

The Economic Impacts of Cigarette Tax Reductions on Youth Smoking in Canada

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Abstract

Cigarettes are the most commonly consumed recreational chemicals used by Canadians. The current smoking rates (using 1999 data) are 33.7 % for young adults (20-24 years of age) and 28.1 % for youth (aged 15 to 19). These numbers for younger persons are particularly alarming to health officials and policy makers since most smokers begin smoking in their youth with a “single puff”. As is well documented, cigarette consumption is linked with premature death and supplemental morbidity effects that put increased stresses upon the provision of health care in Canada. Health officials need to know what tools are particularly useful in discouraging youth from taking up smoking in the first place.

This paper estimates smoking demand models for Canadian youth and young adults using the National Population Health Data (NPHS) data from over the period of 1994-1998. The data span a five year period starting after the introduction of very large tax cuts to stem a big increase in the smuggling of illegal cigarettes into Canada from the United States. Since the initial tax cuts, taxes have crept up gradually. In spite of these increases real cigarette prices in 1998 were still less than they were in 1994 for more than half of the Canadian population.

Using the NPHS data we calculate a participation elasticity of -0.914 for youth aged 14 to 18. This suggests that a 1 % decrease in the price of cigarettes would increase the number of daily smokers in this age group by 0.9 %. Thus, the tax cuts almost certainly led to increases in both the number of daily youth smokers and also to increases in the numbers of young people who begin smoking at earlier ages.

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1. Introduction

Cigarettes are the most commonly consumed recreational chemicals used by Canadians (CPA, 2000). The 1999 smoking rate for Canadians aged 15 and over is about 25 %¹. In looking at the rates for younger smokers, the comparable rate for young adults (20-24 years of age) is 33.7%, while the rate for youth (aged 15 to 19) is 28.1% (Gilmore, 2000). These point statistics mask an important difference in the trend rates for smoking over the last decade. While the overall smoking rate in the population fell by 10 % points from a high of 35.1 % in 1985 and the young adult rate fell from 42.7 % to its current rate, the youth rate actually rose from its 1985 level of 26.2 %. Figure 1 illustrates the trend rates over the period 1981-1999. Of particular note is the rapid increase in the prevalence rate for youth aged 15-19 during the period 1990-1996, for this was a period of great flux in the overall smoking environment. Changes that took place during this period included the availability of cheap, illegally imported cigarettes and the consequent move by the Federal government to discourage this activity through a large cut in cigarette taxes that ultimately saw retail cigarette prices reduced from between 10% to 44 % in the ten provinces. (See Table 1.)

Public health officials find this situation worrisome since cigarette smoking has been correlated with an increased incidence of a number of serious health conditions, including heart disease, lung cancer, emphysema, and other chronic lung diseases. In addition to these morbidity effects, smoking is implicated in 45,000 premature Canadian deaths annually (Makomaski-Illing and Kaisermann, 1995), which is approximately 21 % of all deaths in Canada (Health Canada, 1996). Of further concern is the fact that

detrimental health effects are felt not only by the individual who chooses to smoke, but also by individuals who chose not to smoke. External effects from smoking include asthma caused by breathing, second-hand smoke and low birth weights for children of women who smoke during pregnancy. Kaisermann (1997) shows how the costs to Canadian society from smoking have increased steadily over the period 1966-1991 to \$15 billion in 1991 (1991 Canadian \$). This is an underestimate, however, since he includes only direct costs² – these include both health care costs of \$2.5 billion and \$10.5 billion in lost future income due to premature death, as well as costs of residential care, fires, and absenteeism – only for individuals who have ever smoked.

A particular focus for health research and policy in the last decade has been to discourage adolescents from starting to smoke. The argument to support such a policy comes from evidence showing that most adult smokers develop their addictions during their teenage years starting with an occasional ‘puff’. (Mao, Gibbons, and Wong, 1992) provides data to show that 80 % of adult smokers start regular tobacco consumption before their 18th birthday. Thus, in order to prevent established adult smoking and the attendant health effects, it is necessary to reduce the number of adolescents who initiate smoking. The key question is which tools are most effective at providing disincentive effects for potential youth smokers.

In the United States, research has shown that package warnings, negative health publicity and restrictions on the locations in which people may smoke are not really effective at reducing the incidence of smoking (Chaloupka and Grossman, 1996). What does appear to work, however, is an increase in the price of cigarettes via tax increases.

¹ This is somewhat higher than the comparable rate in the US of 23.2 % (WHO, 1997).

This is an important observation since economic models suggest that young smokers are more likely to be sensitive to the price of cigarettes than older, addicted smokers. Empirical evidence from the United States provides support for this view with elasticity estimates that are used to predict how responsive individuals may be to price or tax changes.³ There are two aspects to the nature of responsiveness to tax changes. The first, the elasticity of participation, shows the percentage decrease in numbers of smokers in a population in response to a tax increase. The second, conditional elasticity of demand, applies to actual smokers and shows how many fewer cigarettes are smoked in response to a tax increase. The current consensus using micro data from a number of different surveys conducted in the United States is that the overall price elasticity of youth cigarette demand (this is the sum of the participation and conditional demand elasticities) ranges between -0.9 and -1.5 (Ross and Chaloupka, 2002). Chaloupka and Warner (2000) and Evans et al. (1999), looking at estimates from cross-sectional studies, suggest that the elasticity of smoking participation among youth falls in the range of -0.5 to -0.7 and that adults have a much less elastic demand for cigarettes – their elasticity estimates fall in the range of 0 to -0.25. Taxation, therefore, appears to be an attractive tool that may discourage young people from taking the puff that turns into an addiction.

This discussion and the statistics cited provide the background for the issue of interest to this paper, which is the impact of adjustments made to the level of cigarette excise taxes in Canada over the early part of the 1990s upon smoking decisions of

² He does not include any estimates of the indirect costs imposed by cigarette smokers upon non-smokers.

³ The elasticity of demand is a unit-free measure that yields information about the responsiveness of quantity demanded to a change in the price of a good. It is defined as the percentage change in quantity demanded associated with a one percentage change in the price of a good. A value less than one is considered to be inelastic, thus a one percentage change in price results in a less than one percentage change in quantity demanded (consumed).

Canadian youth. This period saw excise taxes first increase and then fall dramatically in 1994 when officials realized that increased excise taxes led a large increase in cigarettes smuggled into Canada from the United States. Data exist that suggest that the smoking rate for youth, aged 15 to 19, actually rose significantly by 6.5 % from the period of 1991 to January 1, 1994, however, this is found by comparing aggregate rates of consumption across different surveys. There are no Canadian estimates of elasticities that are based upon the decisions of individual consumers. From a public policy perspective, it is necessary to know what the participation and conditional demand elasticities are in order to determine effective future excise tax increases might be at reducing youth participation rates that will, in turn, lead to reduced adult smoking consumption.

While it is possible to apply elasticity estimates from the large number of studies that have looked at smoking decisions of American youth to the Canadian situation, it is preferable to obtain estimates from Canadian data, if possible. Canadian observations reflect not only different regulatory and tax policies, but also different ethnic and cultural influences, than American observations. Thus, the American estimates may not be entirely applicable to the Canadian situation. For example, prices in Canada have tended to be higher than in the United States, although Canada has seen more drastic changes in excise taxes. Moreover, a number of states support large tobacco industries and this has led to somewhat relaxed views in these states about cigarette consumption. Canada does not have a similar situation. Finally, the socio-demographic characteristics of the two countries differ in terms of ethnic backgrounds and racial characteristics and some of these characteristics have been shown to be important factors in determining both the decision to smoke and the intensity of smoking once that decision has been made.

This paper estimates smoking demand models for Canadian youth and young adults using the National Population Health Data (NPHS) data from over the period of 1994-1998. The elasticity estimates are the first ones produced for youth using this micro-level data set.

The remainder of the paper is structured as follows. Section 2 provides institutional background about the consumption and taxation of cigarettes in Canada. Section 3 discussed the previous, largely American, literature on youth smoking. In Section 4 the dataset and variable construction are described. The empirical model and results are discussed in Section 5. The paper concludes with a discussion of the implications of the results in Section 6.

2. Institutional Background

In order to understand how government policy might have an impact upon smoking prevalence, it is instructive to examine the composition of the final cigarette price faced by consumers. Cigarette sales in Canada are subject to a number of different taxes, including a federal excise tax, provincial excise taxes, and both federal and provincial sales taxes. Beginning in the late 1980's both federal and provincial excise taxes were increased by an average of 84 % per pack of 20 cigarettes (from an average of \$1.90 per pack to \$3.50 per pack). By doing so the Department of Finance hoped to reinforce the government's national strategy (the National Strategy to Reduce Tobacco Use or NSRT) to reduce tobacco use in Canada. Ironically due to events south of the border, this had the opposite effect to that intended.

Traditionally, cigarette prices have been lower in the United States than in Canada. For example, over the 1980s and 1990s the average real price per pack of cigarettes in the

United States was \$1.86 (1999 US \$). The comparable average price in Canada was \$2.33 (1999 US \$) (Gruber, Sen, and Stabile, 2002). However, the gap between Canadian and U.S. prices widened in the early 1990's from a combination of two actions. The first was the increase in both federal and provincial excise taxes on cigarettes in Canada. The second was a price reduction in the United States by the Philip Morris Company on its teen-oriented brand of cigarettes (Marlboro)⁴, which encouraged other American cigarette manufacturers to lower their prices. In spite of two increases in US Federal excise taxes on cigarettes, the real price of cigarettes fell by 10 % after inflation-adjustment. This encouraged an increase in smoking prevalence among youth and young adults over the 1990's, which was in contrast to the reduction in smoking prevalence among adults.

The widening price gap for cigarettes in the two countries created an arbitrage opportunity⁵ and encouraged the smuggling of cigarettes from the United States to Canada, thereby giving Canadians access to relatively cheaper cigarettes. Ironically, the smuggling was permitted through the channel of legal export of Canadian-produced cigarettes to the United States and illegal re-import of these cigarettes to Canada. At its peak, it is claimed that smuggled cigarettes amounted to one third of all domestic cigarette consumption (Gruber, Sen, and Stabile, 2002).

In response to the problems of large numbers of cigarettes being smuggled into Canada, the Federal government decided to reduce cigarette and tobacco taxes dramatically, although, not to the same extent in all provinces since the smuggling was concentrated largely in Eastern Canada (namely, in the provinces of Ontario, Quebec, New Brunswick, Prince Edward Island, and Nova Scotia) where the prevalence of native

⁴ Gruber and Zinman (2000) provide evidence that 60 % of youth smokers use this brand.

reservations (not subject to the same regulations as non-native land) close to the border meant that it was relatively easy to re-import legally exported cigarettes. These provinces followed suit and lowered their excise taxes. These tax cuts took place over a very short period of time beginning in January 1994 and ending by mid-April 1994. Combined tax cuts by the latter time amounted to between \$14 and \$21 (\$C1994) per carton (Hamilton et al., 1997a).

3. Previous Literature

While a number of studies have examined the price sensitivity of cigarette demand using aggregate or state level consumption data (Becker, Grossman and Murphy, 1994), the literature most directly relevant to this paper is that which uses micro-based data sets.⁶ Lewit, Coate and Grossman (1981) use Cycle III of the Health Examination Survey (HES-111) conducted from March 1966 through March 1970, which provides data on individual smoking behavior of 5,308 individuals, aged 12 to 17, to estimate smoking participation and condition cigarette demand equations. They estimate two-part cigarette demand models that look first at the probability of smoking participation and then at the quantity of cigarettes smoked as separate decisions. The overall price elasticity they obtain is -1.44 which is found by summing the participation elasticity of -1.20 to the conditional demand elasticity of -0.25. In a later 1982 study Lewit and Coate use the 1976 Health Interview Survey (HIS) to examine the behavior of individuals 20-74 years of age. For the older age groups they find a much lower price elasticity of demand (-0.42

⁵ When the same product can be purchased in one market for a low price and sold in a different market at a higher price, the individual undertaking these two transactions can make a profit.

⁶ Aggregate studies using state level observations are likely to provide elasticity estimates that are upwardly biased (in an absolute value sense) since the unit of observation is the state and quantity of cigarettes consumed is usually taken to be tax-paid cigarette sales per capita (Lewit and Coate, 1982).

overall). As before, however, their findings suggest that the participation elasticity is much larger than the conditional demand elasticity. Thus, an increase in the price of cigarettes is expected to have a much larger impact upon the decision to smoke as compared with its impact upon the quantity of cigarettes smoked.

Since Lewit and Coate use cross-sectional data, they rely upon price differences across the states for price variation. However, these states (particularly those that grow tobacco) employ different types of smoking regulations. Wasserman *et al.* (1991) argue that the finding of significant price elasticities may be the result of neglecting to account for differences in state level antismoking regulations that would have an effect upon individual's behavior. They use National Health and Nutrition Examination Survey II (NHANESII) for individuals aged 12-17. When they include variables such as antismoking regulations, they find that the price variable does not have a significant effect upon the number of cigarettes smoked by youth. A positive correlation between cigarette prices and state tobacco control policies is seen as the culprit in biasing upwards the coefficients found in the earlier studies. However, other studies that include such an index of antismoking regulations find it to be insignificant.

These early studies neglect the role of nicotine addiction in cigarette consumption. Chaloupka (1991) explicitly takes up this issue by developing a model of rational economic behavior and then uses data on 17 to 24 year olds from the National Health and Nutrition Examination Survey II (NHANESII) to estimate smoking demand functions that include previous and future cigarette prices. He finds strong evidence that cigarette smoking is addictive and that men are more responsive to price changes than women.

However, such sales do not reflect actual consumption in a number of states, particularly where smuggling or bootlegging is wide-spread.

Interestingly, he also finds that the group of young adults being studied, who are aged 17 to 24, are less responsive to price changes than older groups of individuals, which contradicts the earlier findings of Lewis and Coate (1981). Finally, the long-run price elasticity of demand is estimated to be about double that of the short run price elasticity.

Chaloupka and Grossman (1996) use three years of data (1992-94) on students in grades 8, 10, and 12 from the Monitoring the Future Project to focus upon how youth smoking is affected by a number of different anti-smoking policies, including the use of excise taxes to raise cigarette prices, restrictions on smoking in public places, and limits on the accessibility of cigarettes to youth. The dataset includes information on a nationally representative sample of individuals and is used to estimate both a smoking participation demand model and a conditional smoking demand model. The authors find that cigarette prices have negative and significant coefficients in both equations. When they control for the percentage of excise tax revenues devoted to anti-smoking activities, however, they find that the value of the price coefficient falls by a large amount.⁷ The authors calculate a set of average elasticities from their various model specifications. The participation (or prevalence) elasticity is found to be -0.675, while the conditional demand elasticity is -0.638, leading to an overall (or unconditional) elasticity of -1.313. These results suggest that youth do have a larger degree of price sensitivity than adults since the consensus on the adults' price elasticity is that it falls within the range of -0.3 to -0.5 (National Cancer Institute, 1993). However, anti-smoking regulations appear to have little impact upon choices, possibly because they are not strictly enforced. Outright

⁷ They argue that this result is to be expected since the percentage of excise taxes devoted to anti-smoking activities and cigarette prices are highly correlated. The reason for this correlation is that states with the largest excise tax increases (leading to higher cigarette prices) are those which have increased the tax-supported anti-smoking activities the most, especially, California, Massachusetts, and Michigan.

bans on smoking in public places that are stringently enforced appear to have more effect than restrictions on youth access to cigarette purchases.

Evans and Huang (1998) take up the challenge of trying to control for state-specific attitudes towards smoking that might influence the results. They use repeated cross-sections of the Monitoring the Future data and include state fixed effects to control for fixed state tastes towards smoking. They find a significant participation price elasticity of -0.5 for teenagers over the 1985- 1992 period.

Using the Monitoring the Future data described above, Chaloupka and Pacula (1998) look at the implications of limits on youth access for smoking rates. Their total price elasticity demand estimate is -1.141, with the participation elasticity being -0.618 and the conditional price elasticity being -0.523. They also find differences in the price elasticity by gender, with young males being more responsive to price than young females, and race, with young blacks being more sensitive to price than young whites.

More recently, researchers have begun to look at heterogeneity of responses to cigarette price changes among adolescents. Gruber (2000) and Gruber and Zinman (2000) compare teen smoking elasticities from a number of different surveys conducted over the 1990's. These surveys include: the public use data set from the Monitoring the Future (MTF) surveys over the 1976-1997 period, (only high school seniors and little locational information), the restricted use MTF data on 8th, 10th, and 12th graders, from 1991 through 1997, Youth Risk Behavior Survey (YRBS) with data from 1991, 1993, 1995, and 1997 on a large sample of 9-12th graders, and the Vital Statistics Natality Detail Files. The data yield information on the smoking behavior of mothers during pregnancy. The authors find that high school seniors in the MTF data set have a

participation elasticity of -0.67 and a conditional elasticity of -0.06. However, they find no significant price impacts for younger students (8th and 10th graders) in the MTF data set. Over the full sample of MTF data, the price elasticity for participation is only -0.31, with a conditional intensity elasticity of -0.03. In contrast, the elasticities obtained from the YRBS data are very large: the elasticity of participation is -1.5, as is the elasticity of conditional intensity. Using the Natality data, however, the elasticities are -0.38 for participation and -0.15 for conditional intensity.

Thus, they find that older teens are more price sensitive. It may be that that younger teens experiment with cigarettes by borrowing from friends and not through their own purchases. In this case, they are likely to be less sensitive to prices. However, as they get older, these teens are purchasing the cigarettes themselves and we would expect them to be more sensitive to price changes. A further reason for differences in the elasticities arises from the population sampled. In this case, it is important to note that, for the YRBS and MTF data sets, observations are only available for students and not high school dropouts. These latter may have a different price sensitivity, particularly if they are earning their own money and using that to purchase cigarettes.

Confirmation of some of the concerns expressed by Gruber and Zinman (2000) about the role of experimentation among younger teens is provided by Emery, White and Pierce (2001). These authors use the 1993 data from TAPS (the longitudinal teenage attitudes and practices survey) conducted in the United States to identify three categories of smokers: never smoked, experimenters, and established smokers. Their hypothesis is that experimenters may have different price elasticities from established smokers. They find that cigarette prices are not significant explanatory variables for experimenters.

However, the overall price elasticity of demand that they calculate for so-called established smokers (individuals who have smoked in the last 30 days and have smoked more than 100 cigarettes in their lifetime) who are 14 to 22 years of age was -2.24 (-1.56 for participation and -0.68 conditional demand). Current smokers of 14 to 22 years of age are defined as having smoked in the last 30 days but not having smoked 100 cigarettes in their lifetime. For this group, the elasticity of demand was smaller: -1.70 overall comprised of -0.83 for participation and -0.87 for conditional demand.

Most recently, Ross and Chaloupka (in press) use data from a survey conducted in 1996 amongst high school students in the United States. Using a number of different measures of cigarette price (including individually perceived prices and high school average perceived prices along with state average prices), they find the elasticity values associated with the perceived prices are higher than those associated with the state prices. Their total price elasticity values range from -0.670 using state average prices to -1.514 using individually perceived prices.

Some general conclusions can be made about the sensitivity of youth to cigarette prices and anti-smoking policies that take the form of excise tax increases. First, results from cross-sectional micro data on individual respondents generally confirm that youth smokers are sensitive to prices with a current consensus for the overall price elasticity of youth cigarette demand is in the range from -0.9 to -1.5 (U.S. Department of Health and Human Services, 2000). Second, not all youth are the same and there are likely to be differences amongst daily smokers and casual smokers, as well as differences by gender and racial/ethnic group. Third, it appears that the participation elasticity is generally larger than the intensity elasticity, thereby providing partial confirmation about the

addictive nature of cigarettes. Thus, if public policy aimed at increasing taxes in order to reduce smoking rates is to be effective, it should be aimed at discouraging participation in the first place.

In contrast to the many studies from the United States, there have far fewer Canadian efforts to look at price elasticity of cigarette demand. Those studies that have used Canadian data have tended to use national time series data on aggregate consumption, although work by Hamilton et al. (1997b) and Sen and Wirjanto (2002) are exceptions. The estimates of the overall elasticity of cigarette demand using a number of different periods within 1950-1981 of national time series data are around -0.73 (Thompson and McLeod, 1976; Collinshaw and Rogers, 1984). Using more recent data for the period of 1968 to 1990 Reinhardt and Giles (2001) obtain an overall estimate of -0.62. Galbraith and Kaiserman (1997) also use national time series data on legal cigarette sales over 1980 to 1994 and add estimates of smuggled exports to it in order to obtain the total number of cigarettes sold. They find a short run elasticity of legal consumption of -1.01, but a much lower elasticity of -0.40 for total consumption. Hamilton et al (1997b) obtain elasticities in the range of -0.3 but do not focus especially upon youth. Sen and Wirjanto (2002) use a longitudinal data set for the period 1990-1996 (the third Waterloo Smoking Prevention Project (WSPP-3)) of smoking habits of children from grades 8 to 12, attending schools in the Waterloo region of Ontario. They find participation elasticities that range between -0.155 and -0.393 with the former pertaining to individuals who do not have smoking peers and the latter pertaining to youth with smoking peers. They also calculate daily smoking elasticities for the same two groups -0.105 and -0.491. In order to compare their Ontario-based results, the authors also use a single year (1994)

of nationally representative data from the Youth Smoking Survey (YSS). However, they find the coefficient on price in the smoking participation equation is positive and insignificant. The coefficient on price in the conditional demand equation is positive and significantly different from zero. The YSS data confirm that smoking behaviour of family and friends is significantly and positively linked to the respondent's own smoking choices.

4. Data

Our study uses data from the National Population Health Survey (NPHS). This is a national longitudinal data set intended to provide information about the health of Canadians. The target population is persons aged 12 and older in all provinces, territories and residents of institutions. Data to date have been collected in three waves. Cycle 1 data were collected over the period from June 1994 to March 1995 (in four quarters, June, August, November, and March). Data collection included a personal interview conducted at the individual's home using computer-assisted technology. A random group of individuals were chosen from Cycle 1 respondents to participate in subsequent cycles. Cycle 2 data were collected two years later, mostly by telephone interview, and again collected in quarters (June, August, November of 1996 and February 1997). The attrition rate between these two cycles was quite small; only 1.7 % of longitudinal respondents could not be found for Cycle 2. Cycle 3 data were collected over the period June 1998 to March 1999.

In our analysis we look at individuals who range in age from 14 to 24 during the Cycle 1 (1994) collection period. We divide respondents into two groups based upon their

ages: individuals in the first group included are between the ages of 14 and 18, while those in the second group are between the ages of 19 and 24. We choose these age ranges for two reasons. First, we want to have a group of teenage smokers so that we can compare our results to those from the U.S. studies. Since the data are not collected in a high school setting, unlike many of the U.S. surveys, this group includes both individuals still in high school (grades 9 through 12 or 13, in the case of Ontario) and individuals who dropped out of school. Second, since much of the literature suggests that the price elasticity of demand decreases with age, we want to have a group of younger adolescents and a group of young adults in order to examine differential impacts of the cigarette tax price increases upon the two groups. This second group includes university and college students, as well as individuals who dropped out of high school. Table 1 gives mean information about the respondents in the sample.

Since the 1994 survey was conducted over the period following shortly after the tax cuts in five of the provinces we anticipate that responses to the price decreases for the younger respondents might not be complete or fully reflect the full response to the tax cuts, in particular, for regular (daily) smokers. In order to have a second look at the impacts of the tax decrease a couple of years removed, therefore, we create a second sample of individuals, aged 14 to 18 years. This group is drawn from the third cycle of the survey conducted in 1998 and consists of individuals who were under 14 years of age during Cycle 1. Our second group in 1998 includes those individuals who were in the 14 to 18 group from 1994, along with those who were already 19 in 1994. Thus, it contains individuals aged 19 to 28. Since the survey was designed to be nationally representative,

the unfortunate consequence is that the numbers of observations on youth are relatively small. Our sample sizes reflect this.

As with other studies we have two measures to describe smoking behaviour. The first, a measure of smoking participation, is a dichotomous choice indicator. The variable SMOKER takes on a value of 1 if the respondent said he/she smoked daily and 0 otherwise. The NPHS survey question was: At the present time, do you smoke cigarettes daily, occasionally or not at all? We choose to focus upon daily smokers in this paper.⁸ Table 2 provides information on the different types of smokers in the data set. It is notable that the percentages of daily smokers in the various categories have increased, substantially in a number of cases, particularly for males in the 14 to 18 year old group.

We have a second variable for smoking behaviour. This is conditioned upon the respondent being a smoker since NUMCIG describes the intensity of smoking for individuals who are classified as smokers. The measure we use is the number of cigarettes usually smoked each day. As in other studies, we take the natural log of this variable. Table 3 gives information on the mean numbers of cigarettes smoked each day by daily smokers in the data set. As might be expected, the Table suggests that younger smokers tend to smoke fewer cigarettes per day than do older smokers. One potential finding that is of concern is that, while a smaller percentage of males in the younger age group are heavy smokers in 1998 as compared to 1994, the trend is opposite for females of this age group. This might suggest that they are more heavily influenced by the price reductions.

⁸ This latter group includes occasional smokers as well as non-smokers and we are looking into a closer examination of this group up at a later date.

The NPHS data contain much socio-demographic information about each of the respondents, including the province of residence, the census metropolitan area, and whether the respondent lives in a rural or urban location. We use this information to pinpoint the respondent's location, which we subsequently use to obtain a match with cigarette price data. Unfortunately, the survey does not ask any cigarette price information. In order to construct an appropriate price series we begin with data collected by Statistics Canada, which we have obtained from the Non-Smokers' Rights Association. These price data cover the period of 1994-2000 and consist of average retail prices (including PST and GST) collected from grocery stores, gas stations, pharmacies for each month within 18 major cities across the country. The retail prices are the monthly nominal price per package and nominal price per carton containing 200 cigarettes. For individuals living in a city we use the price data specific to that census metropolitan area. For those individuals not living in a large city, we use province-specific prices. Finally, we take note of the information on when each person's survey was completed to determine which monthly price to use. We adjust the prices by city-specific CPI to create real prices with a base year of 1992. We use the same CPI to adjust nominal household incomes in the survey. Table 4 gives annual mean real prices per cigarette averaged over all Canadian provinces, then averaged separately for the five provinces that experienced the biggest tax cuts (the smuggling provinces) and the five other provinces that saw only minor tax cuts (the non-smuggling provinces). The January 1994 prices are included separately from those of the rest of the year in order to illustrate the impact upon real cigarette prices of the tax cuts. As the Table illustrates, by 2000 real

prices in the so-called smuggling provinces have not yet climbed back to their pre-tax cut levels.

In addition to price and household income data that are of interest to models describing economic demand, we include variables that have proven to be of interest in other smoking behaviour studies. MALE is a dichotomous choice variable that takes on a value of 1 for males and 0 otherwise. NATIVE is a dichotomous choice variable that takes on a value of 1 for natives and 0 otherwise.⁹ Two variables are included to explore the importance of staying in school or higher education upon smoking behaviour. INSCH and HSGRAD are dichotomous choice variables. The former takes on a value of 1 if the respondent is still in school and 0 otherwise; while the HSGRAD takes on a value of 1 if the respondent has graduated from high school and 0 otherwise. Personal circumstances are accounted for by four variables. PREG is a dichotomous choice variable indicating whether the respondent is pregnant or not, while HHSMOKE takes on a value of 1 if the respondent indicated that someone else in the household smokes (unfortunately, the identity of this person – parent or sibling – was not specified) and 0 otherwise. SINGPAR is a variable taking on the value of 1 if the respondent indicates that she/he lives with a single parent. YEARSMOKE indicates the number of years that the respondent has been smoking.

For 1994 we have 830 observations on individuals aged 14 to 18, with 130 of those observations belonging to daily smokers. The corresponding numbers of observations for that age group in the 1998 data set is 650 (132). For the older age group, the numbers of total observations/daily smokers in 1994 are 1140 (364) and for 1998 the

numbers are 1778 (539). It is interesting to compare the proportions of smokers in these two periods. For 1994 the percentages of daily smokers in the younger age group/older age group are 15.7 %/31.9%, while for 1998 the corresponding percentages are 20.0 %/30.3 %. The large increase in the proportion of daily smokers amongst the younger group appears to support the view that these individuals have responded to the tax/price cuts by increasing their daily smoker participation rates. Since we do not have many observations we are unable to include dummy variables for each province and, therefore, completely control for the so-called state effects that have been important in the U.S. studies (Gruber and Zinman, 2000). However, we have undertaken to control for an important provincial effect by including a dummy variable to indicate whether a respondent lives in one of the five provinces that struggled with smuggling problems and tried to solve these with very large tax cuts. DUMSMUG takes on a value of 1 if the province is Ontario, Quebec, Nova Scotia, New Brunswick or Prince Edward Island and 0 otherwise.

5. Empirical Methodology and Results

Following the smoking demand literature we adapt Cragg's (1971) approach to modeling two separate but related decisions. The first part of the model estimates the propensity to smoke, while the second part estimates the conditional demand function. The propensity to smoke function is modeled as a probit function where the dependent variable is the binary variable indicating whether the individual is a daily smoker

⁹ We explore the role of race with our data set, since this has been of interest in the American studies (Chaloupka and Pacula, 1998) by including a dummy variable for individuals indicating that they were black. This is insignificant largely because so few individuals in the sample indicate that they are black.

(SMOKER). The conditional demand function uses only the observations on those individuals who are daily smokers. The dependent variable is the natural log of the number of cigarettes smoked daily (LN(NUMCIG)) and it is estimated using a linear regression model.

Equation (1) represents the propensity to smoke function where Φ is the standard normal cumulative density function. The index i represents individuals and the variables are those described earlier.

$$\begin{aligned} \text{PROB}(\text{SMOKER}_i > 0) = & \phi(\alpha_0 + \alpha_1 \text{PRICE}_i + \alpha_2 \text{SMUGPROV}_i + \alpha_3 \text{MALE}_i + \alpha_4 \text{NATIVE}_i \\ & + \alpha_5 \text{SINGPAR}_i + \alpha_6 \text{HHINC}_i + \alpha_7 \text{AGE}_i + \alpha_8 \text{HHSMOKE}_i + \alpha_9 \text{HSGRAD}_i + \alpha_{10} \text{INSCH}_i \\ & + \alpha_{11} \text{PREG}_i + \alpha_{12} \text{YEARSMOKE}_i) + \xi_i \end{aligned} \quad (1)$$

The conditional demand function is shown in equation (2).

$$\begin{aligned} \text{LN}(\text{NUMCIG})_i = & \beta_0 + \beta_1 \text{PRICE}_i + \beta_2 \text{SMUGPROV}_i + \beta_3 \text{MALE}_i + \beta_4 \text{NATIVE}_i \\ & + \beta_5 \text{SINGPAR}_i + \beta_6 \text{HHINC}_i + \beta_7 \text{AGE}_i + \beta_8 \text{HHSMOKE}_i + \beta_9 \text{HSGRAD}_i + \beta_{10} \text{INSCH}_i \\ & + \beta_{11} \text{PREG}_i + \beta_{12} \text{YEARSMOKE}_i + \varepsilon_i \end{aligned} \quad (2)$$

The pair of equations (1)-(2) is estimated using maximum likelihood to obtain coefficient estimates and standard errors. In total, four sets of estimation are done using the 1994 and 1998 data separately for each of the two age groups: 14 to 18 and 19+. Coefficient estimates and their standard errors are presented in Table 5 (for the 14 to 18 year olds) and in Table 6 (for the 19 + age group).

The price coefficients are always negative when the 1994 data are used, but for both the smoking participation model and the conditional demand model these coefficients are positive in the 1998 data for the older age group. The smoking participation coefficient for the younger age group is also positive but not significantly

different from zero in 1998. However, it is only the smoking participation coefficient for youth aged 14 to 18 in 1994 that is significantly different from zero (-0.0021). It is not uncommon to find insignificant and even positive coefficients when using cross-sectional data (Emery, White and Pierce, 2001; Gruber and Zinman, 2000)¹⁰, which makes the finding of the negative coefficient on participation for 14 to 18 year olds even more important. This finding may arise from the fact that survey respondents completed their questions within six to eight months of the tax cuts. One interpretation is that young people were particularly affected by such price reductions, which encouraged them to become daily smokers.

Table 7 gives the estimated participation and conditional demand elasticities, as well as the overall elasticity of cigarette demand for the two age groups and for each of the years 1994 and 1998. The participation elasticity for youth aged 14 to 18 is -0.914 in 1994, however, this falls to 0.434 with the 1998 sample of respondents. The conditional demand elasticity moves in the opposite direction as we move through time, going from -0.0005 in 1994 for this group to -0.555 for 1998. For the older age group the participation elasticity is -0.260 in 1994 and, since the conditional elasticity is virtually zero, this is effectively the overall elasticity of cigarette demand. However, for 1998 both elasticities are positive, although not significantly different from zero. Since the individuals in this group include people who were 14 to 18 in 1994 and daily smokers the compositional effect discussed in footnote 9 may be at play in generating these positive elasticities.

¹⁰ Gruber and Zinman (2000) note that such a finding may arise since the pool of daily smokers may have changed in the sample. Individuals who choose not to remain daily smokers are likely to have the lowest intensity of smoking. This might lead to a positive bias to the estimates.

These results are comparable to those obtained from the United States. First, we find that the elasticity of demand for our younger age group (14 to 18 years of age) is higher than that for the older age group. Second, the conditional elasticity is generally smaller than the participation elasticity (the exception is the 14 to 18 year old group in 1998). Third, our magnitudes are within the consensus ranges for both age groups but at the lower end which is to be expected since the smokers in our group are daily smokers.

Returning to Tables 5 and 6 provides some insight into non-price factors that may be important to smoking decisions. We begin our discussion with the younger age group. For this group a number of factors are significant determinants of the smoking participation decision. In 1994, but not 1998, being female meant a much higher likelihood of being a daily smoker for the 14 to 18 year old age group, although this finding is not obtained for 1998. It could be that the tax cuts really impacted upon young girls of this age who tend to have less pocket money than young boys since the job options are more limited for them. During the early part of this period health authorities did notice a large upswing in smoking prevalence rates among teenage girls.

Living with a single parent is also highly significant in determining participation in 1994, as is the presence of another smoker in the household. In fact, this variable is highly significant in each of the four participation models. One might speculate about the various reasons why this might be the case. First, the presence of another smoker in the house likely means easier access to cigarettes, particularly, for young people who are not legally able to purchase them. This lowers the overall opportunity cost to these individuals of obtaining cigarettes. Second, the presence of smoke in the house may increase the physiological dependence upon nicotine. Third, observation of a family

member smoking may generate what psychologists call normative behaviour – that is, smoking is the default behaviour. Sen and Wirjanto (2002) discuss the literature on peer effects and use a longitudinal data set (the third Waterloo Smoking Prevention Project (WSPP-3)) of smoking habits of children from grades 8 to 12, attending schools in the Waterloo region of Ontario between 1990 to 1996 to show that smoking participation is greater for individuals whose peers also smoke.

As with other work in the field, we find that older individuals in the 14 to 18 year old age group are more likely to smoke than younger ones but only for 1994. In 1998, the age variable is negative and significantly different from zero. Thus, older individuals in the 14 to 18 year old age group were less likely to be daily smokers. However, for 1998, the number of years smoked is positive and significantly different from zero in the participation model, thereby lending support to the view of cigarette smoking as addicting. Together, these factors suggest that those individuals who were in the lower range of the 10-13 year old span over the period between 1994 and 1998 (and thus are in the 1998 data as 14 to 18 year olds) may have been induced by the tax cuts immediately in 1994 to become experimenters (Emery, White and Pierce, 2001) and became addicted. Table 8 provides some evidence that this may have happened in Canada. The Table shows the percentages of respondents who started smoking at different ages. The 1998 group of younger individuals (14 to 18 years of age) are more likely to have started smoking prior to age 14 than the 1994 group of individuals of the same age. The ages at which older individuals (19 +) started smoking are not significantly different over the two data sets (1994 and 1998).

Factors that tend to reduce the likelihood of an individual being a smoker include education and income. Thus, respondents who have not dropped out of the education system, ie., they are either high school graduates or still in school, are significantly less likely to be daily smokers. In addition, smoking participation among those aged 14 to 18 is more likely to arise in low income households (the coefficient on household income is negative). This finding is not uncommon (Emery, White and Pierce, 2001). Indeed, research on adult smoking suggests that it tends to be concentrated amongst lower income individuals and that price elasticities for adults fall with income (Evans et al. 1999). Finally, being pregnant tends to reduce the likelihood of a female smoker being a daily smoker, especially with the 14 to 18 year olds in the 1998 data set, where the coefficient is very large (-1.4452) and significantly different from zero at the 5 % level. Gruber and Koskrezi (2001) find that pregnant women have higher price elasticities of cigarette demand.

Turning next to the conditional demand model we see that teenage boys (age 14 to 18) have significantly higher smoking intensities than teenage girls in 1994, although this does not show up in the 1998 data. This is consistent with other work. The only other significant determinants are the number of years smoked (for 1994), age (for 1998) and being native (significant and negative in 1998).

Table 4 reports coefficient estimates for the older group of individuals examined in this paper. For 1994 this corresponds to individuals aged 19 to 24, however, for 1998 we do not remove any individuals from this sample, so the age range extends to 28. In both years age is negatively related to smoking participation, suggesting that individuals who have passed through their adolescence without becoming daily smokers are less

likely to take up the habit as adults. (Data in Table 8 confirm this.) This reinforces the concern that potential smokers need to be prevented from ever beginning as youth. Having other smokers in the household contributes significantly to the likelihood of one's being a daily smoker, whereas being pregnant is a significant deterrent to being a daily smoker. In terms of the role played by the variables in determining the smoking intensity of daily smokers, we see that men are significantly heavier smokers than women of this age group, as are lower income individuals and pregnant women are less likely to smoke heavily than non-pregnant women. However, once the habit has become engrained in terms of the number of years smoked the greater the daily consumption. The role of education appears to be less significant a smoking deterrent for the older group of individuals. While the coefficient is negative in three of the four models, it is significant only for smoking intensity in 1998.

6. Conclusions and Directions for Future Research

This paper presents the first estimates of youth and young adult elasticities of cigarette demand using the Canadian National Population Health Survey data set for 1994 and 1998. We find that youth aged 14 to 18 are more responsive to cigarette price changes than are their slightly older counterparts (young adults aged 19 to 28). This is unfortunate given the large tax cuts in 1994 that drastically reduced the prices of cigarettes for more than half the Canadian population. Using our 1994 estimate of a participation elasticity of -0.914 for youth aged 14 to 18, our results suggest that a 1 % decrease in the price of cigarettes would increase the number of daily smokers in this age group by 0.9 %. In fact, the average tax cut between January 1994 and the rest of the

year meant that cigarette prices fell on average in Canada by 27 %, thereby suggesting a 25 % increase in the number of youth daily smokers. The data from the NPHS as shown in Tables 2 and 8 support this finding. Table 2 shows the large increase in daily youth smokers, particularly males, over the period 1994 to 1998. Table 8 shows the increase over the same period in the number of youth smokers who begin smoking prior to age 14. Both of these trends are worrisome since cigarettes tend to be addicting and youth smokers go on to become adult smokers who tend to place additional burdens upon the Canadian health care system.

While the results in this paper are suggestive of price sensitivity amongst young smokers, our plans to continue this work involve a number of additions to the modeling. Two particular modifications are foreseen. First, we want to explore two further determinants of smoking decisions. They are: the role played by provincial and municipal access restrictions and smoking location bans and the efforts undertaken by cigarette manufacturers to aim their advertisements at youth interests. The second modification involves modeling the addictive nature of cigarette consumption through use of the longitudinal data provided by the NPHS.

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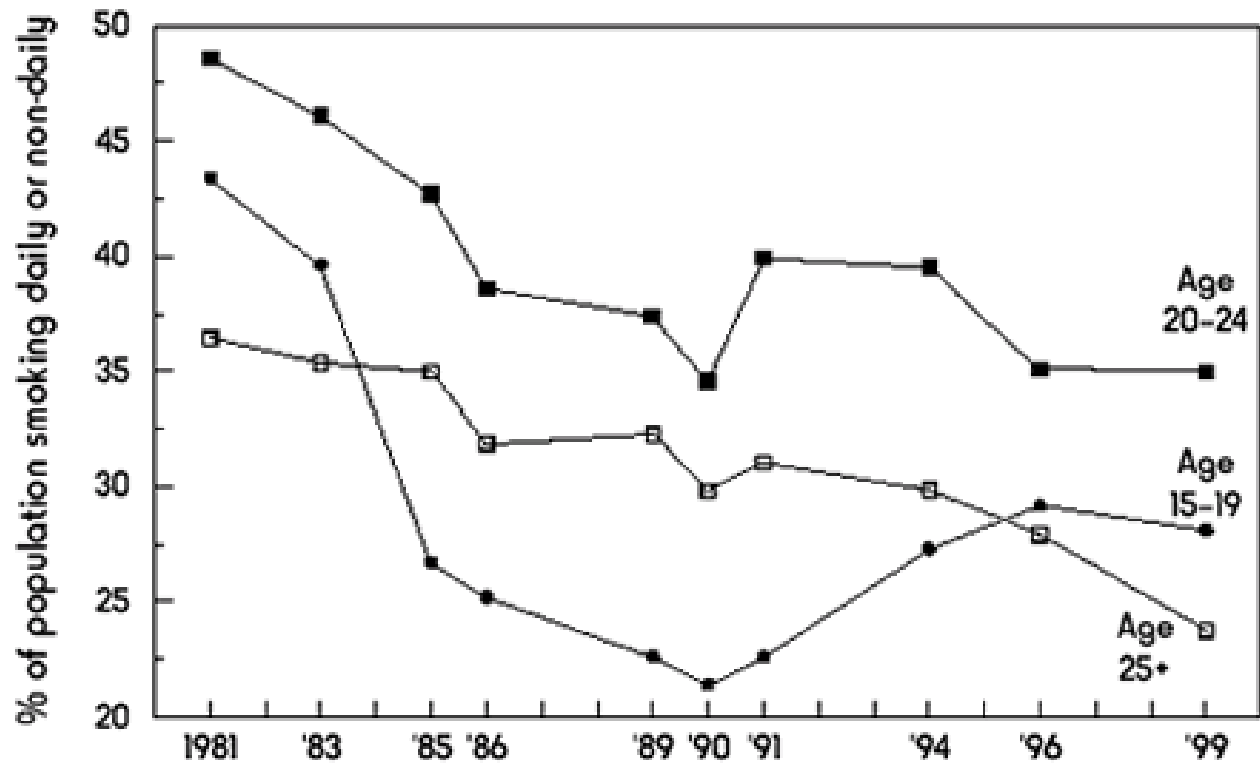
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Figure 1: Smoking Prevalence in Canada – 1981 to 1999



Sources: Sources: 1981-1986 Labour Force Survey supplements; 1989 National Alcohol and Other Drugs Survey; 1990 Health Promotion Survey; 1991 General Social Survey; 1994 Survey on Smoking in Canada, Cycle 1; 1996-97 National Population Health Survey; 1999 Canadian Tobacco Use Monitoring Survey, Full Year

Table 1: Information on Variables in Data Set (Mean Values)

Variable	1994		1998	
	<i>14-18 year olds</i>	<i>19+</i>	<i>14-18 year olds</i>	<i>19+</i>
Price per Cigarette	17.04 ^a	17.11	20.77	20.65
Smuggling Province Dummy	61%	58%	60%	59%
Male	48 %	47%	52%	47%
Native	- ^b	-	-	-
Lives with Single Parent	19%	9%	20%	9%
Household Income				
Age	15.95	21.56	16.49	23.72
Someone in Household Smokes	46%	45%	43%	37%
High School Graduate	16%	80%	22%	81%
Still in School	66%	34%	85%	25%
Pregnant	- ^b	6.2%		
Daily Smokers	16 %	32%	20%	30%
Number of Years Smoked (Daily Smokers)	2.56	6.24	2.86	7.94
Number of Cigarettes Smoked Daily (by Daily Smokers)	9.8	10.5	12.5	13.2

^a Real price (1992 index) per cigarette

^b Value is less than 5 % and cannot be reported due to confidentiality concerns.

TABLE 2: Percentages of People that Smoke in NPHS Data Set

Percentage of People that Smoke Daily			
Age		1994 Data	1998 Data
14 to 18 group	Male	12.6	16.2
	Female	18.5	19.3
19 + group	Male	18.4	27.7
	Female	21.5	23.1

Percentage of People that Smoke Occasionally			
Age		1994 Data	1998 Data
14 to 18 group	Male	5.8	6.2
	Female	8.8	7.0
19 + group	Male	7.1	3.6
	Female	11.3	3.6

TABLE 3 Number of Cigarettes Smoked Daily by Daily Smokers, by Percentages

Number of Cigarettes Smoked Daily by Daily Smokers, Percentage			
Age		1994 Data	1998 Data
14 to 18 Group	Male		
	1 to 10	38.0	50.0
	11 to 15	34.0	32.3
	16 to 20	12.0	8.8
	Over 20	16.0	8.8
	Female		
	1 to 10	65.0	54.1
	11 to 15	26.3	21.7
	Over 15	8.7	24.5
19 + Group	Male		
	1 to 10	14.6	17.1
	11 to 15	19.5	22.8
	16 to 20	22.2	19.4
	21 to 25	28.9	27.8
	Over 25	14.9	11.1
	Female		
	1 to 10	26.6	33.3
	11 to 15	24.7	26.7
	16 to 20	20.5	17.4
	21 to 25	22.8	18.5
	Over 25	5.3	3.4

**Table 4: Real Prices Per Cigarette in cents \$1992 – Averaged
Over Census Metropolitan Areas and Provinces**

Year	Mean	Standard Deviation
All Provinces		
<i>Jan. 1994</i>	24.87	2.25
<i>Feb.-Dec. 1994</i>	18.00	5.48
<i>1995</i>	18.60	5.43
<i>1996</i>	19.16	5.31
<i>1997</i>	20.19	5.11
<i>1998</i>	21.44	4.73
<i>1999</i>	22.23	4.68
<i>2000</i>	23.52	4.65
Non-Smuggling Provinces		
<i>Jan. 1994</i>	25.45	2.62
<i>Feb.-Dec. 1994</i>	22.94	2.73
<i>1995</i>	23.73	2.77
<i>1996</i>	24.16	2.78
<i>1997</i>	24.90	2.71
<i>1998</i>	25.64	2.42
<i>1999</i>	26.36	2.25
<i>2000</i>	27.54	2.40
Smuggling Provinces		
<i>Jan. 1994</i>	24.13	1.02
<i>Feb.-Dec. 1994</i>	13.41	2.88
<i>1995</i>	13.88	2.14
<i>1996</i>	14.50	2.03
<i>1997</i>	15.70	1.74
<i>1998</i>	17.38	2.03
<i>1999</i>	18.19	2.06
<i>2000</i>	19.59	2.29

Table 5: Parameter Estimates: Individuals aged 14 to 18

	1994		1998	
Smoking Status	<i>Smoking Participation Model</i> (N=830)	<i>Conditional Demand Model</i> (N=130)	<i>Smoking Participation Model</i> (N=650)	<i>Conditional Demand Model</i> (N=132)
<i>Independent Variable</i>				
Intercept	-4.1539 (0.9789)*	1.5556 (0.8457) **	0.06331 (1.5800)	0.9291 (1.1446)
Price	-0.0021 (0.0011)**	-0.0003 (0.0011)	0.0010 (0.0018)	-0.0019 (0.0013)
Smuggling Province Dummy	-0.3917 (0.2681)	-0.6052 (0.8095)	0.4248 (0.3496)	0.3148 (0.2496)
Male	-0.2185 (0.1166)**	0.3377 (0.0986) *	0.0191 (0.1478)	0.0548 (0.1018)
Native	0.1963 (0.2471)	0.0052 (0.1872)	0.1416 (0.3432)	-0.5082 (0.2105) *
Lives with Single Parent	0.3442 (0.1369) *	-0.0578 (0.1077)	0.2574 (0.1691)	-0.0765 (0.1164)
Household Income	-0.0500 (0.0209) *	-0.0100 (0.0177)	-0.0071 (0.0201)	0.0081 (0.0146)
Age	0.2639 (0.0521) *	0.0400 (0.0513)	-0.1349 (0.0795) **	0.1340 (0.0561) *
Someone in Household Smokes	0.7861 (0.1206) *	0.0279 (0.1168)	0.4531 (0.1511) *	0.1861 (0.1182)
High School Graduate	-0.2856 (0.1756) **	0.0203 (0.1414)	0.2911 (0.2136)	-0.1708 (0.1293)
Still in School	-0.3077 (0.1346) *	-0.1251 (0.1073)	-0.2685 (0.2161)	-0.1692 (0.1220)
Pregnant	-0.4488 (0.8771)	-0.5721 (0.5680)	-1.4452 (0.7321) *	-0.5933 (0.5903)
Number of Years Smoked	-0.0002 (0.0015)	0.0729 (0.0299) *	0.6072 (0.0518) *	0.0316 (0.0263)

* Significant at 95 %

** Significant at 90 %

Table 6: Parameter Estimates: Individuals aged 19 and over

	1994		1998	
Smoking Status	<i>Smoking Participation Model</i> (N=1140)	<i>Conditional Demand Model</i> (N=364)	<i>Smoking Participation Model</i> (N=1778)	<i>Conditional Demand Model</i> (N=539)
<i>Independent Variable</i>				
Intercept	2.4301 (1.1065) *	2.6246 (0.4402) *	2.1003 (0.7920) *	1.7291 (0.3487) *
Price	-0.0010 (0.0014)	-0.00003 (0.0005)	0.0004 (0.0011)	0.0007 (0.0005)
Smuggling Province Dummy	-0.1221 (0.2954)	0.0961 (0.1191)	0.1095 (0.2101)	0.1350 (0.0927)
Male	-0.0758 (0.1406)	0.1979 (0.0554) *	0.0782 (0.0985)	0.1580 (0.0440) *
Native	0.4629 (0.3024)	-0.1081 (0.0993)	-0.0612 (0.2405)	-0.0864 (0.0861)
Lived with Single Parent	-0.3233 (0.2453)	-0.0307 (0.1071)	-0.0220 (0.1575)	-0.0535 (0.0758)
Household Income	-0.0093 (0.0240)	-0.0272 (0.0106) *	-0.0310 (0.0161) **	-0.0023 (0.0076)
Age	-0.2153 (0.0435) *	-0.0223 (0.0177)	-0.1892 (0.0220) *	0.0034 (0.0106)
Someone in Household Smokes	1.6137 (0.1500) *	0.2880 (0.0940) *	1.3034 (0.0974) *	0.3178 (0.0549) *
High School Graduate	0.0953 (0.1642)	-0.0255 (0.0584)	-0.0982 (0.1182)	-0.2146 (0.0479) *
Still in School	-0.1998 (0.1465)	-0.1046 (0.0672)	-0.1701 (0.1182)	-0.0146 (0.0586)
Pregnant	-0.7015 (0.3626) **	-0.3101 (0.1628) **	-0.6841 (0.3525) **	-0.0799 (0.1402)
Number of Years Smoked	0.4173 (0.0263) *	0.0426 (0.0112) *	0.3003 (0.0150) *	0.0230 (0.0078) *

* Significant at 95 %

** Significant at 90 %

Table 7: Elasticity Estimates

	1994 14-18 years	1998 14-18 years	1994 19 + years	1998 19+ years
Participation Elasticity	-0.914	0.434	-0.260	0.117
Conditional Elasticity	-0.005	-0.555	-0.0004	0.107
Total Elasticity	-0.919	-0.121	-0.2604	0.224

TABLE 8: AGE OF TAKING UP SMOKING,
PERCENTAGES

Age		Age Started Smoking, Daily Smoker	1994 Data	1998 Data
14 to 18 group	Male			
		Younger than 14	33.3	37.3
		14 to 18	66.6	62.7
	Female			
		Younger than 14	35.6	47.3
		14 to 18	64.4	52.7
Age 19 + group				
	Male	Under 14	18.5	17.3
		14 to 18	62.9	61.7
		19 and 20	8.9	10.4
		Over 20	8.8	10.3
	Female	Under 14	13.3	15.3
		14 to 18	58.1	58.3
		19 and 20	10.6	10.8
		Over 20	17.9	15.6