

MPRA

Munich Personal RePEc Archive

Retailer Compliance as a Predictor of Youth Smoking Participation and Consumption

Diener, Alan; Ahmed, Rashid; Snider, Judy and Kaiserman,
Murray
Health Canada, Tobacco Control Programme

April 2007

Online at <http://mpra.ub.uni-muenchen.de/3078/>
MPRA Paper No. 3078, posted 07. November 2007 / 02:56

Retailer Compliance as a Predictor of Youth Smoking Participation and Consumption

Alan Diener^{1,*}
Rashid Ahmed²
Judy Snider¹
Murray Kaiserman¹

April 2007

DO NOT CITE OR QUOTE WITHOUT PERMISSION FROM AUTHORS

Keywords: youth smoking; two-part model; retailer compliance

¹ Office of Research Surveillance and Evaluation, Tobacco Control Programme, Health Canada

² Department of Statistics, University of Waterloo

* corresponding author:

Address: 123 Slater St.,
Ottawa, ON. A.L. 3507C,
K1A 0K9

email: alan_diener@hc-sc.gc.ca

The authors would like to acknowledge the assistance of David Boucher and Lea Gamache in the preparation of this paper and Byron Rogers for providing helpful comments and suggestions.

Abstract

Ninety per cent of smokers report having their first whole cigarette before the age of 19. Thus, it is important to have policies such as youth access laws which may prevent youth from becoming future smokers. In Canada, the Tobacco Act prohibits retailers from furnishing tobacco products to individuals under the age of 18. For such laws to be effective, however, it is important that retailers comply with them. The objective of this study was to examine the effect of retailer compliance on youth smoking behaviour. Data on individual smoking behaviour in conjunction with provincial retailer compliance rates and cigarette prices for the years 1999-2005 were employed to examine the effects of retailer compliance on youth smoking participation and consumption. Both price and retailer compliance were significant predictors of smoking participation. Price elasticity of demand for the overall sample was estimated to be -0.54. Our results which are consistent with previous research indicate that retailer compliance must be considered when examining the effects of youth access laws. This research confirmed that youth access laws can be an important component of a successful public policy approach to youth smoking prevention.

1. Introduction

Given that 90% of smokers report having their first whole cigarette before the age of 19, it is important that programs and policies target youth to prevent them from becoming future smokers. Restrictions on youth access to cigarettes, such as provincial or federal minimum age laws, are one type of such a prevention strategy affecting youth who may intend to smoke. In Canada, the *Tobacco Act* prohibits retailers from furnishing tobacco products to individuals under the age of 18. Hence, it is important to examine whether youth access laws have an effect on youth smoking behaviour.

Evidence suggests that youth access laws, in and of themselves, may not be effective if retailers do not comply with the legislation. In fact, it has been suggested that retailer compliance must be at least at the 90% level for such policies to be effective. (Levy et al., 2000) From 1999 to 2005 the rate of retailer compliance in Canada increased from 70% to 81%. At the same time smoking prevalence amongst youth¹ fell from 26% to 14%. During this time frame there was also a great degree of provincial variability in both compliance rates and smoking prevalence. Examining the relationship between retailer compliance and youth smoking using provincial data over this seven year span allows for the opportunity to assess whether compliance with youth access laws does affect smoking behaviour amongst youth even when compliance rates are below the suggested threshold of 90%.

The objective of this study was to examine the effect of retailer compliance on youth smoking behaviour. While many studies have examined the effects of prices and taxes, there have been relatively few studies examining the effects of compliance with youth access laws on cigarette demand. Since, in order for youth access laws to be effective they must actually reduce the availability of tobacco products to youth, we first examined whether retailer compliance and cigarette prices have an impact on how

¹For the purposes of this paper youth are defined as those individuals 15 years of age and older to whom tobacco products cannot be furnished legally, i.e. youth aged 15 to 17, or 18 depending on the province of residence.

youth get their cigarettes. We then estimated a two-part demand model to estimate the effect of these variables on both smoking participation and the quantity of cigarettes consumed by those who have already made the decision to smoke.

In the next section the recent literature focussing on econometric studies of youth smoking and other empirical analyses relating to the effects of compliance with youth access laws on youth smoking are reviewed. In section 3 the sources of data employed and the methods used in our analysis are presented. Section 4 presents the results both with respect to the current situation regarding youth smoking and retailer compliance with youth access laws in Canada and the econometric analysis. Section 5 and Section 6 include the discussion and conclusions respectively.

2. Previous Research

Several econometric studies have been published which include a variable for youth access laws. These studies have also included price as a variable allowing for an estimate of price elasticity of demand to be derived in these models. Most studies of smoking behaviour employing individual level data have used models which allow smoking participation and consumption of cigarettes (i.e. conditional demand) to be examined separately. Separate price elasticities of participation and consumption can be estimated and total elasticity of demand is the sum of the two elasticities.

One of the first studies to examine demand for cigarettes by youth was conducted by Lewit et al. (1981). The overall price elasticity of 12-17 year olds was estimated at -1.44 with most of the effect coming from the participation equation. Most studies published since then have found lower price elasticity estimates - a finding likely due to the inclusion of significant policy variables in addition to taxes (or prices).

Chaloupka and Grossman (1996) used Monitoring the Future (a U.S. survey of students in Grades 8, 10 and 12) data from 1992, 1993, and 1994. They analysed the effects of several policies - excise taxes, restrictions in public places, and limits on the availability of tobacco products to youth and estimated a two-part model of cigarette demand. A dummy variable for the existence of legal restrictions was included but enforcement or compliance with these restrictions was not accounted for. The estimated overall price elasticity of cigarette demand of -1.313 was similar to the elasticity estimated by Lewit et al. (1981). The study found that strong restrictions on smoking in public places reduced smoking participation while limits on smoking in schools reduced average cigarette consumption. Youth access laws, however, had no effect on smoking. The latter finding may be attributable to weak enforcement of these laws as enforcement or compliance with youth access laws was not included in the analysis. Using the same data set to examine sub-groups, Chaloupka and Pacula (1999) found that black youths were responsive to youth access laws.

Lewit et al., (1997) examined the impact of taxes, access laws, limits on public smoking, as well as pro and anti-tobacco messages on youth smoking participation (cigarette consumption was not included). Pooled data from two cross-sectional surveys of ninth grade students in the U.S. and Canada (the 1990 and 1992 Community Intervention Trial for Smoking Cessation, known as COMMIT) were employed in their analysis. The youth access variable was defined as the existence of any laws or ordinances restricting the purchase of cigarettes to those 18 years of age and older. While the youth access variable was a significant predictor of smoking participation in all the estimated models for both males and females, price was only significant for the overall sample when only one or none of the policy variable was included in the model and never a significant predictor of female smoking participation. Price elasticity of participation was -0.87 in the price-only model for the overall sample and -1.51 for males (price was not significant for females).

Gruber and Zinman (2000) utilized several data sets including Monitoring the Future (MTF) and the Youth Risk Behavior Survey (YRBS) to estimate cigarette demand by youth. They undertook separate analyses using pooled data from the 1991-1997 MTF surveys and pooled data from the 1991, 1993, 1995 and 1997 YRBS surveys. The study included a tobacco youth access index developed by Alciati et al. (1998) modified to include more restrictions. While the index was meant to capture the extensiveness and comprehensiveness of state policies aimed at reducing youth access to tobacco products, it did not include an explicit measure of actual compliance. The study found that laws restricting youth access reduced the quantity of cigarettes smoked by those who chose to smoke, but did not affect participation. The most reliable estimate of price elasticity was -0.66 and there were no consistently significant differences between males and females among the different models.

Ross and Chaloupka (2003 and 2004) employed the The Study of Smoking and Tobacco Use Among Young People, 1996, a survey of 17,287 U.S. high school students to study the effects of price and public policies on youth smoking. These studies explicitly included retailer compliance with youth access laws as an explanatory variable. Data on compliance with these youth access laws were added to the survey from State Synar Profiles.² The estimated total price elasticity was between -0.722 and -0.763 depending on the model employed, with most of the response occurring from the participation equation. The authors found that all of the policy variables, including retailer compliance with youth access laws, had negative effects on smoking participation. Retailer compliance, however, did not have an impact on the consumption of cigarettes.

Powell and Chaloupka (2005) and Powell et al. (2005) employed the same data set as Ross and Chaloupka (2003, 2004). The main focus of these papers was on the effects

²The State Synar Profiles are a summary of enforcement efforts that each state must provide to the federal government. They relate to the Synar Amendment, a federal law which requires states to enact and enforce laws that prohibit tobacco sales to consumers under the age of 18.

of parents and peers, respectively, on smoking behaviour. However, their model also included policy variables, including the youth access index used by Gruber and Zinman (2000). Estimating a demand function for participation only, they found that the youth access index was a significant predictor of smoking participation. Participation elasticity, in the two papers, was estimated to be between -0.27 and -0.50 depending on the specification of the model.

Other, non econometric research has investigated the effects of compliance with youth access laws on youth smoking. In general, these studies compared smoking behaviour between intervention and control communities, or between pre and post intervention time frames in the same communities with mixed results. (See for example, Jason et al., 1991; DiFranza et al., 1992; Rigotti et al., 1997; Gilpin et al., 2004) While a systematic review and a meta analysis of eight studies concluded that “there were no statistically significant differences in youth smoking in communities with youth access interventions compared with control communities with no such efforts” (Fichtenberg and Glantz, 2002; p. 1091), the methodology employed has come under criticism. In addition to other strong concerns about the systematic review and meta-analysis, DiFranza (2002, 2006) noted that several of the papers included in the review did not adequately account for compliance with youth access laws. Additionally, it has been observed that “...it is crucial to demonstrate that the intervention has reduced the commercial availability of tobacco.” (Difranza 2006; p. 96); Many of the studies finding youth access laws to be ineffective did not account for this.

In summary, the econometric research that has included youth access laws as policy variables (Chaloupka and Grossman, 1983; Lewit et al., 1997; Chaloupka and Pacula, 1999; Gruber and Zinman, 2000; Ross and Chaloupka, 2004; Powell and Chaloupka, 2005) have yielded mixed results with respect to their effectiveness. Gruber and Zinman (2000) found that the youth access index affected consumption only; Ross and Chaloupka (2004, 2005), which explicitly included a retailer compliance variable, found that it affected smoking participation only (as did all the policy variables included);

Powell and Chaloupka (2005) found that the youth access index was a significant predictor of youth participation. While the results of the non-econometric literature are also mixed, they are not inconsistent with the findings of the econometric research. Youth access laws appear to have some effect on youth smoking, however the extent of the effect remains unclear. The findings of the research suggest that some measure of retailer compliance, or enforcement, must be adequately considered in studies of youth access.

3. Methods

3.1. The Data

Data for this paper were extracted from 3 sources: the Canadian Tobacco Use Monitoring Survey (CTUMS 1999-2005 Annual data), the Evaluation of Retailer Behaviour Towards Certain Youth Access to Tobacco Restrictions (Corporate Research Group, 2005), and Statistics Canada's Cansim database. Detailed information on survey sampling and methodology for each of these sources is available elsewhere (Statistics Canada, 1999-2005; Corporate Research Group, 2005).

CTUMS has collected data related to smoking behaviour among Canadians 15 years of age and older since 1999. Each year approximately 20,000 Canadians living in the 10 provinces (2000 per province) were surveyed using random digit dialling. Approximately half the sample each year was 15-24 years of age. To ensure a nationally representative sample, a stratified sample design was employed and probability weights were provided with each data set. For this paper, data from 1999 to 2005 were extracted and were restricted to include youth 15 to 17 years of age for the four provinces where it is illegal to furnish tobacco products to youth under the age of 18 years, and 15 to 18 years in the six provinces where it is illegal to furnish tobacco

products to youth under the age of 19 years.³ The variables for 30-day smoking status (i.e. whether the respondent had smoked any cigarettes in the past 30 days), average number of cigarettes smoked⁴, usual source of cigarettes (retail or social), sex and age were extracted. The sample employed in the analyses consisted of 29,514 youth, with 5,727 of the respondents reporting that they had smoke within the last 30 days. Fifty-two percent of the sample were males and the average age was 16.31 years old.⁵

Retailer compliance data with respect to youth access to tobacco products, have been collected since 1995. With the exception of 2001, a random sample of over 5,000 retailers in at least 25 cities were visited each year across all ten provinces⁶. CTUMS data were used to impute the 2001 retailer compliance rates for each province. Annual provincial compliance rates were estimated from the proportion of respondents reporting being refused a sale. This estimated rate was then used as an independent variable in a non-linear regression and the retailer compliance rate as the dependent variable. The missing year (2001) of retailer compliance rates were then estimated using the coefficients from this regression. Retailer compliance rates, by province, are presented in Table 1.

Annual price indices and personal income data by province were obtained from Statistics Canada's Cansim database for 1999 to 2005. Variables for consumer price index for cigarettes and all goods were extracted. The real cigarette price was obtained

³According to the Tobacco Act it is illegal to furnish cigarettes to youth under the age of 18. Several provinces have further regulations which make it illegal to furnish cigarettes to youth under the age of 19. These provinces include Newfoundland and Labrador, Prince Edward Island, Nova Scotia, New Brunswick, Ontario, and British Columbia.

⁴In the survey, respondents are asked how much they smoked on each of the past seven days as an open ended question. The average number of cigarettes smoked per day is derived from these questions.

⁵These averages are based on the weighted data.

⁶Only between one and seven cities in each province were used to derive the provincial compliance rates. From 1999 to 2000 25 cities were included in the survey. From 2002 to 2005 30 cities were included.

by deflating the consumer price index for cigarettes by the consumer price index for all goods. Mean annual cigarette prices were constructed for each province. Personal income data were divided by population estimates to obtain annual per-capita personal income for each province for each year included in the analysis.

3.2. The model

To ascertain whether retailer compliance had an effect regarding how youth obtained their cigarettes the following model was estimated using probit methods.

$$\text{SOURCE} = \beta_0 + \beta_1\text{COMP} + \beta_2\text{P} + \beta_3\text{AGE} + \beta_4\text{SEX} \quad (1)$$

The variable SOURCE was equal to one if the respondent stated that they usually obtained their cigarettes from retail sources and was zero otherwise; COMP was the retailer compliance rate; P was the real cigarette price; AGE was respondents actual age and SEX was a dummy variable equal to 1 if the respondent was male.

A two-part model (Cragg, 1971) was estimated to examine the separate effects of retailer compliance and prices on smoking participation and consumption of cigarettes by those who reported being smokers. In the first part of the model probit methods were used to estimate an equation which employed 30-day smoking status as the dependent variable - i.e., it was equal to 1 if the respondent had smoked in the last 30 days and zero otherwise. In the second part of the model, the average number of cigarettes smoked daily was employed as the dependent variable. Only those observations where the individual had indicated that they had smoked in the last 30 days were included. As the average daily cigarettes smoked was based on the last seven days only, it was possible for some of the respondents to be classified as smokers (based on smoking in the last 30 days) yet have a recorded average daily cigarette consumption of zero. These individuals might have been occasional smokers who happened to not smoke in the past seven days. Such responses were considered

to be valid and included the analysis. Any observations for which the derived average cigarettes smoked per day was missing were excluded from the analysis. The following two equations represent the model which was estimated.

$$\text{SMOKE}_{30} = \beta_0 + \beta_1 \text{COMP} + \beta_2 \text{P} + \beta_3 \text{AGE} + \beta_4 \text{SEX} + \varepsilon \quad (2)$$

$$\text{QUANTITY} = \beta_0 + \beta_1 \text{COMP} + \beta_2 \text{P} + \beta_3 \text{DUR} + \beta_4 \text{SEX} + \varepsilon \quad (3)$$

The independent variables used in both equations were the real cigarette price (P), retailer compliance rate (COMP) and sex (SEX). Age (AGE) was used as an independent variable in the participation equation, while duration (DUR) was used as an independent variable in the consumption equation. Duration, measured as the number of years since smoking the first whole cigarette, was hypothesized to be a better predictor of the quantity of cigarettes smoked than age which was supported by the data. QUANTITY was the average number of cigarettes smoked per day.

Price elasticity of participation and consumption were estimated at the mean values of participation and consumption respectively, and mean prices⁷. Total elasticity is equal to the sum of the two separate elasticities. Separate equations were estimated for males and females to further examine any sex differences and to calculate separate price elasticities. Time was included as a random effect in all of the models and all analyses were done using SAS (SAS Institute, 2001). The GLIMMIX procedure was used for the binary models (Equations 1 and 2) and the MIXED model procedure was used for equation 3. For all the analyses the data were weighted using the sampling weights provided in the CTUMS data set.

Although there has been some debate regarding the use of two-part versus sample selection models (Jones, 2000), the two-part model has been recommended in the case

⁷Elasticity was estimated using the following formula in the participation equation:

$$\frac{\partial E(y|x)}{\partial x_k} \frac{\bar{x}_k}{E(y|x)} = \frac{\beta_k}{\sqrt{2\pi}} \exp\left(-\frac{1}{2}(\beta' \bar{x})^2\right) \frac{\bar{x}_k}{E(y|x)}$$

of modelling smoking demand (Madden 2005) and was preferred given the nature of our data and analyses. The definitions used for the participation equation (smoking in last 30 days) and for the consumption equation (average cigarettes smoked per day in the last 7 days) resulted in many observations having a valid consumption of zero cigarettes per day. Restricting the sample to those respondents that had positive consumption in the past seven days (in either the participation equation or the consumption equation) would not have allowed for a proper representation of those who smoke, including occasional smokers or those who were experimenting with cigarettes. In addition, there was a lack of valid exclusion criteria for the selection equation (i.e. the participation equation). When the same variables are used in each equation, there is a strong likelihood of high collinearity among the independent variables in the consumption equation making the results difficult to interpret.⁸

4. Results

For the seven-year time frame covered in the paper, overall participation of smoking in the last 30 days was 18.7% with the average number of cigarettes smoked per day in the last seven days being 8.4 (Table 2). Participation was slightly higher for females than males (20.1% and 17.4%, respectively) while consumption of cigarettes per day was slightly higher for males than females (9.1 and 7.8 cigarettes per day, respectively; Table 3). Between 1999 and 2005 the prevalence of youth smoking decreased from 25.5% to 13.7% and the average number of cigarettes smoked per day fell from 8.9 to 6.4 cigarettes per day.

⁸In sample selection models the inverse mills ratio is derived from the first equation (the selection equation). This variable is then included as one of the independent variables in the second equation. Although the inverse mills ratio is a non-linear function of the independent variables included in the first equation, it can be often approximated by a linear function. Thus there is a strong likelihood of high multicollinearity in the consumption equation if both equations include the exact same independent variables. Although age is included in the participation equation and duration of smoking is used in the consumption equation, the inclusion of the inverse mills ratio in the consumption equation resulted in results which were difficult to interpret and extremely sensitive to the model specification.

With respect to how youth obtained their cigarettes, 57% of youth over the entire time frame stated that they usually obtained their cigarettes from retail sources, however, the percentage fell from 58.2% in 1999 to 52.4% in 2005 (Table 2). The reduction in the prevalence of youth who reported obtaining their cigarettes from retail sources coincides with an increase in retailer compliance rates from 69.7% to 80.8% between 1999 and 2005. More males than females reported that they had obtained their cigarettes from retail sources (60.4% and 53.9%, respectively; Tables 2 and 3) over the entire time frame.

Examining how youth obtained their cigarettes both the price of cigarettes and retailer compliance had a significant influence (Table 4). Increases in either price or retailer compliance resulted in a movement away from retail sources and towards social sources of cigarettes. While the result with respect to the effects of retailer compliance held for both sexes, cigarette price was not a significant predictor with respect to how males obtained their cigarettes. As expected, the results show that older youth were more likely to obtain their cigarettes from retail sources.

With respect to the demand model, both price and retailer compliance were significant predictors of smoking participation. Nevertheless, while retailer compliance was a significant predictor of cigarette consumption, price was not. Both the age and sex variables were also significant predictors of smoking participation and cigarette consumption, indicative of the fact that older youth, and males, were more likely to smoke and those who smoked consumed more cigarettes. Price elasticity of demand for the overall sample was estimated to be -0.5353 meaning that a 10% increase in price would have resulted in a 5.4% decrease in smoking participation.

Retailer compliance was a significant predictor for both males and females with respect to smoking participation, however, cigarette prices were not a significant predictor of male smoking participation. The price elasticity of demand for females was -0.80 implying that 10% increase in price would have resulted in a 8% decrease in smoking

participation for females. In other words, females were more responsive than males to changes in price.⁹

5. Discussion

The motivation behind youth access laws is that if it is more difficult for youth to obtain cigarettes they will be less likely to smoke. Nevertheless, if such laws are to be an effective deterrent of youth smoking, it is imperative that retailers comply with these regulations. This is important since, as noted by DiFranza (2006), youth access interventions are only effective if they reduce the commercial availability of cigarettes. The results of this study have demonstrated that as retailer compliance increased youth were less likely to obtain their cigarettes from retail sources. In other words, youth access restrictions, when retailer compliance was considered, did affect the commercial availability of cigarettes. A reduction in the commercial availability of tobacco products increases the costs of smoking by increasing the hassle factor. (DiFranza 2006) This hypothesis is supported by the finding that, accounting for retailer compliance, youth access restrictions effected smoking participation for both sexes and decreased cigarette consumption amongst females. This result is consistent with the findings of Ross and Chaloupka (2003 and 2004) which also explicitly considered retailer compliance with youth access laws in their models.

Consistent with previous research, price had a greater effect on smoking participation than on cigarette consumption. In fact, the price coefficient was not significant in the conditional demand equation in the estimated model. It has been noted that higher prices affect youth smoking by preventing youth from smoking, rather than by getting current smokers to cut down or quit, in contrast to the price effects in adult smoking which have been shown to affect cigarette consumption. (Chaloupka and Warner, 1999) The estimated price elasticity of demand in our model (-0.53) was consistent with

⁹Price elasticity was not calculated for males as the price coefficient was insignificant in both parts of the demand equation.

previous research on youth smoking.

There are several explanations regarding the finding that cigarette consumption was not affected by price. Firstly, youth, in our sample, did not smoke large quantities of cigarettes; The average quantity of cigarettes smoked was 8.4 cigarettes per day over the time period employed in the analysis. Thus, changes in cigarette prices may not have a large effect on how much youth spend on their cigarettes. Secondly, 35% of the smokers in the sample were occasional smokers (did not smoke every day in the last 7 days). These individuals are likely to be less responsive to price changes than daily smokers. (Emery et al., 2001) In addition 43% of youth obtained their cigarettes from social sources and thus may not have paid for them at all. These youth would not be expected to be influenced by prices except to the extent that prices influenced their upstream suppliers of cigarettes.

This study found that males were less responsive than females to changes in prices with respect to whether they obtained their cigarettes from retail or social sources and to whether or not they smoked. In addition, while retailer compliance significantly affected both smoking participation and cigarette consumption for the overall sample, it was not a significant predictor of cigarette consumption amongst males. It is not clear why males were less responsive than females to changes in these variables. As a greater percentage of males than females usually obtained their cigarettes from retail sources (60.4% versus 53.9%), it is possible that males were more likely to be the source of cigarettes for other youth than were females. Those who were relied upon to provide cigarettes for other youth may be less responsive to policy tools such as taxes (through price changes) or youth access restrictions. More research, however, would be required to properly answer this question, as these data cannot properly address this question.

Conclusion

Compared to other research that has examined the effects of youth access laws on youth smoking behaviour, this paper is unique in that it contains seven years of individual level smoking behaviour data in conjunction with provincial retailer compliance data in the Canadian context. To the best of our knowledge, this is the only paper to include actual retailer compliance with youth access laws in a pooled cross-sectional and time series data set. The results of our analyses indicated that as the compliance rate of retailers increased, youth moved away from retail sources and towards social sources to obtain their cigarettes. More importantly, however, our study also found that as retailer compliance with access laws increased, the prevalence of youth smoking cigarettes decreased. With respect to cigarette consumption it is unclear whether retailer compliance is effective with only female smokers showing a decrease in the consumption of cigarettes.

Our results, in conjunction with some of the previous research, indicate that youth access laws can be an important component of a successful public policy approach to youth smoking prevention. The failure of previous research to find an impact of youth access laws on youth smoking behaviour may be due to gaps in information on compliance with these laws. It is noteworthy that retailer compliance was found to be effective even at levels below 90%, the threshold considered necessary by some researchers for retailer compliance to have an effect on youth smoking. While it is not clear that youth access laws affect cigarette consumption, the evidence does indicate that youth access laws may play a role in preventing youth from starting to smoke in the first place.

References

Alciati, MH, Frosh M, Green SB, Brownson RC, Fisher PH, Hobart R, Roman A, Sciandra RC, Shelton DM. State laws on youth access to tobacco in the United States: measuring their extensiveness with a new rating system. *Tob Control* 1998; **7**(4): 345-352.

Chaloupka, FJ, Pacula RL. Sex and Race Differences in Young People's Responsiveness to Price and Tobacco Control Policies. *Tob Control* 1999; **8**(4): 373-377.

Chaloupka, FJ, Grossman M. Price, *Tobacco Control Policies and Youth Smoking*. Working Paper 5740. Cambridge, MA, National Bureau of Economic Research, 1996.

Chaloupka, FJ, Warner KE. The economics of smoking. In: Newhouse J., and Cuyler, A., eds. *The Handbook of Health Economics, Volume 1B*: 1539-1627; North-Holland: New York, 2000.

Corporate Research Group. *Evaluation of Retailers' Behaviour Towards Certain Youth Access-to-tobacco Restrictions, Final Report Findings*: Prepared for Health Canada, Tobacco Control Program; 2005.

Cragg, JG. Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods, *Econometrica* 1971; **39**(5): 829—844.

DiFranza, JR, Carlson RP, Caisse Jr. RE. Reducing Youth Access to Tobacco, *Tob Control* 1992; **1**(1): 57-58.

DiFranza JR. Is it time to abandon youth access programmes? *Tob Control* 2002; **11**(3): 282 - 284.

DiFranza JR. Restricted Access to Tobacco Reduces Smoking Rates Among Youth, in Owing JH, ed. *Focus on Smoking Research*, pp 77-100. Nova Biomedical Books: New York; 2006.

Emery S, White MM, Pierce JP. Does cigarette price influence adolescent experimentation? *J Health Econ* 2002; **20**(2): 261-270.

Fichtenberg CM, Glantz SA. Youth Access Interventions Do Not Affect Youth Smoking, *Pediatrics* 2002; **109**(6):1088-1092.

Gilpin, E, Lee AL, Pierce JP. Does adolescent perception of difficulty in getting cigarettes deter experimentation? *Prev Med* 2004; **38**(4): 485—491.

- Gruber, J, Zinman J. *Youth Smoking in the U.S.: Evidence and Implications* NBER Working Paper No. W7780; 2000.
- Jason LA, Ji PY, Anes MD, Birkhead SH. Active Enforcement of Cigarette Control Laws in the Prevention of Cigarette Sales to Minors. *JAMA* 1991; **266**(22): 3159-3161.
- Jones A. Health Econometrics. In: Newhouse J, Cuyler A, eds. *The Handbook of Health Economics, Volume 1A*, pp. 265-344. North-Holland: New York; 2000.
- Lewit E, Coate MD, Grossman M, Benham L. The Effects Of Government Regulation On Teenage Smoking. *J Law Econ* 1997; **24**(3): 545-573.
- Lewit EM, Hyland A, Kerrebrock N, Cummings KM. Price, Public Policy, and Smoking in Young People, *Tob Control* 1997; **6**(Suppl. 2): S17-S24.
- Levy DT, Chaloupka FJ, Slater S. Expert Opinions on Optimal Enforcement of Minimum Purchase Age Laws for Tobacco 2000; *J Public Health Manag Pract*; **6**(3): 107-114
- Madden D. *Sample Selection Versus Two-Part Models Revisited: The Case of Female Smoking and Drinking* . UCD Centre for Economic Research Working Paper WP06/04 University College Dublin, 2006.
- Powell LM, Chaloupka FJ. Parents, Public Policy, and Youth Smoking, *J Policy Anal Manage* 2005; **24**(1): 93-112.
- Powell LM, Tauras JA, Ross H. The importance of peer effects, cigarette prices and tobacco control policies for youth smoking behavior. *J Health Econ* 2005; **24**(5): 950–968.
- Rigotti NA, DiFranza JR, Chang Y, Tisdale T, Kemp B, Singer D. The effect of enforcing tobacco-sales laws on adolescents' access to tobacco and smoking behaviour. *New Engl J Med* 1997; **337**(15):1044-1051.
- Ross H, Chaloupka FJ. The effect of cigarette prices on youth smoking, *Health Econ* 2003; **12**(3): 217-230.
- Ross H, Chaloupka FJ. The Effect of Public Policies and Prices on Youth Smoking, *Southern Econ J* 2004; **70**(4): 796-815.
- SAS Institute Inc (2001) *The SAS System for Windows*. SAS Institute Inc., Cary, NC
- Statistics Canada. *Canadian Tobacco Use Monitoring Survey, Annual Microdata File* Ottawa, Ontario: Statistics Canada; 1999 - 2005.

Statistics Canada. Microdata user guide, Canadian tobacco use monitoring survey. Ottawa, Ontario: Statistics Canada; 1999 - 2005.

Wasserman J, Manning WG, Newhouse JP, Winkler JD. The effects of excise taxes and regulations on cigarette smoking, *J Health Econ* 1991; **10**(1): 43-64.

Table 1: Retailer Compliance, by year and province (%)

	NL	PE	NS	NB	QC	ON	MB	SK	AB	BC	Canada
1999	52.4	86.0	73.3	42.1	65.2	79.1	83.7	78.9	73.6	59.3	69.7
2000	87.8	86.0	70.9	72.7	47.0	83.7	78.9	81.4	67.3	75.3	69.8
2001*	93.0	80.8	67.4	72.9	52.0	79.3	72.1	87.4	77.2	72.3	76.3
2002	98.2	75.6	63.8	81.6	57.0	74.8	65.2	93.4	87.0	69.3	71.2
2003	67.2	74.8	89.7	78.7	36.6	76.3	90.5	81.7	83.2	84.2	67.7
2004	70.3	91.9	79.3	72.6	76.5	83.9	64.5	76.5	91.8	91.5	82.3
2005	98.4	90.1	84.5	84.1	70.4	77.1	72.0	96.0	84.7	91.8	80.8

*Retailer compliance rates for 2001 have been estimated as detailed in the Methods section

Source: Corporate Research Group (2005)

Table 2: Selected results for Study Sample, by year¹

Year (N)	1999 (N=4505)	2000 (N=4086)	2001 (N=4363)	2002 (N=4623)	2003 (N=4130)	2004 (N=3833)	2005 (N=3974)	Overall (N= 29514)
Smoked in last 30 days (%)	25.5	23.4	20.0	19.8	14.9	14.0	13.7	18.7
Average number of cigarettes smoked per day ²	8.9	8.4	9.2	9.8	8.4	6.7	6.4	8.4
Usually obtain cigarettes from retail source (%) ²	58.2	54.7	61.3	56.4	57.8	‡	52.4	57.0
Percent male	51.0	52.3	52.3	52.5	50.9	51.7	51.3	51.7
Average age	16.3	16.3	16.3	16.3	16.4	16.3	16.3	16.3

¹Note that all results are based on weighted data. However the sample sizes correspond to the actual sample of the data set.

²among those who smoked in the last 30 days

‡This question was not included in the 2004 CTUMS

Source: CTUMS, 1999-2005 annual results

Table 3 Selected results for Study Sample by year, by sex

Year (n)	1999 (N=2246)		2000 (N=2053)		2001 (N=227)		2002 (N=2287)		2003 (N=2044)		2004 (N=1848)		2005 (N=2002)		Overall (N= 14627)	
	female	male	female	male	female	male	female	male	female	male	female	male	female	male	female	male
Smoked in last 30 days (%)	27.2	23.9	25.6	21.5	20.8	19.3	21.6	18.1	16.8	13.1	14.7	13.0	14.5	13.0	20.1	17.4
Avg. no. of cigarettes smoked per day ²	8.4	9.4	7.6	9.3	8.5	9.8	9.3	10.3	8.0	9.0	5.8	6.9	5.9	6.9	7.8	9.1
Usually obtain cigarettes from retail source (%) ²	57.1	59.5	49.8	60.2	57.0	65.5	56.6	56.2	51.6	65.1	‡	‡	48.9	56.2	53.9	60.4
Average age	16.4	16.3	16.3	16.4	16.3	16.3	16.4	16.3	16.3	16.4	16.3	16.2	16.3	16.2	16.3	16.3

¹Note that all results are based on weighted data. However the sample sizes correspond to the actual sample of the data set.

²among those who smoked in the last 30 days

[‡]This question was not included in the 2004 CTUMS

Source: CTUMS, 1999-2005 annual results

Table 4: Estimated coefficients from estimated models, entire sample

	males			females			entire sample		
	<u>Demand model</u>			<u>Demand model</u>			<u>Demand model</u>		
	source of cigarettes (N=2360 ¹)	participation (N=14,887)	conditional demand (N=2511 ¹)	source of cigarettes (N=2529 ¹)	participation (N=14,627)	conditional demand (N=2700 ¹)	source of cigarettes (N=4889 ¹)	participation (N=29,514)	conditional demand (N=5211 ¹)
price	-0.003*	-0.0012	-0.0165	-0.007***	-0.0033***	-0.0054	-0.0056***	-0.0018***	0.0072
retailer compliance	-0.0057***	-0.0053***	0.0104	-0.0149***	-0.0095***	-0.0045***	-0.0106***	-0.0073***	-0.0184**
age	0.3958***	0.1928***	0.907***	0.3845***	0.0897***	0.998	0.3869***	0.1373***	0.9595***
sex	-	-	-	-	-	-	0.1422***	-0.9455***	1.1188***
price elasticity	‡	‡	‡	-0.8008	-0.9789	‡	-0.5353	-0.77	‡

*significant at the 10% level

**significant at the 5% level

***significant at the 1% level

¹Although 5727 respondents reported that they had smoked in the past 30 days, not all respondents answered all questions.

[‡]Elasticity not presented as price coefficient is insignificant