approach is that researchers can study price changes much larger than those seen in the data used in econometric studies. The behavioral economic analyses produce elasticity estimates that are surprisingly consistent with those from econometric studies (Bickel and Madden, 1998). One particularly interesting finding from this research is that the price elasticity of demand rises as price rises.

Addiction and Demand

Many recent studies have explicitly modeled the addictive nature of smoking. In these analyses, consumption is considered addictive if an increase in past consumption leads to an increase in current consumption because the marginal utility of current consumption is increased by past consumption. Empirical studies of addictive demand generally fall into two categories - those treating smokers as myopic and those treating smokers as rational. Both model the tolerance, reinforcement, and withdrawal associated with addiction. The key implication of these models for the effect of price on demand is that, because of addiction, demand will respond slowly to permanent changes in price and the long-run elasticity will exceed the short-run elasticity. The key difference is that myopic demand models assume smokers completely ignore the future consequences of their current decisions, while rational demand models assume that smokers account, at least somewhat, for the future health and other consequences of their addiction.

Myopic models of addiction developed from the literature on irreversible demand functions (those where current demand depends on all past price and income combinations), with the implication that price elasticities may differ for increases and decreases in price (e.g. Farrell, 1952). Young (1983) and Pekurinen (1989) applied this notion of asymmetric responses to cigarette price changes to data from the US and Finland, respectively. Both found that demand was almost twice as responsive to price reductions as it was to price increases. Most empirical applications of myopic models of addiction are based on the early work by Houthakker and Taylor (1966) that modeled current demand as a function of a "stock of habits" representing the depreciated sum of all past consumption. Mullahy (1985), for example, applied this approach to individual-level data from the 1979 US National Health Interview Survey (NHIS). He found strong evidence that smoking is an addictive behavior, and estimated an overall price elasticity centered on -0.47. Other approaches to estimating myopic demand models have similarly concluded that smoking is an addictive behavior and that price has a significant impact on cigarette demand (e.g. Jones, 1989; Baltagi and Levin, 1986).

Several studies have empirically modeled cigarette smoking as a rationally addictive behavior applying a theoretical model developed by Becker and Murphy (1988). In this model, addiction is reflected by adjacent complementarity, implying that current use of an addictive good will be inversely related to all past and future prices, as well as the current price, of the good. Among other things, the model predicts that addicts with higher discount rates will be more responsive to price than those with lower discount rates and that the ration of the long run to short run price elasticity will be larger as the degree of addiction rises (Becker, et al., 1991).

Chaloupka (1991) used individual-level data to estimate cigarette demand equations derived from the rational addiction model, finding consistent evidence that smoking was addictive and that smokers did not behave myopically. He estimated long-run price elasticities in the range from -0.27 to -0.48, about double his estimated short run price elasticities. Similarly Becker, et al. (1994), used aggregate, state-level sales data for the US over the period 1955-1985 to estimate short and long-run price elasticities centered on -0.40 and -0.76, respectively. More recently, Douglas (1998) used hazard models to examine the determinants of smoking initiation and cessation in the context of the rational addiction model, concluding that price increases significantly raise the hazard of smoking cessation, with the duration of smoking approximately unitary elastic with respect to cigarette price.

Recent extensions to the rational addiction model address its often criticized assumption of perfect foresight and consequent lack of regret. Orphanides and Zervos (1995), for example, assumed that inexperienced users are not fully aware of the potential harm from consuming an addictive substance. Instead, their knowledge comes from observing the effects of addictive consumption on others as well as through their own experimentation. Thus, an individual who underestimates his or her potential for addiction and experiments can end up hooked to his/her regret. Suranovic, et al. (1999), emphasized the 'quitting costs' implied by adjacent complementarity in order to explain the seeming inconsistency between smokers' stated wishes to quit and their continued smoking, as well as their use of alternative behavior modification treatments. Rather than assuming fully rational behavior, they assumed 'bounded rationality' implying that individuals choose current consumption only rather than choosing a lifetime consumption path to maximize the present value of their lifetime utility. Empirical applications of these extensions are likely to add significantly to our understanding of the impact of price on cigarette smoking.

Subgroup Differences in the Price Elasticity of Cigarette Demand

Several studies use individual level data explore the price sensitivity of population subgroups, including those defined by age, race/ethnicity, socioeconomic status, and gender. Lewit and his colleagues first examined differences in price sensitivity by age (Lewit, et al., 1981; Lewit and Coate, 1982). They found that demand among young adults (20-25) was more than twice as responsive to price as demand among adults and that most of the effect of price on young adult smoking was on prevalence (Lewit and Coate 1982). Similarly, Lewit, et al. (1981), found that youths (12-17), were even more responsive to price. A decade later, however, two studies based on relatively small samples from the same survey, concluded that youths and young adults were

not significantly more sensitive to price than older adults (Wasserman et al., 1991; Chaloupka, 1991).

A number of recent studies based on large, nationally representative surveys for the US support the earlier findings of an inverse relationship between price elasticity and age (Chaloupka and Grossman, 1996; Chaloupka and Wechsler, 1997; Lewit, et al., 1997; Evans and Huang, 1998; Tauras and Chaloupka, 1999; Farrelly, et al., 1998). Chaloupka and Grossman (1996), for example, used data on over 110,000 youths to examine the impact of price and several tobacco control policies on youth smoking, estimating a total price elasticity of -1.31. Similarly, using 13 of the USNHIS from 1976-1993, Farrelly and his colleagues estimated a total price elasticity of demand for young adults (18-24), almost 40 percent higher than they estimated for 25-39 year olds and well above their estimates for older adults.

In general, researchers estimating the effect of price on smoking prevalence assume that their estimates reflect the impact of price on youth smoking initiation and adult smoking cessation. A few recent studies have directly examined the effect of price on smoking initiation. Douglas (1998) and Douglas and Hariharan (1994) applied hazard methods to retrospective data from several of the USNHIS, concluding that cigarette prices had little impact on smoking initiation. However, they note, errors-in-variables associated with both the retrospective data on initiation and the cigarette price data biased their price effects towards zero. DeCicca, et al. (1998), addressed the same issue using data from the 1988 US National Education Longitudinal Survey and also found little impact of cigarette taxes or prices on the onset of daily smoking between eighth and twelfth grade. However, another study using these data (Dee and Evans, 1998) that treated missing data differently produced an estimated price elasticity of smoking onset of -0.63, consistent with estimated prevalence elasticities from recent studies of youth smoking based on cross-sectional data.

A few recent studies have examined differences in price sensitivity by race and ethnicity. Farrelly, et al. (1998), for example, concluded that smoking by Hispanic and Black adults is more sensitive to price than smoking among White adults. Chaloupka and Pacula (1998) found similar differences among Black and White youths. To the extent that socioeconomic status is correlated with race/ethnicity, these findings may reflect differences in price sensitivity related to socioeconomic status. Townsend, et al. (1994), for example, using data from the British General Household Survey, concluded that people in the lowest income groups were most responsive to price increases. Farrelly, et al. (1998), found similar evidence in the US, estimating that the price elasticity of cigarette demand by persons at or below median family income was over 70 percent larger than for persons above the median. Chaloupka's (1991) finding that less educated persons were relatively more sensitive to price than more educated is consistent with these conclusions.

These findings have implications for the regressivity of tobacco tax increases. Over time, tobacco use has become increasingly concentrated in lower income groups and tobacco taxes paid as a share of income falls as income rises. Given this, many have argued that tobacco tax increases are highly regressive. However, the finding that lower income persons are more responsive to cigarette prices suggests that the regressivity of tobacco tax increases may be overstated. Using his recent estimates, Farrelly concludes that the relative share of federal taxes

paid by low income smokers in the US would decline as price increases, reducing the apparent regressivity of tobacco taxes (Farrelly, personal communication).

Finally, several studies have examined differences in price sensitivity between men and women. In general, studies from the US have found that men are more price sensitive than women (e.g. Lewit and Coate, 1982; Farrelly, et al., 1998) while those from the UK conclude the opposite (e.g. Townsend, et al., 1994).

Price, Tax, Substitution, and Compensating Behavior

Relatively few studies have examined the demands for other tobacco products, and fewer still have estimated cross-price effects for tobacco products. Using US survey data, Ohsfeldt, et al. (1998), found that higher taxes on smokeless tobacco products significantly reduced the prevalence of smokeless tobacco use among adult males. Chaloupka, et al. (1997), found similar evidence for young males. In addition, several studies have found evidence of substitution among tobacco products in response to changes in relative prices (e.g. Ohsfeldt, et al., 1998; Thompson and McLeod, 1976; Pekurinen 1989).

In a recent study, Evans and Farrelly (1998) considered a different type of substitution. Using data from the 1979 and 1987 USNHIS, they examined compensating behavior by smokers in response to cigarette taxes. They constructed alternative measures of daily smoking intensity that included total cigarette consumption, total length of cigarettes consumed, tar intake, and nicotine intake. While finding that smoking prevalence and daily consumption fell with higher taxes, Evans and Farrelly concluded that continuing smokers engaged in a variety of compensating behaviors. Specifically, smokers (particularly younger smokers) in high-tax states consumed longer cigarettes and cigarettes with higher tar and nicotine content than those consumed by smokers in lower-tax states. Given this compensation, they suggested that tar and nicotine based taxes may be needed to ensure the maximum health benefits from tax increases. In practice, however, tar and nicotine based taxes have been infrequently used because of the administrative difficulties associated with them.

While compensating behavior may partially offset the health benefits of higher tobacco taxes, two recent studies that directly examined the impact of cigarette taxes on health-related outcomes show that the health benefits of higher taxes are substantial. Moore's (1996) econometric analysis of annual US state-level data on tobacco-related death rates from 1954-1988 concluded that higher cigarette taxes would significantly reduce smoking-related deaths. Similarly, Evans and Ringel (forthcoming), using data on approximately 10.5 million US births from 1989-1992, concluded that higher cigarette taxes would significantly raise birth weight.

Finally, some have suggested that higher cigarette taxes would lead to substitution of other licit or illicit substances for cigarettes. The limited empirical evidence, however, suggests the opposite. Using data for adults from several of the US National Household Surveys on Drug Abuse, Farrelly and his colleagues (1999) found that higher cigarette prices reduced the probability and frequency of alcohol and marijuana use. Chaloupka and his colleagues (1999) reached a similar conclusion for youth marijuana use.

DISCUSSION

The empirical evidence clearly indicates that higher tobacco taxes will significantly reduce cigarette smoking and other tobacco use. Several caveats, however, should be noted.

First, for tobacco tax increases to have their maximum impact on consumption, the real value of the increase must be sustained. While *ad valorem* taxes will increase with nominal prices, specific taxes will be eroded by inflation unless they are increased frequently and by sufficient amounts to maintain their real value. In the US for example, the stability of cigarette taxes was a key factor in the nearly 40 percent decline in real cigarette prices from 1971-1981.

Second, given the evidence on substitution among tobacco products, comparable increases in the taxes on all tobacco products are needed to maximize the health benefits of a tobacco tax hike. Moreover, given the recent study by Evans and Farrelly (1998) on the compensating behavior of smokers, differential cigarette taxes based on tar and nicotine content may be needed to maximize the health benefits of a cigarette tax increase; more research is needed, however, to determine the impact of this type of tax structure.

Third, the impact of a tobacco tax increase on consumption depends on the magnitude of the price increase that results. Several studies have considered the relationship between cigarette taxes and prices in the US. Harris (1987), for example, concluded that the doubling of the federal cigarette tax in 1983 led to a price increase that was more than twice as large as the tax increase and that could not be accounted for by increased production costs. Instead, he suggested that firms used the tax increase as a coordinating mechanism for an oligopolistic price increase. Recent research by Keeler and his colleagues, however, does not find evidence of disproportionately large price increases resulting from tax increases (e.g. Keeler, et al., 1996). In general, they conclude that a one-cent increase in the US federal cigarette tax would produce about a one-cent increase in cigarette prices, while a comparable increase in a state's cigarette tax would lead to a somewhat smaller increase in price given the potential for cross-border shopping.

Fourth, to the extent that organized and casual smuggling of tobacco products results from a tax increase, the effect on consumption may be reduced. While increased tax differentials do result in some tax evasion, these differences are not the only determinant of cigarette smuggling. Joossens and Raw (1995, 1998) suggest that informal distribution networks, nonexistent or weak policies concerning cigarette smuggling, and their lack of enforcement can be as or more important determinants of smuggling than price differentials. Several options exist for limiting cigarette smuggling, including prominent tax-paid markings on all tobacco products and sizable increases in the penalties for cigarette smuggling. The Advisory Commission on Intergovernmental Relations (1985), for example, concluded that increases in the penalties for interstate cigarette smuggling in the U.S. led to substantial reductions in this activity.

Finally, earmarking tobacco taxes for tobacco control efforts, including education and prevention, media campaigns, cessation programs, and other public health efforts, as well as for crop diversification and other efforts to reduce the impact on tobacco growers can reduce some

of the welfare losses associated with the tax increase and lead to larger reductions in tobacco use (Hu, Xu and Keeler, 1998).

CONCLUSIONS

The review of the literature clearly shows that the answer to the question posed in the title of this chapter is 'very effective'. Increasing cigarette and other tobacco taxes will lead to significant reductions in the use of these products, resulting from reductions in the frequency of use by continuing users, as well as reductions in the prevalence of use. Given this evidence, higher tobacco taxes are likely to be the single most effective policy option for reducing the public health toll from tobacco. When combined with other tobacco control activities, which could be funded by earmarked tobacco taxes, even larger reductions in youth and adult tobacco use could be achieved.

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