

Effect of Cost on Cessation

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BACKGROUND ON THE ROLE OF PRICE/TAXATION

One of the best known principles of economics is that of the downward sloping demand curve. As the price of a commodity increases, the demand for that commodity will decrease. This law of economics can be extremely valuable in population-based tobacco control strategies. We can increase tobacco prices through tax policy, thus promoting reduced consumption.

The pricing of tobacco products is recognized as a key strategy in the “comprehensive plans” that health organizations have developed to guide tobacco control. The major health and medical organizations in the United States identify tax strategy as critical to achieving reductions in tobacco use, and the World Health Organization (WHO), in its publication *Guidelines for Controlling and Monitoring the Tobacco Epidemic* (WHO, 1998), lists tobacco taxes as a key strategy. It is important to ensure that the accessibility of tobacco products reflects the gravity of harm produced by these products. One important way of reducing this accessibility is to reduce the affordability of tobacco products by increasing the taxes imposed on them.

There is a substantial body of evidence, from the United States and elsewhere, demonstrating that a cigarette price increase will lead to a fall in overall cigarette consumption, though that fall will be less than proportionate to the increase in price. Much of the evidence on the role of price was summarized in the 1992 report of the Surgeon General, *Smoking and Health in the Americas* (U.S.DHHS, 1992), a 1993 summary report of a National Cancer Institute Expert Panel (NCI, 1993), and in the report of the Institute of Medicine (IOM), *Growing Up Tobacco Free* (IOM, 1994). In general, these analyses of the literature estimate that a 10 percent increase in the price of cigarettes will, all other things being equal, result in roughly a 4 percent decline in overall consumption (Chaloupka and Warner, 1999).

Price is also one of the few things tobacco companies acknowledge as affecting tobacco consumption. Filings with the Securities and Exchange Commission (SEC), and similar bodies in other countries, and reports to current or potential shareholders often mention the impact of price on sales. For example, the current 10-K filing with the SEC by Philip Morris Companies Inc. states (p. 4):

“In the opinion of PM Inc. and Philip Morris International, past increases in excise and similar taxes have had an adverse impact on sales of cigarettes. Any future increases, the extent of which cannot be predicted, could result in volume declines for the cigarette industry, including PM Inc. and Philip Morris International...” (Philip Morris, Inc.)

Recent research has reiterated the importance of price. A review of this evidence was carried out by Dr. Frank Chaloupka as a policy analysis paper for the Health Science Analysis Project (Chaloupka, 1998), which looked at the potential impact on health of the price components of the various tobacco-related bills which had recently been introduced in Congress. His review of the research leads to the conclusion, "...that substantial sustained cigarette tax increases are potentially the most effective means of achieving long-run reductions in smoking in all segments of the population."

The impact of price is sufficiently strong that it can be demonstrated simply by juxtaposing data on price and consumption. As shown in Figures 6-1 through 6-3, there is a pronounced tendency for per-capita consumption to move in an inverse relationship to real prices.

**OVERVIEW OF
RECENT STUDIES**

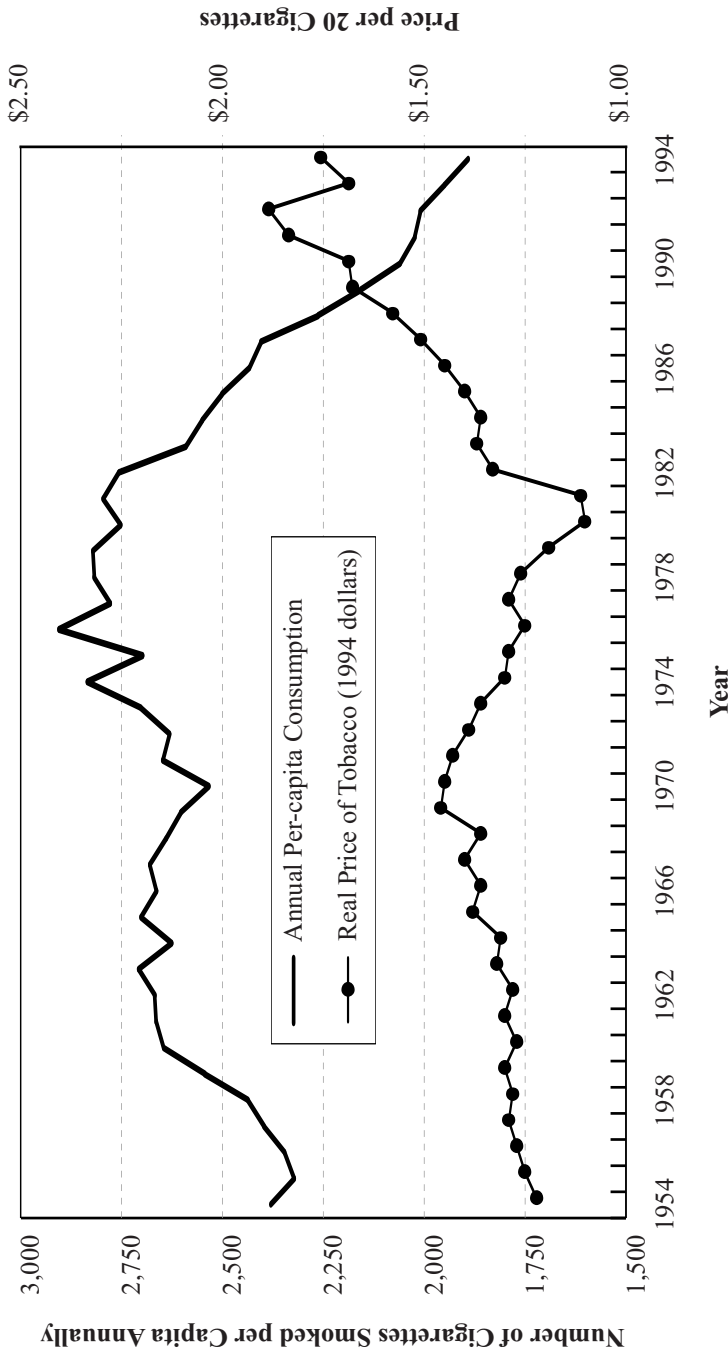
Although cigarette smoking is an addiction, even addictive behaviors have been shown to have downward sloping demand curves. This is an established effect quite independent of tobacco price studies. For example, it has been shown in animal experiments that there is an inverse relationship between the amount of work required and the consumption of an addictive substance (Bickel and DeGrandpre, 1996).

The idea that decisions about the use of addictive products can be made on the basis of a rational decision-making process is encompassed within the "rational addiction" model (Becker and Murphy, 1988), which is now widely accepted among economists (Chaloupka, 1991; Keeler *et al.*, 1993; Becker *et al.*, 1994; Sung *et al.*, 1994). Within this model, present consumption is influenced by past consumption and by the perception of the various costs of anticipated future consumption. Because of the role of past consumption in influencing current consumption, measures that reduce cigarette use in the present will have an additional effect on longer term use. In addition, increases in the perceived future costs of smoking will lead to reductions in current smoking.

There is significant evidence that young people are particularly price sensitive, and that this price-sensitivity will be reflected primarily in whether they smoke at all (Grossman and Chaloupka, 1997). By reducing the overall level of tobacco use within a population cohort, we create a strong tendency toward reduced consumption over the longer term. This, in part, explains the estimates that the long-term price elasticity is about double the short-term effect (Chaloupka, 1991; Becker *et al.*, 1994). This effect suggests that a 10 percent price increase could be expected to reduce overall cigarette use by about 4 percent in the short term, but by about 8 percent in the long term.

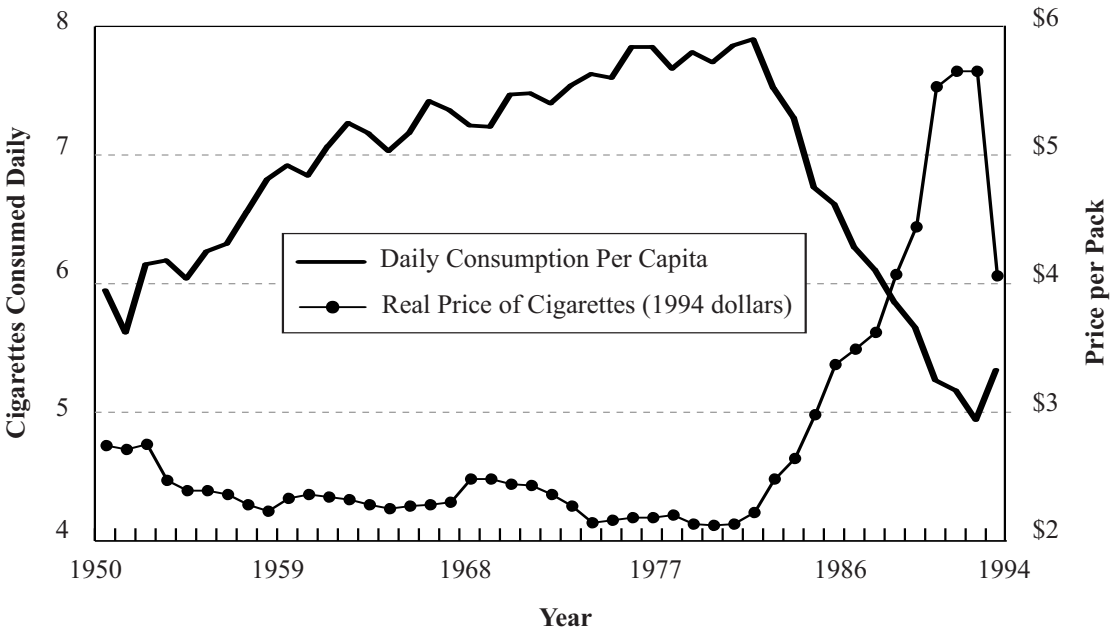
In terms of estimating overall population-based cessation, it is important to note that estimates of price responsiveness among smokers measure aggregate cigarette consumption. This is a combination of the effects of those who quit (or do not start) and those who reduce their consumption. A 4 percent decline in consumption does not mean a 4 percent decline in smoking prevalence. A recent analysis (Evans and Farrelly, 1996) estimated that approximately half of the impact of price on adult smoking is on the decision to smoke in the first place.

Figure 6-1
**Annual per Capita Consumption of Cigarettes and Real Price of Tobacco (per 20 Cigarettes):
 United States, 1954–1994**



Sources: *The Tax Burden on Tobacco*, published by The Tobacco Institute, Washington, DC, vol. 33, 1998
 U.S. Bureau of Labor Statistics, CPI (all items)

Figure 6-2
Daily Consumption of Cigarettes (per Capita) and Real Price of Tobacco (per 20 Cigarettes): Canada, 1950–1994



Notes: Data include the highest credible estimate of contraband tobacco.
 Cigarettes include fine-cut tobacco equivalents (1 g)

Sources: Canadian Tobacco Consumption, 1990–1994, Prepared by The Non-Smokers' Rights Association, 1994
 Statistics Canada, catalogues, 32-022 Monthly, 91-022, vol. 7, no. 3, 91-512 and 91-213
 Linquist Avey MacDonald Baskerville, Inc. "Contraband Estimate 1992—An Update" September 27, 1993

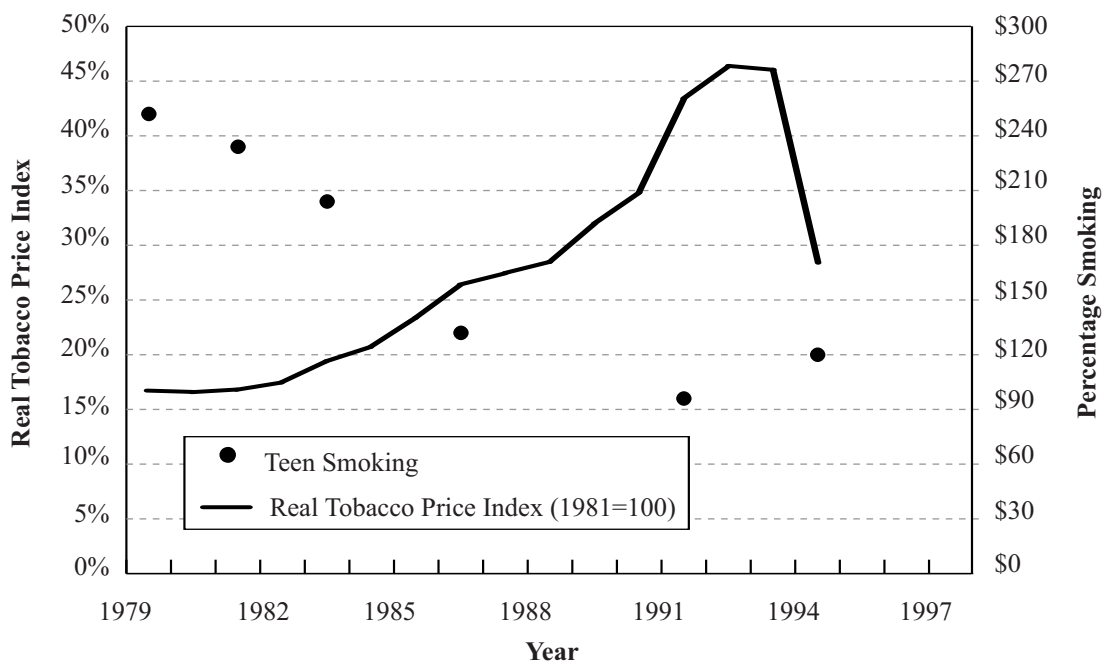
THE CANADIAN EXPERIENCE

From 1982 to 1991, there were rapid increases in the cost of cigarettes in Canada, caused primarily by a series of large tax increases. The real price of a pack of 20 cigarettes went from about \$2.10 to about \$5.40 (Sweanor *et al.*, 1994). Smuggling of tobacco products—supplied overwhelmingly by Canadian cigarettes shipped to the United States—led to a significant contraband market, which began to erode prices in 1992 and 1993. In early 1994 there were large tobacco tax reductions, bringing the average price of a pack of 20 back to about \$3.20.

There is no doubt that the rapid escalation of tobacco prices in Canada was accompanied by significant declines in consumption. In terms of total per-capita consumption, the decline among adults from 1982 to 1992 was approximately 40 percent, and among 15- to 19-year-olds, the decline was roughly 60 percent (Sweanor *et al.*, 1994; Sweanor and Martial, 1994).

This decline in Canadian per-capita consumption was significantly more rapid than that experienced in the United States. Figures compiled by the Canadian Tobacco Manufacturers' Council (CTMC, 1993) show that per capita cigarette consumption among those over the age of 15 declined by 42.4 percent in Canada from 1982 to 1992, compared to a decline of 25.7 percent in the United States.

Figure 6-3
Real Cigarette Prices and Daily Cigarette Smoking among Canadians: Age 15 to 19



Sources: Statistics Canada, *Labor Force Survey, 1991*
Canadians and Smoking: An Update, Health and Welfare Canada, 1991
Survey on Smoking in Canada, Cycle 3, 1994

The Canadian experience also showed that the declines in per capita consumption were accompanied by significant declines in prevalence. The federal health department (Health Canada, 1991) does periodic polling of smoking rates, and these rates show a decline in smoking prevalence from 39.5 percent in 1981 to 31 percent in 1991. Gallup, who does an annual survey, found a decline from 45 percent in 1981 to 33 percent in 1991. By far the most comprehensive surveys of smoking behaviors, however, are conducted by tobacco companies themselves. Data from Imperial Tobacco, a BAT affiliate that controls two-thirds of the Canadian market, show a decline in smoking prevalence from 39.4 percent in 1981 to 30.6 percent in 1991 (Imperial Tobacco, 1989; Imasco, 1993). In all cases, the percentage decline in the prevalence of smoking increased significantly during the time of rapidly increasing prices (Stephens, 1994).

The decline in smoking prevalence among 15- to 19-year-olds in Canada was more pronounced, as shown in federal government surveys (Health Canada, 1991). In 1981, 43.5 percent of 15- to 19-year-olds were smoking cigarettes and 39.5 percent were smoking daily. By 1991, only 22 percent were smoking at all and only 16 percent were smoking daily.

With the reduction in tobacco prices—a process that began with smuggling and was greatly enhanced by the tax reductions—the trend lines in tobacco consumption reversed. The best example of this is, again, data from the tobacco industry. RJR's Canadian subsidiary does monthly polling of smoking trends in Canada, and a year ago this information became available for the years 1988 to 1996 (RJR-Macdonald, 1997). The relationship of consumption rates with price changes is very strong. Among all adults it shows a decline in smoking prevalence from 31.0 percent in 1988 to 26.7 percent in 1991. There was a further small decline in 1992, coinciding with the growth of smuggling, but a slight increase (to 26.9 percent) in 1993 as smuggling peaked. The price cuts of 1994 correspond to an increase in smoking prevalence to 27.9 percent that year, followed by an increase to 28.4 percent in 1995 and a slight decrease (to 28.2 percent) in 1996.

The price effects indicated by the RJR data are even more pronounced among 19- to 24-year-olds. The data show a decline in prevalence from 33.4 percent in 1988 to 28.4 percent in 1992 and 28.3 percent in 1993. With the tax cuts, prevalence went to 29.6 percent in 1994 and was 32.3 percent in 1996.

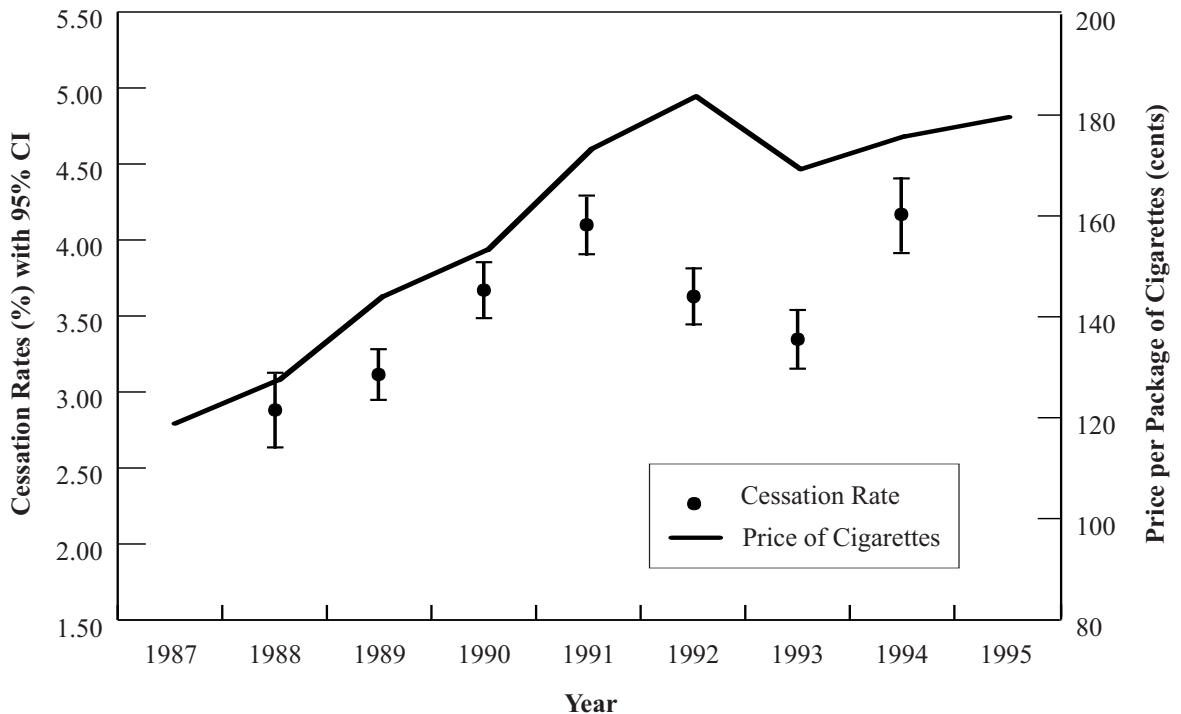
**EFFECTS OF COST
ON MEASURES OF
CESSATION**

Much of the work examining the role of cigarette cost as a tobacco control intervention has centered around using cigarette consumption as the measure of smoking behavior that is changing in relation to changes in cost. However, consumption can change because smokers quit long term, because smokers reduce the number of cigarettes that they smoke per day, because large numbers of smokers quit for brief periods and then relapse, or because fewer adolescents begin to smoke. Obviously the public health benefits of these different causes of reductions in consumption are vastly different, but few studies have been able to examine the effect of changes in cost of cigarettes on cessation due to the difficulties in obtaining population-based cessation data around the time of a price increase and the difficulty in finding an appropriate comparison group. We have utilized the 1992/93 and 1995/96 Current Population Surveys (CPS) which provide state-specific smoking prevalence and cessation data to examine the effect of cost on cessation in the United States.

**LONG-TERM
SUCCESSFUL
CESSATION**

The CPS asks all former smokers when they quit smoking, allowing identification of the calendar year in which they quit. These data allow estimation of annual successful cessation rates. The number of current smokers for each of the years prior to the survey is estimated by adding those who are current smokers at the time of the survey and those who have quit between the year in question and the survey year. This number forms the denominator of the cessation rate for each calendar year. The number of these current smokers who report having quit during that year forms the numerator. By restricting the analyses to those who have been quit for at least 1 year at the time of the survey, only those who are successfully quit for 1 year or more are included in the numerator; and the estimates become an annual estimate of long-term (1 year or more) successful cessation for each of the calendar years. Use of 5- and 10-year digit preferences in the response to the question on how long ago the former

Figure 6-4

Long-Term Cessation Rates* versus Price of Cigarettes: United States

* The at-risk population for each calendar year includes those CPS subjects who reported smoking during that year and who responded to the CPS no less than 2 calendar years and no more than 4 calendar years from the year for which the rate was calculated. Long-term quits are those that are at least 1 year long.

smoker quit limits the utility of calendar year quit rate estimates to those within 4 years of the survey. But by combining the 1992/93 and 1995/96 CPS it is possible to get calendar-year, long-term successful cessation rates for the period of 1988-1995.

Figure 6-4 presents these calendar-year, long-term successful cessation rates in conjunction with the average sales-weighted cost (Tobacco Institute, 1998) of a pack of cigarettes for the same years. There is a remarkable concordance between the cost and cessation data, particularly for the fall in cost and fall in cessation that occurred between 1992 and 1993 as part of a price competition triggered by the discounting of the prices of Marlboro and other premium cigarettes. This pattern suggests that at a macro level there is a concordance between cost of cigarettes and cessation rates.

MEASURES OF CESSATION

There is a marked disparity in the cost of cigarettes among different U.S. states. This disparity is produced by differences in the state excise taxes on cigarettes and by differences in the market share of different brands of cigarettes, particularly of generic brands that sell at a steep discount to full-price premium brands such as Marlboro. Differences across states in cost of cigarettes can be compared to differences in state-specific

cessation measures (cessation attempt, being a former smoker, being a former smoker for 3+ months (see Chapter 2)) for those who were daily smokers 1 year prior to the CPS. These measures provide state-specific estimates of the rates of cessation attempts and cessation success that can be compared to the differences across states in the absolute cost of cigarettes.

Cost measures were calculated separately for each month of the CPS (September, January, and May). The cost measures were the average of the annual costs for the 12 months prior to the survey month, with the change in cost estimate for the 3+ month cessation analysis excluding the costs for the 3 months prior to the survey—*i.e.*, it was an average of 9 months rather than 12. An appendix to this chapter contains a more detailed description of the methods used in these analyses.

An analysis of repeated measures for these data were performed and are included in the appendix. There are statistically significant effects identified for the association between absolute costs of cigarettes and increases in cessation attempts, being a former smoker of any duration, and 3+ month cessation success. The effect of the prior year's absolute cost on becoming an occasional smoker was not statistically significant. Table 6-1 quantifies the magnitude of this effect of cost on cessation by expressing the change expected in the cessation measures based on various percentage differences in the cost of cigarettes. The differences are somewhat dependent on the starting point chosen for calculation of the differences in cost and the baseline rate of cessation in the state, but these estimates provide a general measure of the magnitude of the effect found in the analysis. For example, if the difference in the price per pack of cigarettes between states is from \$2.00 to \$2.30 (a 15 percent difference), the analyses would predict that there would be a difference in cessation attempts from 30 percent to 32.1 percent (a 7.1 percent increase) and a difference in 3+ month cessation rates of from 5 percent to 5.4 percent (a 10.6 percent increase). These absolute differences may appear small, but they are similar to or larger than the price elasticities calculated for the acute effects of cost changes on consumption, and they would accumulate over time to have a much larger effect on prevalence as described above. These analyses are cross-sectional in nature, and it is likely that many of the same environmental factors that allow a high excise tax within a state will have an effect on cessation independent of their effect on the cost of cigarettes. The association of these other factors with the cost measure will overestimate the independent effect of cost on cessation in these analyses. However, these data provide further support for an effect of cigarette cost on smoking cessation as one mechanism for the reduction in cigarette consumption measures demonstrated following increases in excise taxes.

CAVEATS Many factors must be kept in mind when analyzing the potential impact of price policies on population-based cessation. To begin with, economists talk about “real” (*i.e.*, inflation-adjusted) prices. Price increases must be sustained, or the impact will be eroded by inflation.

Table 6-1

Predicted Difference in Cessation Measures for Various Differences in the Cost of Cigarettes

(Estimated from the Relationship across States between the Percentage Difference in Cost and Percentage Difference in Cessation Measures, Controlling for the Random Effects of Time and State, CPS 92/93 & 95/96 Combined)

Percentage Difference in Cost (%)	Difference in Cessation Measures Expressed as a Percentage		
	Cessation Attempts* (%)	Former Smokers	
		Any Length (%)	3+ Months (%)
5	2.4	2.6	3.6
10	4.8	5.2	7.1
15	7.1	7.7	10.6
20	9.4	10.1	14.0
25	11.6	12.5	17.4
-5	-2.5	-2.7	-3.6
-10	-5.0	-5.4	-7.3

*Attempts: Includes those who have made a quit attempt or have become former smokers, excludes occasional smokers.

For example: A state charges \$2.00 for a pack of cigarettes, 30% of its residents made a quit attempt and 5% became former smokers. If the price per pack is raised to \$2.30 (a 15% increase in cost), the analysis would predict the reported cessation measures to increase to 32.1% and 5.4%, respectively.

Price data may not accurately reflect what is actually paid for the product. For instance, “average prices” in the United States often use the price of Marlboros as the standard or use a market-weighted average price. Such methodologies fail to take into account market segmentation on pricing issues. Looking at average prices ignores the role of cheaper cigarettes as a way of retaining price-sensitive smokers.

To examine the effect of price on price-sensitive smokers we need to know what prices these people are actually paying. This means knowing about not only cheaper cigarette brands, but also about the role of discount coupons and the provision of merchandise (such as Marlboro gear) that effectively lowers the price paid for the product.

Most pricing analyses, like most other research on tobacco consumption, are based on examining one variable while holding other variables “constant.” This, of course, does not work well in practice, as many other factors change over the same time periods that a change in price occurs. Studies of price need to consider the following:

- Disposable income. There is an income elasticity as well as a price elasticity. Looking only at prices will miss the overall impact of affordability. This is particularly significant when looking at relatively small price increases during times of significant disposable income changes. These income changes may be particularly significant among adolescents and young adults and may dwarf the effects of measured price changes.
- Promotional activities. The activities of tobacco companies can increase the perceived value of tobacco products in the eyes of purchasers as a way of combating the effects of higher prices. Tobacco companies are quite capable of fighting back against an increase in excise tax by increasing promotional activities in

order to retain existing users and attract new users. This can happen through promotions such as Marlboro gear, Joe Camel, and tobacco-product movie placement.

- Population differences. Populations change over time. Looking at the effects of price on smoking rates over time in, say, Vancouver or California without taking into account changing demographics may simply miss key associations. It may be that there is a broad-based change in consumption due to price, but this change needs to be distinguished from consumption changes due to other factors such as high numbers of non-smoking immigrants.

SUMMARY

Cost is clearly one of the major public policy tools that can influence smoking behavior. Increases in the cost of cigarettes have been shown to reduce cigarette consumption across a wide range of political jurisdictions and time periods. It is estimated that a 10 percent increase in the cost of cigarettes can be expected to reduce cigarette consumption by 4 percent, for a price elasticity of 0.4. Adolescents appear to be more sensitive to the effect of increasing cigarette costs. Data comparing long-term cessation rates in the United States with changes in the sales-weighted average cost of cigarettes show a fall in cessation when the cost of cigarettes was reduced between 1992 and 1993 as part of a cigarette price competition. Comparison of differences in costs across states with differences in cessation rates shows a statistically significant association of the absolute cost of cigarettes with both cessation attempts and 3+ month successful cessation. Taken as a whole, these data support an effect of cost on both cigarette consumption and smoking cessation.

Appendix

CPS CESSATION MODELS WITH COST: SUMMARY OF METHODS USED IN REPEATED MEASURES ANALYSIS

Population

The analysis includes cessation measures based on respondents of the Current Population Surveys for 1992/93 and 1995/96, who are 25 years of age or older. To be included in the analyses, these respondents must have a valid current smoking status (daily, occasional, or former) and must have been daily smokers 1 year ago. In other words, respondents who did not answer whether they had smoked at least 100 cigarettes (Question 32), whether they currently smoke (Question 35), and whether they smoked daily 12 months ago (Question 61) are excluded from the analysis. Additionally, respondents are excluded from the analysis if they are:

- current daily and occasional smokers with unknown quit attempts (Questions 44 and 45),
- current occasional and former smokers who have not been daily smokers for at least 6 months (Questions 39 and 55), or
- current former smokers with unknown lengths of quit time (Question 59).

Additionally, the cessation measures were calculated for all states (plus D.C.) for each survey month (Sept 92, Jan 93, May 93, Sept 95, Jan 96, and May 96), yielding six repeated measures for each state.

Below is a summary of the number of respondents used for the cessation measures for the CPS for various years.

Population	Sept 92	Jan 93	May 93	Sept 95	Jan 96	May 96
Respondents to Current Population Survey	105,937	105,148	104,920	98,082	87,336	87,811
Daily Smokers 12 months ago	15,194	15,367	14,255	13,314	11,564	11,516
Daily Smokers 12 months ago, age 25+	13,676	13,830	12,815	12,081	10,473	10,363

Outcomes The five different cessation outcomes modeled using the CPS algorithm were as follows:

Change	Daily smokers 1 year ago who have either tried to quit (current daily smokers with quit attempts in the past year), have become occasional smokers, or have quit altogether (current former smokers).
Attempts	Daily smokers 1 year ago, excluding current occasional smokers, who have tried to quit or who have quit. Current occasional smokers have been excluded from the analysis of this outcome since their attempts to quit are not monitored on the CPS.
Occasional	Daily smokers 1 year ago who have become occasional smokers.
Former	Daily smokers 1 year ago who have quit smoking, regardless of the length of this current quit effort.
Former, greater than 3 months	Daily smokers 1 year ago who quit smoking at least 3 months prior to the survey.

Covariates The following fixed effects are used to model the cessation outcomes:

Time-weighted Price for Prior Year's Absolute Cost	The price of cigarettes for all states (plus D.C.) was obtained from <i>The Tax Burden on Tobacco</i> (Tobacco Institute, 1998). Each price is the weighted average price per package for the calendar year.
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To calculate an appropriate cost measure of time for the cessation measures Change, Attempt, and Any Former, we weighted the price for each calendar year by the number of months in each year that spans the 12-month period prior to the survey month.

To calculate an appropriate cost measure of time for the cessation measure Formers with at Least 3 Months Quit Time, we weighted the price for each calendar year by the number of months in each year that spans the 9-month period 3 months prior to the survey month.

The following random effects are used to model the cessation outcomes:

Month/Year A continuous variable that takes into account the length of time between the survey months. This variable is needed to account for the unequal time intervals in our repeated measures analysis.

Month/Year	Code
September '92	1
January '93	2
May '93	3
September '95	10
January '96	11
May '96	12

State A categorical variable that assigns a number to each state (plus D.C.).

Variables *State* and *Month/Year* were used as random effects to address the issue that observations from the same state are correlated as are observations from the same year.*

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* SAS System for Mixed Models by Littell *et al.*, Chapter 3, pp. 130-132.

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