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Abstract

It is necessary to understand the determinants of the hazards of starting smoking in developing effective policies and programs to reduce the number of smokers. In this paper, we develop a split-sample duration model of the decision to start smoking. For the empirical estimation, we use data from the 2002 Canadian tobacco use monitoring survey. The hazard rate of starting smoking peaks sharply at age 15 and quickly declines thereafter. Our parametric estimates provide evidence that gender, education level, marital status and household size are important determinants of the smoking habit. We also find that increased cigarettes price has an impact on picking up the habit, but not on the initiation age. Thus, the results highlight the importance of cigarette taxes in influencing the likelihood of smoking.

Keywords: Smoking, Price, Split population model, Canada.
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1. Introduction

The adverse health effects of smoking are well understood and accepted. It is thus shocking that the behaviour is still fairly prevalent. In 2002, 23% of the sample population in Canada reported to be smokers, out of which 18% were categorized as daily smokers, and only 37% of the population reported to have never smoked.[3] What's even more concerning is the proportion of young adults taking to smoking despite well documented and advertised health effects. Smoking is not only detrimental to the smokers but also a significant drain on the Canadian economy. Kaiserman (1997) estimates the overall economic cost of smoking in Canada; his approximate figures are close to $15bn in 1991. He highlights various cost components such as: excess utilization of the health system (estimated at $2.5bn.), smoking-attributable mortality, hospital, physician and drugs costs, institutional costs, residential care ($1.5bn.), workers' absenteeism ($2bn.), and future earnings lost due to death ($10.5bn.) etc.

These high prevalence rates can be attributable to various factors like big corporations bombarding people with cigarette advertisements, peer pressure to "have a smoke", false perception of increased maturity, nicotine-induced weight loss and many more. To counter these push factors the Canadian government has various tobacco control policies[4] in place, and several others are being designed to prevent people from smoking, as well as to get the smokers to quit.[5] Given that the smoking habit is addictive in nature, abstinence is certainly easier to influence than quitting. Thus major focus of public policies should be to prevent individuals from initiating the habit. Furthermore, in order to design, develop and implement an effective policy measure, it is important to understand the determinants of the hazard of starting smoking, as well as the probability of smoking. In other words what are the key variables that influence an individual to take up this habit? This is the focus of our research in this paper

We attempt to give some insight into smoking behaviour to better help design the preventive policy measures. We draw attention to the various factors that can influence this habit. We highlight the

[3] Source: Statistics Canada, Canadian Community Health Survey, 2003
[4] For example taxation, bans on advertisements, clean indoor laws, advertisements emphasizing Smoking-Attributable Mortality.
[5] The smoking control strategy by Health Canada[5] comprises of four major directions: prevention (stop youth from taking up the habit), cessation (convince smokers to quit), protection (bylaws against smoking in public places) and demoralization (make smoking socially unacceptable).

importance of prices on the decision to start smoking, and the likelihood of smoking. Thus, we emphasize the importance of tax policy changes; we empirically analyze the effect of the Canadian government's decision to decrease taxation rate on cigarettes in 1994. Also, given the limited resources, it's important to find the target population where preventive policies would be the most effective.

This paper, thus intends to answer the following questions: First, What are the key determinants of the hazard of starting smoking, as well as the likelihood of smoking? We consider the important of prices, education attainments, marital status, ethnicity etc. Second, is the hazard rate and probability of smoking similar across subpopulations? Specifically, does the association between the above factors and smoking behaviour differ across gender? In order to answer the above questions we use data from a sample of 22,396 individuals drawn from the 2002 Canadian Tobacco Use Monitoring Survey (CTUMS).

The target population, as shown in the following graphs, is teenagers around the age of 15. From the sample, as seen in Figure 1, teenagers have the highest risk of picking up the smoking habit. The hazard of initiating the habit[6], starts increasing sharply around the age of 10, peaks at the age of 15, and falls off sharply thereafter. Thus, the policy would have its greatest impact around the time when the individual turns 15.

Figure 1: Empirical hazard rate of starting to smoke

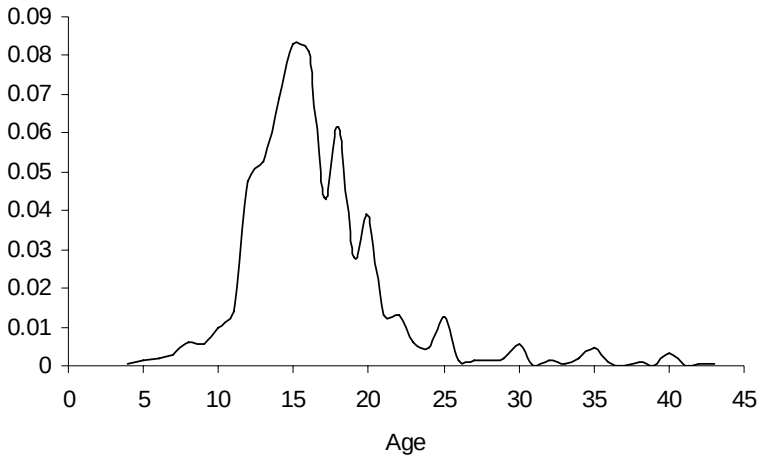


Figure 2 and 3, show differences across gender. Empirical hazard rate of starting to smoke is the highest in the teen years for both genders. The rates are much higher for males than for females, but

[6] This is defined as the probability of starting smoking at age *t* conditional on having never smoked before this age (See Section 3).

they peak around age 15 for both genders. It tapers off faster for males than for females such that by the age of 26 the hazard rates for the two groups are very similar. Also, the quit rates seem to be higher for males than for females.

Figure 2: Empirical hazard rate of starting to smoke by gender

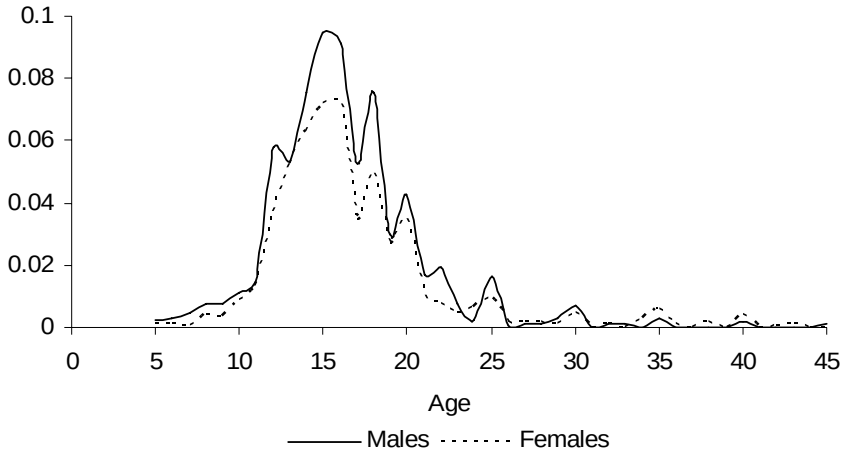
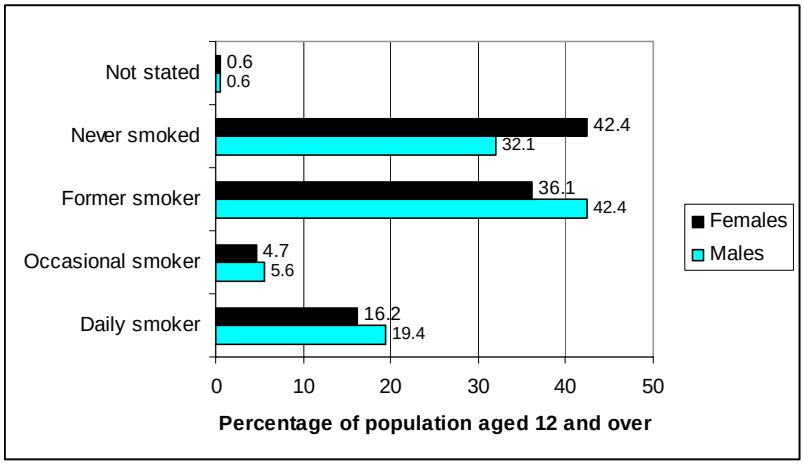


Figure 3: Smoking status by gender



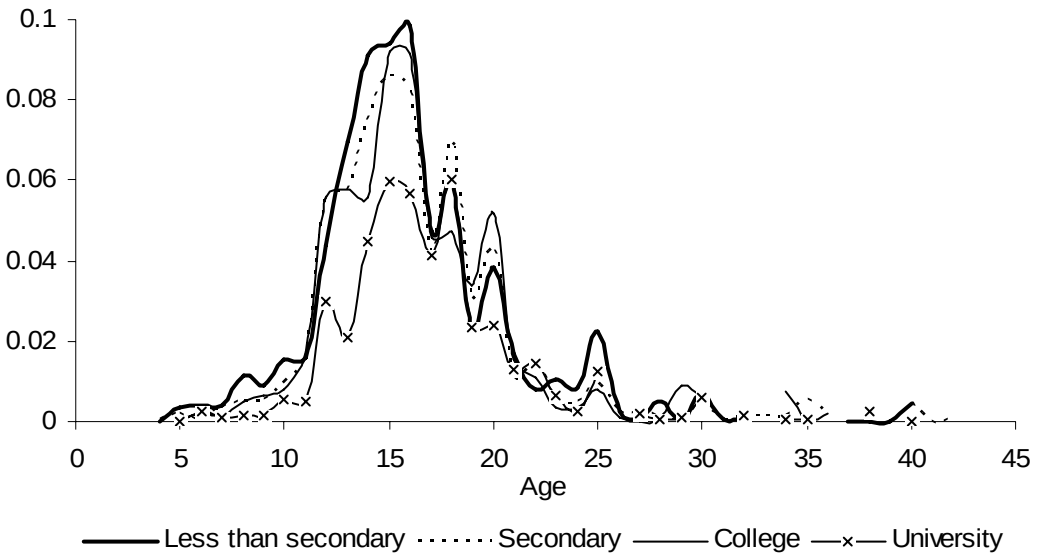
[7]

Figure 4, highlights the hazard rate of starting to smoke across individuals with different education attainment levels. Evidently, there is a significant variation in the initiation habit across education levels. Initiation rates are the lowest among those that hold a university degree. For those that go on to

[7] Source: Statistics Canada, Canadian Community Health Survey, 2003
(a) Daily smokers refers to those who reported smoking cigarettes every day.
(b) Occasional smokers refer to those who reported smoking cigarettes occasionally. This includes former daily smokers who are now occasional.
(c) Former smokers are those who previously smoked either daily or occasionally and are now non-smokers.

obtain a college degree, the rates are high when they are teens but taper off once they are in colleges. From early 20's to 40's the hazard rates are the highest for those that had less than secondary education. There are two explanations that are widely mentioned in literature. Individuals that go on to receive university degrees inherently have a lower discount rate, and hence value the future cost of smoking more than the present benefits. The other explanation, links education to knowledge; Higher education implies increased knowledge and ability to understand and accept medical research.

Figure 4: Empirical hazard rate of starting smoking by highest level of education



Our one aim is to study the effect of price change on the likelihood of smoking and the age of initiation. One policy mechanism that has been widely used in Canada, as well as various other countries, as a smoking control strategy, is sale taxes on tobacco products. Taxes raise the price of cigarettes and hence the cost of smoking. However, in the midst of an array of public policies by the Canadian government to curb smoking, the Canadian government in 1994 wavered and decreased the taxation rate on cigarettes. The major reason for this policy change was to curb the illegal re-importation of Canadian-made cigarettes and thus the loss of tax revenue. This policy change necessitates the analysis of prices of tobacco on the hazard of smoking and the probability of smoking so that the government can weigh the loss in revenue with the costly increase in smokers.

Gospodinov and Irvine (2005) provide some *stylized facts* on smoking trends in Canada. Consumption peaked in 1980-1982, falling continuously afterwards. Taxation also increased starting in 1980s, translating into price increases. In 1994 taxation rate decreased in an attempt to curb the illegal re-importation of Canadian-made cigarettes. Hamilton et al. (1997) show how smoking prevalence, although declining throughout, was higher in provinces that had tax cuts in 1994, while quit rates there were lower and number of cigarettes smoked was higher. The study points to the need that health side-effects are considered when assessing the success of the anti-smuggling policy. Supported by price increases in the US, provincial taxes increased lately to levels comparable to 1994. Cigarette prices increased in Canada by approximately 35% from 2000 to 2002, and this increase has led to a decrease in consumption of manufactured cigarettes by around 8%. Due to these price hikes, smoking restrictions and various health warnings, smoking rates are a lowest level in recorded history. We add to the above belief, and the existing literature, with our detailed empirical analysis of the price effect on smoking in Canada.

In this paper we use rational addiction model, as used by Douglas and Hariharan (1994) in their paper for the US sample and later used by other studies. The economics of addiction encompasses various approaches. The papers surveyed here belong to the class of *rational addiction models* following Becker and Murphy (1988), and among those, to the split-sample group of models. Douglas and Hariharan (1994) find that the non-economic variables have a much larger impact than economic variables (price, income) on participation and starting age. Forster and Jones (2001) focus on estimating British cigarette tax elasticities of the age of starting and the years of participation before quitting. Unlike in Douglas and Hariharan (1994) and Douglas (1998), price does have an effect on starting, albeit small in magnitude. Kidd and Hopkins (2004) perform an analysis similar to Douglas (1998), using Australian Health Survey data and matching cigarette prices series to estimate a split-population hazard model. However, they find price to have a significant impact on starting and an insignificant impact on quitting decisions.

DeCicca, Kenkel and Mathios (2002) cite widespread belief among American policymakers that price increases via taxation is an effective instrument. Using a micro data panel from the National Education Longitudinal Survey of 1988, which contains data on smoking by eight graders with follow-ups, they find that there is no conclusive evidence that price hikes are effective in curbing smoking, and argue that cross-sectional models that find strong tax elasticities in the US are biased by unobserved heterogeneity in "antismoking sentiment" across states. In our paper we introduce provincial dummies to account for unobserved heterogeneity in the model.

Our study provides evidence that education (increase in knowledge), price of Cigarettes, marital status and ethnicity (captured by the language they speak) are significant determinants of not only the probability of smoking but also the age (hazard rate) at which teenagers pick up the smoking habit. Results suggests that policies aiming at teenagers around the age of 15, that aim at increasing knowledge, and policies that increase price of cigarettes (via taxes) would be more effective as a preventive tools. Also, taxing cigarettes can have an impact on the number of smokers as this influence the probability of picking up the habit.

In Section 2, we present a descriptive analysis of the CTUMS data. The econometric approach is presented in Section 3, with the empirical results discussed in Section 4. In Section 5, we conclude.

2. Data and Descriptive Analysis

Our sample is drawn from the 2002 Canadian Tobacco Use Monitoring Survey (CTUMS).[8] The latter was administered by Statistics Canada from February to December 2002 with the cooperation and support of Health Canada. Conducted since 1999, the CTUMS is a valuable source of data on tobacco use and related issues in Canada. The primary objective of the survey is to track changes in smoking status, especially for populations most at risk, such as the 15 to 24 year olds. The 2002 sample includes 23,341 persons aged 15 and older representative of the population of the ten provinces of Canada at the time of selection. Residents of the Yukon, Northwest Territories, and Nunavut, and full-time institutional residents were not eligible for selection into the sample. In addition, households (and thus persons living in households) that do not have telephones were excluded from the sample population[9] (represent less than 3% of the 2002 target population).[10]

We trim a total of 945 observations with missing data. The final sample consists of 22,396 individuals. Descriptive statistics relevant to our study are presented in Table 1. Roughly 46% of the sample population fall in the category 'Ever Smoked'. Ever smokers include current and former smokers. Following the CTUMS definitions, a current smoker is defined as a person who currently smokes cigarettes daily or occasionally. A former smoker is a person who has smoked at least 100 cigarettes in his life, but currently does not smoke. Never smokers include experimental smokers, which are referred as persons who have smoked at least one cigarette, but less than 100 cigarettes, and currently doe not smoke cigarettes.

[8] This study is based on public use files data.
[9] The survey was conducted using a sample of telephone numbers.
[10] For further information on the CTUMS design and data processing refer to the "Canadian Tobacco Use Monitoring Survey, Annual 2002, – User Guide" produced by Statistics Canada.

Table 1: Descriptive statistics in the data set

Variable	Mean
Ever smoked	0.4559
Female	0.5063
Age	43.06
	(17.65)
Highest level of education	
Less than secondary	0.23
Completed secondary	0.4057
Complete college	0.1614
Complete university	0.1986
Marital status	
Single/never married	0.2865
Married/living common-law	0.6044
Widowed	0.0509
Divorced/separated	0.0582
Household size	2.86
	(1.24)
CMA (population of 100,000 or more)	0.6372
Cigarette price index at age 15 (100 in 1992)	30.45
	(30.35)
Language spoken most often at home	
English(*)	0.6773
French	0.2193
Other	0.1034
Province of residence	
Newfoundland	0.0180
P.-E.-I.	0.0046
Nova Scotia	0.0315
New Brunswick	0.0253
Quebec	0.2434
Ontario	0.3816
Manitoba	0.0350
Saskatchewan	0.0313
Alberta	0.0955
British Columbia	0.1337
Age starting smoke (uncensored)	14.95
	(4.01)
# Observations	22,396

Notes: (*) Includes "Both English & French". Figures in parentheses are standard-deviations.

Mean initiation age for smokers is about 15 with a small standard-deviation, strengthening the fact that individuals are at the highest risk of starting smoking during the teenage years. The difference in the means/proportions between ever smokers and individuals who never smoked is statistically significant at the 5 percent level for each of the variables; gender, age, level of education, marital status, household size, and Census metropolitan area (CMA). This can be straightforwardly inferred from

Table 2, which shows the proportion of ever smokers by observed characteristics in Table1. Men are more likely to pick up the habit of smoking than women. In addition, the prevalence of smoking is the lowest among university graduates, while the remaining levels of education are very comparable. On the surface, the probability of being a smoker is relatively low among single persons. However, many of the latter are still young and may pick up the habit later in their lives. Indeed, the proportion of ever smokers increases sharply with age among single people. It goes from 35.3% among single individuals aged 30 or younger, to 44.4% among single individuals aged between 31 and 40. Thereafter, it reaches 54.9% among those aged between 41 and 50, and hits the highest point of 61.0% for single people aged 51 to 60. Statistics also indicate that increased household size reduces the likelihood of being an ever smoker. Hence, living with other people, especially kids, seem to provide a certain incentive for not smoking. Interestingly, small areas (less than 100,000 residents) show a large proportion of ever smokers, 10 percentage points higher than big areas. However, many factors may explain this situation. For instance, residents in small areas on average are older (a difference of more than three years), less likely to graduate from university, and less likely to remain single. On another side, individuals who speak neither English nor French at home are much less likely to pick the habit of smoking.

The cultural factor appears determinant in this case assuming that these individuals likely are immigrants. Conversely, individuals who speak only French at home exhibit a smoking prevalence rate that is 10 percentage points higher compared to those who speak more often English. Naturally, most of individuals who often speak French at home in our sample live Quebec,[11] which is among the provinces with highest proportions of ever smokers. Incidentally, the prevalence of smoking is much higher in eastern provinces, while Ontario and British Columbia are distinguished by relatively low percentages of ever smokers. The comparison between the French-speaking people and the English-speaking people in Quebec and New Brunswick[12] shows that the first are generally more likely to become smokers than the latter (a 3 percentage point difference in New Brunswick and a 6.5 percentage point difference in Quebec.)

[11] 90.9% of individuals speaking French most often at home in our sample live in Quebec.
[12] The sample proportion of French-speaking people is 29% in New Brunswick and 81.9% in Quebec, versus only between 0.2% and 2.6% in each of the remaining provinces.

Table 2: Percentage of people ever smoked by various characteristics

Variable	% ever smoked
Female	41.4%
Male	49.9%
Highest level of education	
Less than secondary	48.5%
Completed secondary	47.8%
Complete college	47.7%
Complete university	35.9%
Marital status	
Single/never married	39.2%
Married/living common-law	47.5%
Widowed	40.1%
Divorced/separated	61.4%
Household size	
≤2	49.8%
3-4	44.2%
≥5	34.3%
CMA (population of 100,000 or more)	
Yes	42.0%
No	51.9%
Language spoken most often at home	
English(*)	45.5%
French	55.7%
Other	24.6%
Province of residence	
Newfoundland	57.8%
P.-E.-I.	56.0%
Nova Scotia	52.8%
New Brunswick	52.5%
Quebec	54.7%
Ontario	40.2%
Manitoba	48.3%
Saskatchewan	48.7%
Alberta	45.9%
British Columbia	37.5%

Note: (*) Includes "Both English & French".

3. Econometric specification

For individuals that have never smoked, data on smoking initiation age is censored, since we do not know whether they will ever start smoking, and if yes, at what age. This situation requires the use of specific analysis methods based on duration models. These methods initially used in biostatistics were extended to the study of other phenomena such us celibacy, marriage, employment, unemployment,

criminal recidivism, etc. The variable of interest in our analysis of duration is the smoking initiation age, which is the length of time that elapses from birth until starting smoking for the first time.[13]

This duration can be analysed using a nonparametric approach, which imposes no restriction on the data. This approach, known under the name of Kaplan-Meier, produces strictly empirical estimates of the survival and hazard functions. The survival function indicates the probability that smoking does not start before each time period, whereas the hazard function indicates the instantaneous probability that smoking starts at time t, conditional on the fact that this event did not occur before this time. Strict empirical estimates of these functions would be:

$$\hat{S}(k) = \prod_{i=1}^{k} \frac{n_i - q_i}{n_i} = \frac{n_i - q_i}{n_1} \text{ and } \hat{h}(k) = \frac{q_k}{n_k} \qquad (1)$$

where n_k denotes the number of individuals who never smoked before age k and q_k denotes the number of individuals who start smoking at age k.

With this nonparametric approach, it is not possible to measure the effects of some variables of interest on the smoking habit. However, it is possible to carry out calculations in (1) for different groups of the population and compare obtained estimates. For instance, if we would like to compare females to males, one must estimate survival (hazard) function separately for each group and compare estimates by age (a graph is suitable in this case). Incidentally, Figures 1, 2 and 4 are produced using the nonparametric approach.

The parametric approach in the duration models requires an assumption about the distribution of the random variable representing the age when starting smoking. Hence, this approach imposes a restriction on the data, but it has the advantage of making it possible accounting and estimating the effects of observed variables. Let T be the random variable representing the age when starting smoking and suppose that this variable has a continuous probability distribution $f(t \mid \theta)$, where t is a realization of T. The survival and hazard functions are as follows:

$$S(t \mid \theta) = Prob(T \geq t) = 1 - \int_0^t f(s \mid \theta) ds$$
$$h(t \mid \theta) = \frac{f(t \mid \theta)}{S(t \mid \theta)} \qquad (2)$$

[13] Following the definitions given in Section 2, smoking initiation age is relevant to those who become ever smoker afterwards. Experimental smokers are considered as never smokers with censured information on smoking initiation age.

$S(t \mid \theta)$ is the probability that the event of starting smoking for the first time does not occur before time period *t*; $h(t \mid \theta)$ is the probability that the event of starting smoking occurs at age *t* conditional on having never smoked before this age.[14]

Let δ_i be an indicator equal to one if the individual is an ever smoker as of time *t*, zero otherwise. The parameters θ of the density function of *T* can be estimated by maximizing the following log-likelihood function:

$$ln\,L(\theta) = \sum_{\delta_i=1} ln\, f(t_i \mid \theta) + \sum_{\delta_i=0} ln\, S(t_i \mid \theta) \qquad (3)$$

In the terminology of duration models, failure means that the event of interest occurred. An important assumption of standard duration models is that each individual will eventually fail, meaning in our case that all individuals will end up being smokers. This assumption does not seem appropriate in the light of the fact that 54.4% of our sample did not start smoking at all and that some people never smoke in their lives. In their study on the criminal recidivism, Schmidt and Witte (1989) suggest a "Split Population" model that allows for the possibility that the event of interest (start smoking in our case) will never occur for some individuals (among censored observations).[15] This model weights the likelihood of each observation by using the estimated probability that the individual will ever start to smoke. For this purpose, one must model the probability of failure as well.

By defining P_i as the probability that individual *i* will ever be a smoker, the correct log-likelihood function is now:

$$ln\,L(\theta) = \sum_{\delta_i=1} ln\left[P_i\, f(t_i \mid \theta)\right] + \sum_{\delta_i=0} ln\left[(1-P_i) + P_i S(t_i \mid \theta)\right] \qquad (4)$$

In Equation (4), $f(t_i \mid \theta)$ and $S(t_i \mid \theta)$ are weighted by the probability of ever being a smoker, since the duration before starting smoking is applicable only to those who will eventually start to smoke. Moreover, this equation accounts for the probability, $(1-P_i)$ that a censored observation ($\delta_i = 0$) will eventually never fail.

[14] For further details and explanations on standard duration models, see Greene (2003, Chapter 22)
[15] See also Douglas and Hariharar (1994) for an application on the hazard of starting smoking

We estimate Equation (4) under the assumption of a log-logistic distribution for the variable *T* and a *probit* model for the probability of ever being a smoker. The log-logistic distribution allows the hazard to first increase, and then decrease, which corresponds to the pattern of the empirical hazard.[16]

The hazard and survival functions for the log-logistic distribution are:

$$S(t \mid \theta) = \frac{\lambda p(\lambda t)^{p-1}}{1+(\lambda t)^{p}} \text{ and } h(t \mid \theta) = \frac{1}{1+(\lambda t)^{p}} \qquad (5)$$

with $\theta = (\lambda, p)'$. The density function may be obtained as $h(t \mid \theta)S(t \mid \theta)$. The effect of external covariates, X on the survival rate or the hazard function can be incorporated by writing:

$$\lambda = e^{-X\beta} \qquad (6)$$

Estimation is facilitated by the transformation:

$$w = \frac{\ln t - X\beta}{\sigma} \qquad (7)$$

Where, $\sigma = 1/p$. The densities and survival functions for *w* is:

$$f(w) = \frac{e^{w}}{\left(1+e^{w}\right)^{2}} \text{ and } S(w) = \frac{1}{1+e^{w}} \qquad (8)$$

The observed random variable is now:

$$\ln t = \sigma w + X\beta \qquad (9)$$

with $f(\ln t \mid X, \beta, \sigma) = \frac{1}{\sigma} f(w)$ and $S(\ln t \mid X, \beta, \sigma) = S(w)$.

Using a probit model, the probability of ever being a smoker is:

$$P = 1 - \Phi(Z\alpha) = G(X_i\alpha) \qquad (10)$$

where $\Phi(.)$ is the distribution function of the standard normal, and *Z* is a vector of observed characteristics.

Finally, the whole parameters of the model are estimated by maximizing the log-likelihood:

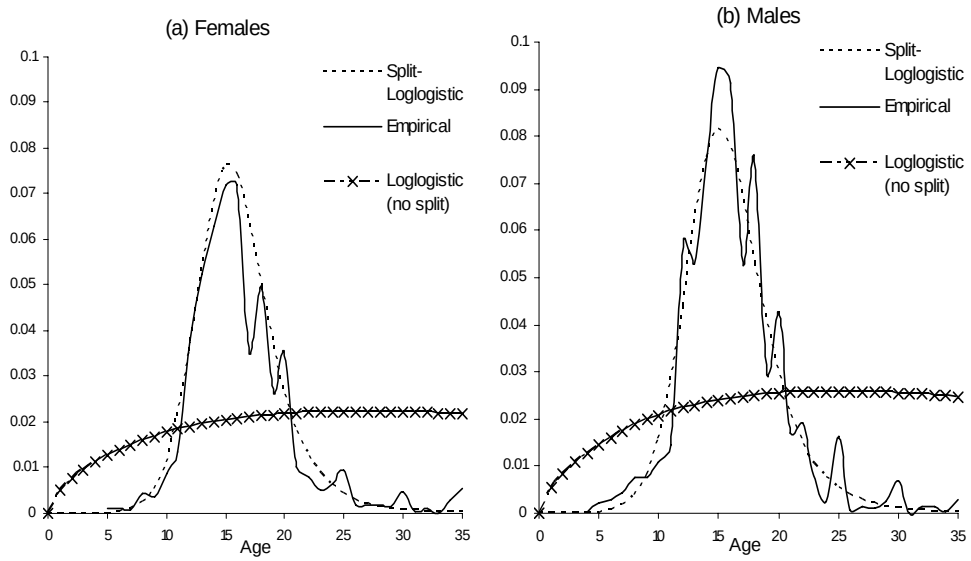
[16] The log-normal distribution also allows the hazard to first increase and then decrease. However our estimates show that the log-logistic distribution fits much better the empirical hazard function in Figure 1. Douglas and Hariharan (1994) also use the log-logistic distribution

$$\ln L(\alpha,\beta,\sigma) = \sum_{\delta_i=1} \ln\left[G(X_i\alpha)\frac{f(w_i)}{\sigma} \right] + \sum_{\delta_i=0} \ln\left[(1-G(X_i\alpha)) + G(X_i\alpha)S(w_i) \right] \qquad (11)$$

Like in Schmidt and Witte (1989), we estimate our model with $Z_i = X_i$. Also, we estimate the model separately for women and men.

The value of the split population model is remarkably visible in Figure 5 for both females and males. Log-Logistic split population model has an estimated hazard function that closely resembles the empirical (nonparametric) hazard function. On the other hand, standard Log-Logistic with no split is far from reflecting the actual empirical by predicting higher probability of smoking at early and later stages of life span, and much lower probability during teenage years.

Figure 5: Estimated hazard functions under different specifications



4. Empirical Results

Econometric results for the two estimations are presented in table 3 and table 4. Table 3 tests the importance of socio-economic variables in starting the smoking habit; a negative coefficient means that higher values of the variable imply a greater probability of smoking (see Equation 10). While Table 4 reports the significance of variables influencing the age at which individuals begin to smoke; positive coefficients mean that higher values of the variable imply starting smoking later in life. Importance of determinants varies across the two sets of results: predictors of smoking initiation are

different from predictors of the age of initiation of smoking. Price of cigarettes is a significant determinant of the probability of smoking, but does not influence the age of initiation. Similarly, size of household and living in a large city influence the probability of smoking and not the age of initiation. Influence of marital status is systematically different across the two analyses. These findings are valid for both genders.

In the pooled sample, the gender coefficient was highly significant, with females less likely to smoke and more likely to start later in life if they smoke compared to males. Previous studies have found differences across gender, which strengthen the case for accounting for different socio-economic realities confronting men and women. One difference arises from the dependence of female on cigarettes as a means to control or loose weight (O'Loughlin et al. 1998). As is evident from the following estimates, gender differences do exist despite a qualitatively similar influence of determinants.

In order to capture the effect of education we introduce three dummy variables: secondary, college degree and university degree, which take the value one if the individual has completed that particular level of education. The reference or the comparison base for these dummies is less than secondary education. Higher level of lifetime educational attainment, measured by secondary, college and university dummies, reduces the likelihood of ever smoking. However, the negative effect is stronger for males than for females. College degree attainment does not have any significant effect on the likelihood of smoking for females. Secondary school and university degree achievements significantly reduce the likelihood of smoking for both genders.

Conditional on becoming a smoker, educational attainment also increases the age of initiation of smoking. The coefficient on Secondary, College and University are all positive and highly significant for both genders. Also, it should be noted that the coefficients increase with higher education levels, and are comparable across gender. It might suggest that with higher education individuals have higher exposure to the health effects of smoking, or that individuals wanting higher education levels have somewhat lower discount rates and thus also do not smoke.

Unfortunately, we were not able to account for income level in our regressions (this would be correlated with the education levels).[17] In earlier studies like Douglas and Hariharan (1994), income variable increases the probability of smoking and has no significant impact on the age of initiation. So,

[17] Two variables on household income and income adequacy exhibit higher non-response rates of 38% each.

if anything, controlling for income would strengthen, is the positive coefficients of education in the first regression (likelihood of ever smoking.)

Marital status seems to influence the smoking habit. Divorced persons are more likely to pick up the habit; again the coefficient is larger for females than for males. Males that are widowed have a lower probability of smoking. Dummy variable Widowed is significant for both genders as a determinant in delaying the age of initiation. Those that are married are no different from those that are single in terms of likelihood for smoking or age of initiation for any of the genders.

We also find that price of cigarettes, especially the price in the critical years of starting the smoking habit (15 years), has a significant effect on the likelihood of smoking for both genders. As Table 3 shows, prices have a highly significant and negative effect on the likelihood of smoking. From a policy perspective, this is an important result, since it highlights the importance of taxes as a determinant of likelihood of smoking. However, price has no effect on the age of initiation for individuals who become smokers. Overall, results on the importance of prices have been mixed across studies. Douglas (1998) and Douglas and Hariharan (1994), Forster and Jones (2001) report an insignificant role of price for the US and the British study, whereas, Kidd and Hopkins (2004) report a significant role of price for the Australian study. Also, Nicolás (2002) shows that prices have a very limited effect on the hazard of starting smoking in the male population and no significant effect in the female population using Spanish data. In a developing context (Vietnam), Laxminarayan and Deolalikar (2004) report that changes in relative prices induce substitution among tobacco products rather than encourage quitting.

An interesting result from our study relates to the dummy variable “Speaks other than French or English at home”, which is picking up the immigrant households (mainly consisting of Asians). The coefficient on this variable was not only significant but also quite large. We also ran the regressions with a dummy variable for French speakers (English speakers as the base); the coefficient was insignificant. There seemed to be no significant differences across the English and the French speaking population once we control for other characteristics. The large significant coefficient of the third group is an important result and needs to be explored further in the future. There can be quite a few reasons for this relative absence of smoking in these households. Among the Sikhs from India,

religion bans them from smoking, while Islam considers it as a bad habit.[18] Mermelstein (1999), in a sample of adolescent groups in the US, find that ethnicity and gender play an important role in adolescent smoking; for example they report that Asian-American/Pacific Islander females reported strong family mandate not to smoke.[19]

The CMA variable was not a significant determinant for the age of initiation of smoking. It, however, was a significant incitement for the likelihood of smoking. People living in small areas are more likely to smoke. Finally, as one may expect, increased household size lowers the probability of being a smoker with a highly significant coefficient for both genders. However, it does not make a difference between likely ever smokers regarding the timing of initiation.

[18] In Sikhism there are 4 cardinal sins (Kurahts). Sikhs should not cut their hair, commit adultery, use tobacco or other drugs and not eat ritually slaughtered meat. Source: "http://www.sikhs.org/gloss2.htm"; http://www.diversiton.com/religion/main/sikhism/traditions-beliefs.asp

[19] The survey we are using does not break down this group any further (into difference ethnicities or cultural backgrounds) so we can not explore this result further using our database.

Table 3: Split population model estimates by gender

Negative coefficients mean that higher values of the variable imply a greater probability of ever smoking

	Females		**Males**	
Variable	Coefficient	Std. error	Coefficient	Std. error
Constant	-0.1743	0.1973	-0.7626***	0.1436
Highest level of education (ref. = Less than secondary):				
Secondary	0.1637***	0.0549	0.1672***	0.0399
College	-0.0020	0.0663	0.2299***	0.0490
University	0.6256***	0.0670	0.7288***	0.0478
Marital status (ref. = Single):				
Married	-0.0183	0.0587	-0.0333	0.0426
Widowed	0.0816	0.0964	0.4877***	0.0783
Divorced	-0.5646***	0.0876	-0.4246***	0.0701
Household size	0.0646***	0.0192	0.0793***	0.0136
CMA (population of 100,000 or more)	0.1933***	0.0429	0.1665***	0.0316
Speaks other than French or English at home	1.3996***	0.0836	0.8179***	0.0530
log cigarette price index at age 15	0.1440***	0.0451	0.1286***	0.0328
Other controls:				
Provincial dummies	Yes		Yes	
Cohort effects	Yes		Yes	
Ancillary parameter σ	0.1225***	0.0013	0.1316***	0.0010

Notes: We control for the cohort effects by including in the set of regressors three dummy variables indicating whether the individual is aged 15-25, 26-45 or 46-65. Those aged 66 and older are the reference group. (***) indicates significance at the 1% level. (**) indicates significance at the 5% level. (*) indicates significance at the 10% level.

Table 4: Duration model estimates by gender

Positive coefficients mean that higher values of the variable imply starting smoking later in life

	Females		**Males**	
Variable	Coefficient	Std. error	Coefficient	Std. error
Constant	2.9269***	0.0312	2.7467***	0.0226
Highest level of education (ref. = Less than secondary):				
Secondary	0.0376***	0.0083	0.0402***	0.0062
College	0.0592***	0.0101	0.0520***	0.0079
University	0.0908***	0.0111	0.0957***	0.0083
Marital status (ref. = Single):				
Married	-0.0122	0.0095	-0.0075	0.0074
Widowed	0.0508***	0.0157	0.1063***	0.0132
Divorced	0.0007	0.0133	0.0148	0.0111
Household size	0.0047	0.0032	0.0037	0.0024
CMA (population of 100,000 or more)	0.0043	0.0069	0.0046	0.0052
Speaks other than French or English at home	0.1582***	0.0152	0.1676***	0.0106
log cigarette price index at age 15	-0.0076	0.0079	0.0012	0.0059
Other controls:				
Provincial dummies	Yes		Yes	
Cohort effects	Yes		Yes	
Split (Probability of ever smoking)	0.4441***	0.01013	0.4853***	0.0077

Notes: We control for the cohort effects by including in the set of regressors three dummy variables indicating whether the individual is aged 15-25, 26-45 or 46-65. Those aged 66 and older are the reference group. (***) indicates significance at the 1% level. (**) indicates significance at the 5% level. (*) indicates significance at the 10% level.

5. Conclusion

In this paper we examine the determinants of both the likelihood of smoking and the age of initiation of smoking, using a sample drawn from the 2002 Canadian Tobacco Use Monitoring Survey (CTUMS). We have obtained some important results in this study that can further help policy makers to shape up anti-smoking policies. Policies influencing prices of cigarettes seem to lower the probability of smoking even though it does not effect the age of starting the habit. Nevertheless, deterring people from smoking is more suitable than making them delay the initiation. Canadian Government has considerable control over taxes, and should be used wisely as a policy tool. Also, females are relatively more sensitive to price changes than males. Given the medical research showing adverse effects of smoking at the time of pregnancy and the difficulty of quitting the smoking habit, the importance of taxes should not be taken lightly. Taxes also have an indirect effect on number of smokers through its impact on tobacco's market. Low taxes allow for higher profit margins which, in turn, allow new smaller companies to enter the market and compete with the traditional firms. Major firms, in turn, respond by cutting the prices further thus, leading to price wars.

We find that females' response to various determinants like education, marital status is quantitatively different in magnitude to males; the coefficients have been consistently different across gender. This necessitates separate anti-smoking campaigns for the two groups.[20] In addition, education not only reduces the likelihood of smoking but also increases the age at which individuals pick up the habit. These results indicate that policies that increase information and knowledge about the dangers of smoking would be more effective in reducing the number of smokers by deterring smoking habit. Also, our results suggest differences across ethnic groups, since those who speak neither English nor French at home are much less likely to smoke, and if they do, they are more likely to do it later in life. Finally, we conclude that increased household size and living in large areas raises the probability of smoking, but have insignificant impacts on the initiation age. Overall, our findings can help in shaping up efficient anti-smoking policies by targeting the groups that are at high risk of picking the habit.

Depending on data availability, a further research that examines the determinants of quitting smoking may be of great interest for policies aimed at making those who cannot be prevented from smoking renounce to the habit sooner.

[20] For example a college degree does not seem to reduce the likelihood of smoking for women. A campaign educating the females and addressing their concerns (weight loss etc) at the school level would be an important deterrent and a good policy choice.

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