Tobacco Taxes in Canada: An Analysis of Elasticities and Salience

By Jeff Hicks

An essay submitted to the Department of Economics in partial fullfillment of the requirements for the degree of Master of Arts.

Queen's University,
Kingston, Ontario
August 21st, 2015

Acknowledgments

I would like to thank Christoper Cotton for his helpful advice during the writing of this paper, and for his feedback on the draft. Thanks to Bin Hu of the Queen's Research Data Centre, and Lee Grenon at the UBC Research Data Center for their assistance with accessing the Canadian Tobacco Use and Monitoring Survey micro data. And thanks to Vincent Pohl, Adib Rahman, and Samuel Gyetvay for their helpful comments at various stages of the project. All errors and omissions are my own.

Abstract

This paper investigates multiple aspects of consumers' behavioural response to tobacco taxation in Canada, using monthly micro-data from 2000 to 2010. I estimate baseline intensive and extensive margin tax elasticities of -.087 and -.03 respectively, and examine demographic and geographic heterogeneity in these elasticities. First, responsiveness to tobacco taxes has decreased over time, implying that tobacco taxes are becoming less effective as a deterrent to smoking. Second, university graduates are shown to be more responsive to tobacco taxes than those without a university degree. This adds an additional degree of regressivity to tobacco taxes. Third, suggestive evidence indicates that Ontario and Quebec no longer have smaller elasticities due to tax evasion opportunities, which was the case in the 1990s. I discuss the reasons why this is the case.

Next, I examine whether taxes included in the price tag are more salient than taxes added at the register, and whether the salience varies by demographic groups. The findings show that lower education groups fully internalize register taxes, while university graduates do not. This has implications for regressivity and legislation dictating that taxes be included in price tags. Finally, I use survey evidence to demonstrate how the common procedure used for estimating intensive margin elasticities is likely biased.

Contents

I. Introduction

This paper first provides an update to the Canadian literature on behavioural responses to tobacco taxation. Historical analyses, almost exclusively from the 1990s, are no longer relevant as the cultural and legislative landscape surrounding smoking has changed so dramatically. I also make two novel contributions to the broader taxation literature. First, I demonstrate hetereogeneous tax salience across educational groups, which has implications for regressivity and legislation requiring taxes be included price tags. Second, I show how the common procedure for estimating intensive margin elasticities is likely downward biased, overstating actual responsiveness.

Surprisingly, the literature on basic tobacco tax elasticities in Canada has fallen out of date. The most recent estimates, by Sen et al. (2010), use two years of data (2003 and 2005)[1], and all prior estimates use pre-2000 data. If smoking has become less responsive to taxes over time, as my results show, either due to legislative or cultural changes, then policy makers should reconsider the effectiveness of tobacco taxes as a method to discourage smoking. Furthermore, other aspects of elasticities in Canada have changed over time – for instance, I provide suggestive evidence that regional elasticity-disparities attributable to tax-evaded tobacco are far lower than they were in the 1990s.

Furthermore, the Canadian literature has not utilized individual-level monthly data. Rather, it often uses aggregate or individual-level data over inconsistent time periods, such as pooling cross-sections that are multiple years apart. I utilize ten years of consistent, monthly, individual-level, cross-sectional data[2]. The data set has yet to be used for this research purpose and is the longest month-over-month

[1]Furthermore, the focus of their paper is the relationship between smoking and obesity – they do not systematically examine intensive and extensive margin tax elasticities.

[2]I use the Canadian Tobacco Use and Monitoring Survey

survey set available.[3] Not only does monthly data increase the time-variation, but it also increases cross-sectional variation, because provinces do not always change their tobacco taxes during the same months. Annual data would not capture this additional variation.

My baseline estimates of intensive and extensive margin elasticities are -.0875 and -.03 respectively (the intensive margin is how much an individual smokes, conditional on being a smoker, and the extensive margin is the decision be a smoker). I also find demographic heterogeneity. Notably, lower education groups are shown to be significantly less responsive to tobacco taxes. As education and income are highly correlated, this implies an additional degree of regressivity to tobacco taxes. Furthermore, because lower education groups are more likely to smoke, the tax burden shifts even more to these lower income groups.

Next, I demonstrate how the wide-spread and typical procedure for estimating intensive margin elasticities with pooled cross-sectional data, which is the norm, is potentially biased. When smokers quit in response to higher taxes, if the 'quitters' smoke more (or less) on average than 'non-quitters', this will bias upward (downward) intensive margin elasticity estimates.[4] I present survey evidence demonstrating that 'quitters' on average smoked four to five cigarettes more, per day, than 'non-quitters'. This provides insight into how large the bias may be. This has not been done in previous literature, to the best of my knowledge. Furthermore, I discuss why estimating time-invariant combined elasticities[5] using micro-data is also likely biased in many cases due to time trends in participation rates and smoking intensity.

Finally, I investigate whether consumers are more attentive to taxes that are in-

[3]Previous papers use the Canadian Community Health Survey.
[4]When considering elasticities in absolute value terms
[5]Total elasticity, rather than decomposed intensive and extensive margin elasticities

cluded in the price tag than to taxes added at the register. If consumers are less attentive, and therefore less responsive, to register-taxes, how then should governments design tobacco taxes? If revenue maximization is the goal, taxes should be levied inconspicuously. If reducing smoking is the priority, taxes should be made as salient as possible. One could argue that reducing smoking is the priority, and therefore sales taxes should be included in the posted price tag. Doing so would marginally reduce smoking without adding to the tax burden of the remaining smokers.

I test for differences in these attentiveness effects across educational groups, and present a robustness check to measure the size of indirect income and substitution effects of sales taxes (which are applied at the register). This is only the second paper to examine heterogeneous salience effects. The first was by Goldin and Homonoff (2013), and they find that high income groups are statistically less attentive. My findings show that lower education groups fully internalize sales taxes, while university graduates do not. Given the correlation between income and education, this supports the findings of Goldin and Homonoff (2013). A common concern with commodity taxes, including tobacco taxation, is that they are often regressive. However, if such taxes are levied at the register, and register taxes are less salient for high-income/high-education groups, this can help to reduce the regressivity.

All of these empirical findings are particularly relevant because tobacco taxes have become increasingly prominent amongst federal and provincial tax collections in Canada. From 2000 to 2010, federal excise taxes increased from $10.86 to $17 per carton (Canadian Tax Foundation, 2010). The average provincial excise tax rose from $13.70 to $35.40 per carton. [6] Furthermore, provincial tax rates differ markedly. Nova Scotia had the highest in 2010 at $43.00, Quebec the lowest at $20.6. The provinces

[6] A carton contains 200 cigarettes.

also differ in their sales tax treatment of tobacco. Quebec, Ontario, British Columbia, and Prince Edward Island all exempted tobacco during the sample period, whereas the remaining provinces did not. [7]

Canada also faces a unique challenge with a large proportion of its population near US-Canada border crossings, and in some provinces near major sites of illegal contraband. The rise in tobacco taxes over the past decade is intriguing in light of Canada's past experience with contraband tobacco. By 1993 the average provincial and federal tax burden per carton had risen to roughly $41.00 (2010 dollars) causing large scale smuggling. In particular, cigarettes were legally exported across the US-Canada border then illegally smuggled back, often through First Nations reserves that straddle the border. Consequently, provincial and federal taxes were cut in 1994, especially in Quebec and Ontario, the provinces most vulnerable to smuggling. However, over the period 2000 to 2010, tobacco taxes increased again surpassing the peak tax levels of the 90s in real terms, averaging $52.00 in 2010. [8]

Furthermore, the general cultural and legislative landscape surrounding smoking behaviour has changed significantly over the past fifteen years. Smoking participation rates have declined significantly. Smoking is prohibited in public places, and in vehicles with children. Graphic images are imposed by law on cigarette packages. The advertisement of tobacco products is extremely limited by the Tobacco Act. Excise taxes have risen significantly. A two-tiered export tax was implemented to reduce tax-evasion.[9] And cultural attitudes have shifted. All these factors suggest that historical

[7]Currently, only Quebec maintains the exemption. In Ontario and PEI, the exemption was removed with the introduction of the HST.

[8]To counter export/illegal reimport operations, a new export tariff system was introduced in 2001.

[9]A common method of avoiding taxes in the 1990s was to export Canadian-made cigarettes to the United States, then to illegally re-import them across the US/CAN border. For instance, the Government of Canada launched a lawsuit in the United States against RJR-Macdonal claiming they did just that.

analyses of tobacco taxation are not relevant today.

Finally, this paper presents only extensive and intensive margin elasticities, rather than total demand elasticities. This provides more detailed insight into how consumers respond than does a total elasticity. It is also useful for policy makers. Quitting smoking altogether (the extensive margin) has different health benefits than marginally reducing smoking consumption (the intensive margin).

The rest of the paper is structured as follows. Section II reviews the recent literature on tobacco taxation and tax salience. Section III outlines the data, estimation strategy, and intensive margin estimation bias. Section IV presents the baseline elasticities, the regional and demographic heterogeneity, and the tax salience results. Section V discusses the policy implications and concludes.

II. Previous Literature

Estimates of smoking elasticities in the U.S. are numerous. Poterba (1999) and Chaloupka and Warner (2000) provide overviews of research prior to 1999. Most estimates of total elasticities range between -.4 and -.5. Decomposition into extensive and intensive margins has not yielded any strong consensus values for the two different elasticities. Farrelly et al. (2001) estimate extensive and intensive elasticities of -.13 and -.15 respectively using U.S. data. Goldin and Homonoff (2013) estimates are -.117 and -.341 using more recent data. In Canada, Sen et al. (2010) estimate an extensive elasticity of between -.001 and -.006, and Gruber et al. (2003) find extensive and intensive elasticities of -.02 and -.41 respectively.

More recently, authors have begun to examine more novel aspects of the incidence and behavioural responses. Harding et al. (2012) use nationally representative micro-

level scanner data to identify strong and highly non-linear effects of distance to lower tax borders on pass-through rates. Chiou and Muehlegger (2014) also uses scanner data in the Chicago area to demonstrate the effect of distance on pass-through rates. Merriman (2010) uses samples of littered cigarette packages to estimate the amount of illegal sales of cigarettes in the Chicago area. Others have looked at specific compensatory behaviour, such as Adda and Cornaglia (2006) which shows that smokers extract more nicotine per cigarette in response to tax increases, calling into question the health benefits of tobacco taxation. Finally, Chiou and Muehlegger (2014) find evidence of stockpiling before tax increases and consumers shifting to lower-quality brands in the short-run to smooth consumption.

The Canadian literature is sparser. Gruber et al. (2003) use aggregate legal sales data to estimate a combined elasticity of -.47 over the years 1981 to 1999 in provinces with relatively minor smuggling prevalence. When they include high smuggling provinces such as Ontario and Quebec, the elasticity is substantially higher at -.72. This indicates very large smuggling effects. They also use household expenditure survey data to estimate a comparable elasticity of -.41. They are unable to accurately decompose the combined effect into extensive and intensive margins. While this paper demonstrated smuggling's effect on elasticities in Ontario and Quebec, my results suggest that this effect has disappeared.

Sen and Wirjanto (2010) estimate extensive and intensive margin elasticities amongst youth of -.1 and -.14 respectively. They use multiple survey data sets corresponding to Central Canada, and use the sudden tax cuts in 1994 as identifying variation. The federal and provincial tax cuts were not simultaneous, providing some further cross-sectional variation.

Finally, there is a very recent and developing literature on the salience of commod-

ity taxation, pioneered by Chetty et al. (2009). They presented two research designs to demonstrate that consumers under-react to sales taxes which are not included in the posted price. First they conducted a controlled experiment at two grocery stores. A treatment group of products had the sales-tax-inclusive price posted. These were compared to control groups without sales-tax-inclusive prices in the same store and other nearby locations. The treatment group experienced a roughly eight percent decline in sales and revenue relative to the control. With price elasticity estimates of around -1 to -1.5, this indicates that consumers completely ignore the 7.375 percent sales tax. The second research design used state-level data on total beer consumption to show that changes in excise taxes (which are included in the price tag) alter total consumption by an order of magnitude more than changes in sales taxes (which are added at the register).

A second paper, by Goldin and Homonoff (2013), presents a theoretical model to analyze the welfare effects under heterogeneous salience, and demonstrate that high-income groups are less attentive to register taxes than low-income consumers. Using individual survey data, they estimate the change in cigarette demand with respect to changes in both excise taxes and sales taxes[10], and test whether these two effects are equal. In the aggregate they are unable to reject differing marginal effects. However they proceed to estimate demand equations by income group, and they find statistically significant evidence that high-income groups are less attentive to sales taxes than low-income groups. As sales taxes could have indirect income and cross-substitution effects, as a robustness check they examine how cigarette demand reacts to sales tax changes in those states with tobacco tax exemptions. They conclude that indirect effects are small and not the cause of differing marginal effects.

[10]Where, as is commonly the case, excise taxes are included in the posted prices, while sales are not.

III. Data, Estimation Strategy, and Bias

The Data

Measuring Smoking: I use monthly micro-level survey data from 2000 to 2010 collected from the Canadian Tobacco Use and Monitoring Survey (CTUMS) published by Statistics Canada.[11] It contains information on smoking status, intensity, and cessation. Respondents are contacted by phone, and are selected by a two-phase stratified random sample of phone numbers[12]. Any resident of Canada age 15 or older with a landline is eligible.[13] Phone calls are conducted roughly evenly across months from February to December. There are 195,338 observations in the sample after removing individuals with non-responses to control variable questions. The data set has yet to be used for this research purpose and is the longest month-over-month survey set available.

Figures 1 and 2 show smoking participation rates by type of smoker and education level over time. Just under five percent of the population identify as occasional smokers, and this proportion has dropped by only one percentage point over the decade. Conversely, the proportion of daily smokers has dropped significantly from 20 percent of the population to 13 percent. Similarly, amongst all educational groups, there has been a decline in smoking participation, and it is far less prevalent amongst university graduates, even relative to college graduates. The gap between university and high school graduates is roughly ten percentage points.

[11] I exclude 1999, 2011, and 2012 because of inconsistency in variable definitions.

[12] The survey is weighted with probability weights to make it representative of the Canadian population along multiple dimensions. All regressions and descriptive statistics in this paper are probability weighted

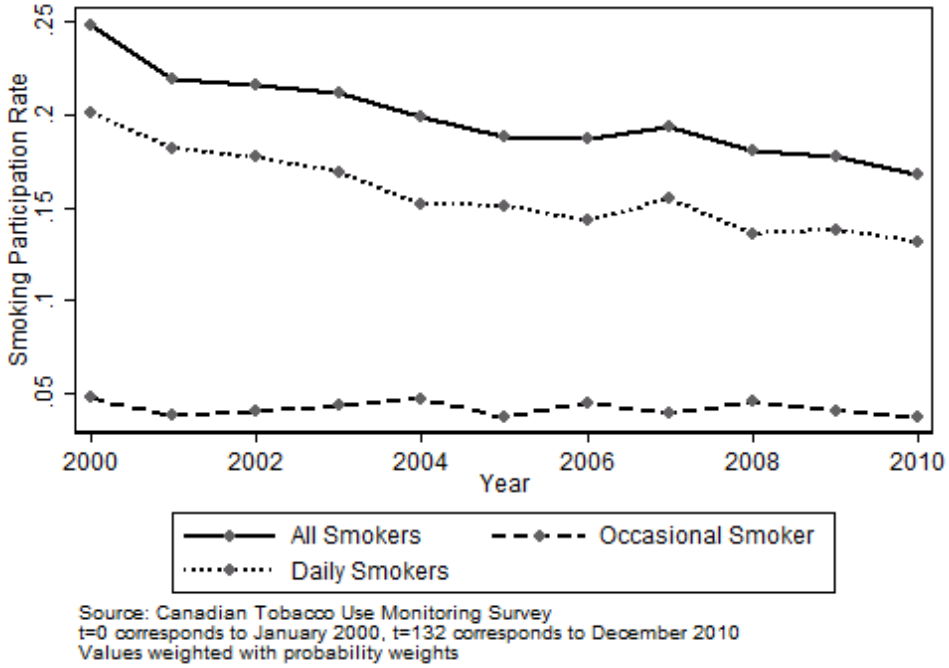
[13] Those without a landline are excluded - this population is estimated to account for 16 % of the target population in 2010, but much lower in earlier years.

Smoking intensity – cigarettes per week – has also declined over the period, shown in Figure 3. From 2000 to 2009, the average consumption per week dropped from 99 to 82 cigarettes. There however was a noticeable uptick in 2010. As with participation rates, university graduates smoked the least intensely on average - the gap between university graduates and high school graduates was almost 40 cigarettes per week. University graduates encompass anyone with a four year university undergraduate, or graduate degree. College graduates include all other post-secondary education, including two-year diplomas and trade schools.

Disaggregated by daily and occasional smokers, average smoking intensity is roughly 15 and 4 cigarettes per day on average respectively, shown in Figure 5.[14]. Figure 5 also illustrates smoking intensity amongst "former smokers" prior to quitting. These are respondents who reported having quit smoking within the past 12 months. 'Quitters' on average self-reported higher smoking intensities than 'non-quitters'. This has important implications for estimation bias of the intensive margin elasticities. I discuss this in the following section.

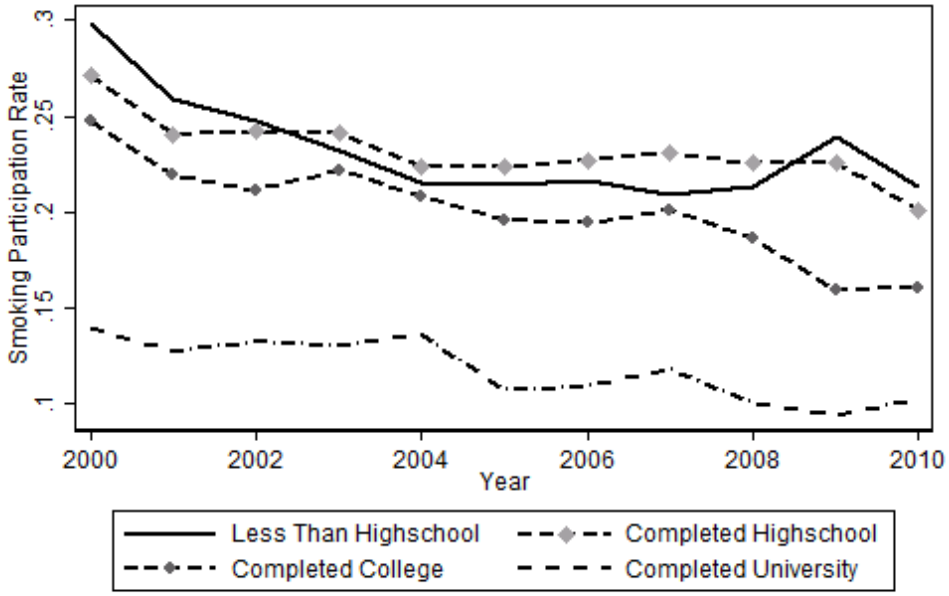
[14]Statistics Canada does not define occasional smoker when asking respondents. So the self-classification by respondents is subjective. Daily consumption is used rather than weekly because in order to compare against the responses of "former smokers" which are asked how much they smoked daily

Figure 1: Smoking Participation Rates



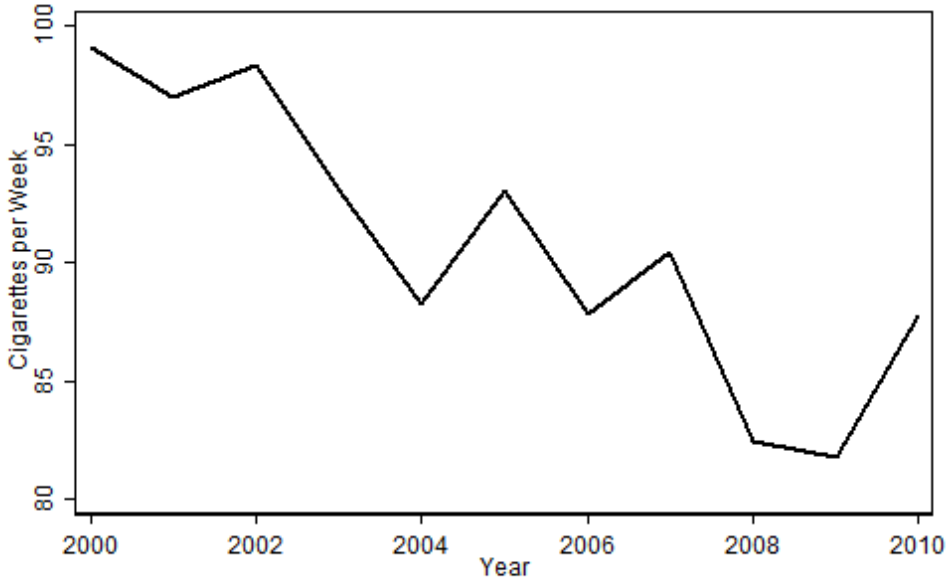
Source: Canadian Tobacco Use Monitoring Survey
t=0 corresponds to January 2000, t=132 corresponds to December 2010
Values weighted with probability weights

Figure 2: Smoking Participation Rates by Education



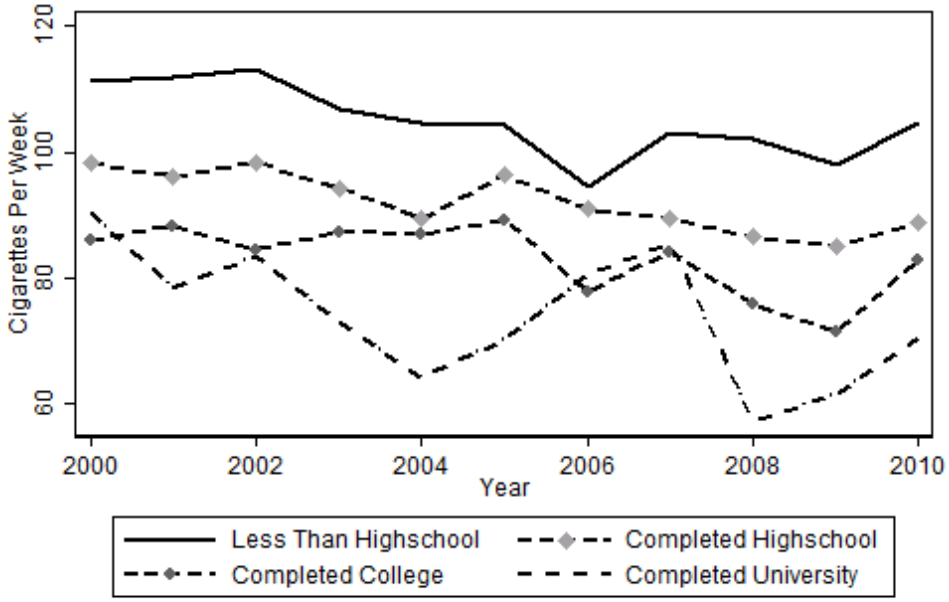
Source: Canadian Tobacco Use Monitoring Survey
t=0 corresponds to January 2000 , t=132 corresponds to December 2010
Values weighted with probability weights

Figure 3: Smoking Intensity



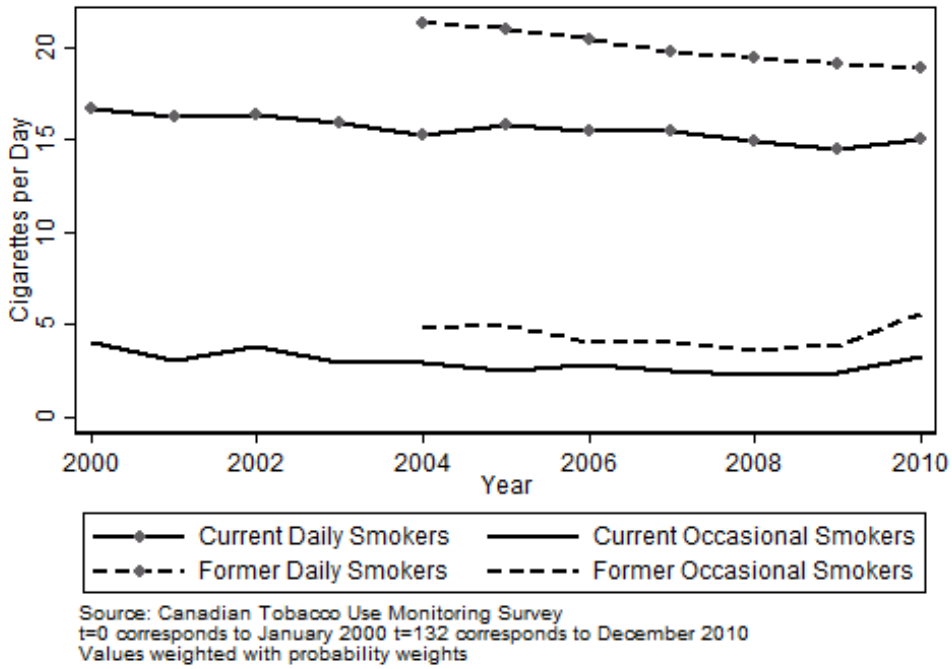
Source: Canadian Tobacco Use Monitoring Survey
Former Smokers is how much a person smoked before quitting, if they quit in past 12 months
t=0 corresponds to January 2000, t=132 corresponds to December 2010
Values weighted with probability weights

Figure 4: Smoking Intensity by Education



Source: Canadian Tobacco Use Monitoring Survey
t=0 corresponds to January 2000 , t=132 corresponds to December 2010
Values weighted with probability weights

Figure 5: Smoking Intensity amongst Daily, Occasional, and Former Smokers



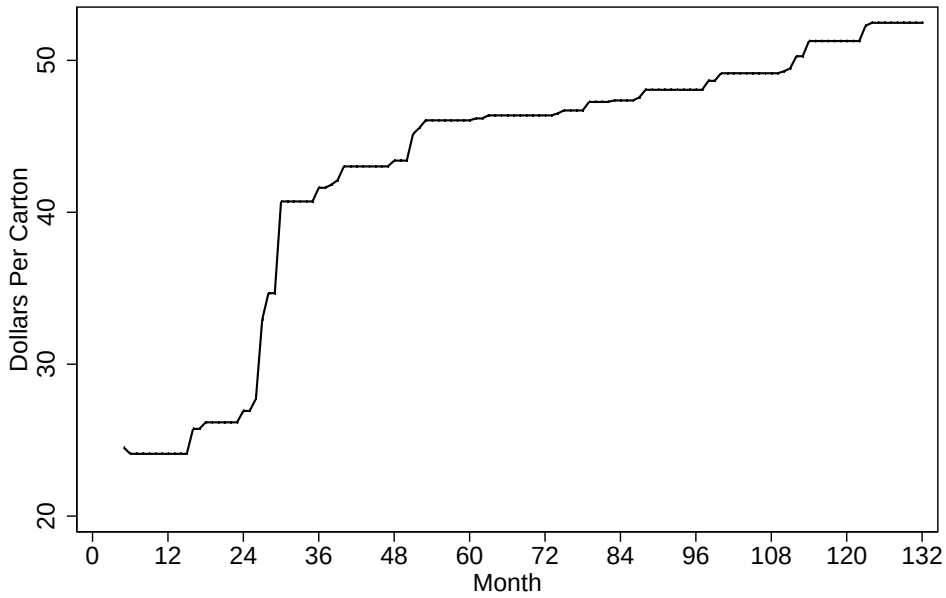
Measuring Taxes: Sales and excise tax rates are collected from *Finances of the Nation* published by Canadian Tax Foundation (2010). One measurement challenge is that tax changes do not always occur at the same point in a month. For instance, there are effective tax changes in the sample on the 1st, 15th, and 31st of the given month. To account for this, I exclude the month during which a tax change occurred, and the month immediately following it. A second measurement issue is whether to inflation-adjust the tax rates. As nominal tax rates change at most once a year, adjusting for monthly CPI changes introduces a large amount of additional variation. I keep in-line with the previous literature in making this adjustment, but it's unclear whether consumers adjust behaviour for month-over-month real fluctuations in the tax. However, both nominal and real data return very similar elasticities, so I report only results using inflation-adjusted taxes.

Figures 6 and 7 show the levels and changes of provincial and federal excise taxes

over the sample period. There were 47 excise tax changes and nine sales tax changes over the sample period. The average real excise tax in 2000 was $25.15 dollars. It was $44.51 in 2010. The spread between minimum and maximum rates was roughly $20 in both years.

Conversely, average sales taxes declined over the period from 13.95 percent to 11.95 percent. This is driven by the two percentage point reduction in the federal rate. Four provinces during the sample period exempted tobacco products from provincial sales taxes.[15].

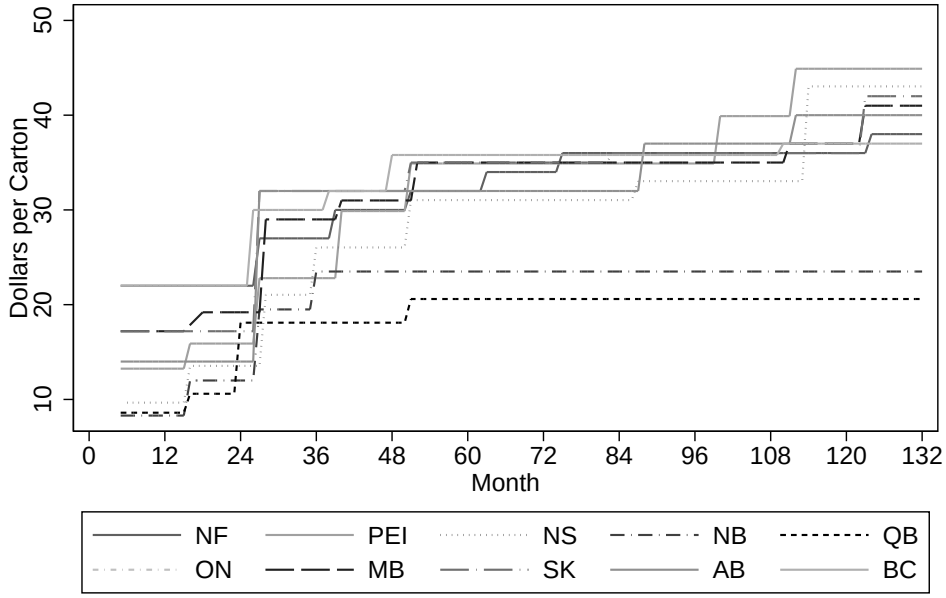
Figure 6: Average Total Excise Tax



Source: Finances of the Nation, Years 2000 through 2010
t=0 corresponds to January 2000. t=132 corresponds to December 2010
Values displayed in nominal terms

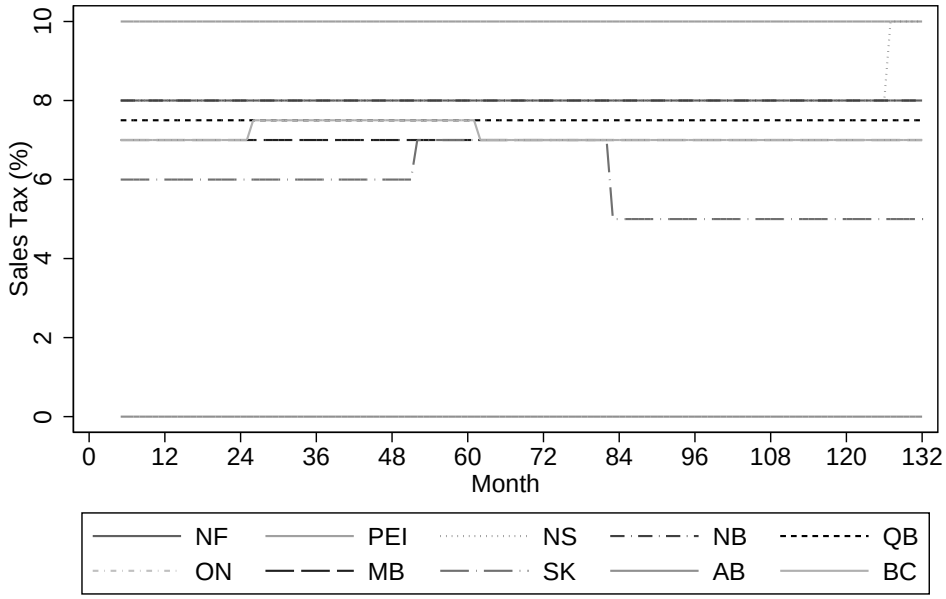
[15]Quebec, Ontario (beginning in 2002), Prince Edward Island, and British Columbia

Figure 7: Provincial Excise Taxes



Source: Finances of the Nation, Years 2000 through 2010
t=0 corresponds to January 2000. t=132 corresponds to December 2010
Values displayed in nominal terms

Figure 8: Provincial Sales Taxes



Source: Finances of the Nation, Years 2000 through 2010
t=0 corresponds to January 2000. t=132 corresponds to December 2010
Values displayed in nominal terms

Table 1: Tax Descriptive Statistics

	Excise Taxes ($)		Sales Taxes (%)	
	2000	2010	2000	2010
Mean	25.15	44.51	13.94	11.95
SD	6.40	6.86	2.54	2.66
Minimum	14.55	32.47	7	5
Maximum	34.34	52.15	17	15
Number of Federal Changes	3		3	
Number of Provincial Changes	44		6	

Values listed in 2002 dollars, adjusted monthly using provincial level CPI-All Items indices.

Intensive and Extensive Margin Decomposition and Bias

As first proposed by McDonald and Moffitt (1980), I decompose the total effect on cigarette demand into intensive and extensive margins, as in equations (1) and (2). This is the standard in previous literature. Yet much the previous literature goes further, assuming that the sum of the extensive and intensive margin elasticities is the total elasticity. Yet adding (3) and (4) together does not result in a total demand elasticity. The total demand elasticity is a weighted average of the intensive and extensive margin, as shown in (2).

Conditional cigarette log demand for an individual is:

$$E[ln(y) \mid x] = E[ln(y) \mid x, y > 0] \times P(y > 0 \mid x) \tag{1}$$

$$\frac{\partial E[ln(y) \mid x]}{\partial ln(x)} = \frac{\partial E(ln(y) \mid x, y > 0)}{\partial ln(x)} \times P(y > 0 \mid x) + \frac{\partial P(y > 0 \mid x)}{\partial ln(x)} \times E(ln(y) \mid x, y > 0) \tag{2}$$

where the intensive and extensive margin elasticities, respectively, are:

$$\frac{\partial E(ln(y) \mid x, y > 0)}{\partial ln(x)} \tag{3}$$

$$\frac{\partial P(y > 0 \mid x)}{\partial ln(x)} \tag{4}$$

I estimate averages of (3) and (4) across the sample. I do not attempt to estimate a combined elasticity by estimating every term in equation (4). Others in the literature have done so, but their estimates are likely biased, because if $P(y > 0 \mid x)$ and $E[ln(y) \mid x, y > 0]$ are not constant over time, then the combined elasticity estimate will not be time-invariant. They represent smoking rates and smoking intensity respectively, which have both decreased non-trivially over time. Therefore a unique combined elasticity for the sample period cannot be estimated using micro-level data[16].

The extensive margin is estimated using probit maximum-likelihood, and is modeled as:

$$Pr(s = 1)_{it} = \Phi[\beta_o + \beta_1 \times ln(\tau^e_{it}) + \gamma_{it} \times time_t + \alpha_{it} + \theta_{it} + X_{it}\omega] \tag{5}$$

Where i and t represent the individual and time period (month-year), s is 1 if the individual is a smoker, τ^e is the excise tax, Φ is the cumulative standard normal distribution, γ_{it} are year fixed effects, θ_{it} are calendar month fixed effects, α_{it} are provincial fixed effects,and X_{it} a set of demographic variables. The intensive margin is modeled as in equation (6), where y is the average number of cigarettes smoked per week, conditional on being a smoker.

$$E[ln(y_{it})] = \beta_o + \beta_1 \times ln(\tau^e_{it}) + +\gamma_{it} + \theta_{it} + \alpha_{it} + X_{it}\omega \tag{6}$$

[16]Furthermore, it is arguably less useful from a policy perspective, because the marginal damage function smoking is likely highly non-linear, so the intensive and extensive margins are associated with differing health benefits.

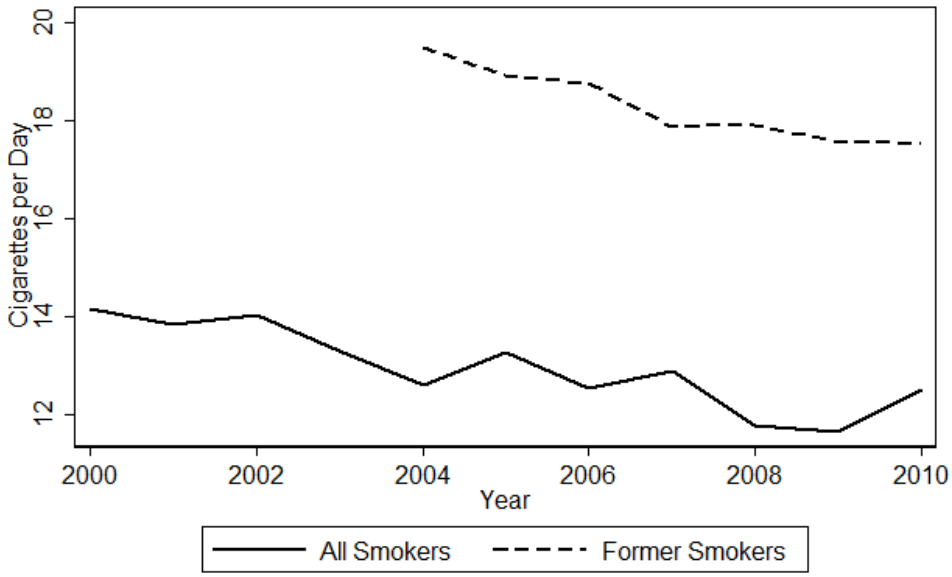
This standard procedure for estimating intensive margin elasticities with cross-sectional data will return biased estimates if the individuals who quit smoking are heavier or lighter smokers, on average, then those who do not quit. To illustrate an extreme case, assume a region consists of ten smokers, all faced with a tobacco tax increase. Before the tax increase, eight of the smokers consumed five cigarettes a day and the remaining two consumed ten per day. The average smoking intensity is six cigarettes per day.

Then the two heaviest smokers quit entirely in response to the tax increase. The remaining eight smokers reduce consumption by one cigarette per day each. Now the average smoking intensity is four cigarettes per day. In this case, the true intensive margin response is a reduction of one cigarette. But the standard estimation procedure estimates it as two cigarettes, a large overestimate.

In the CTUMS survey, all respondents are asked smoking cessation questions. One question asks: "*If you quit within the past year, how many cigarettes per day did you smoke before quiting*". Using the responses, I compare whether quitters smoked the same amount on average as current smokers. Figures 5 and 9 show the visual evidence - those who reported identified as having recently quit smoked on average 6 cigarettes more per day than current smokers. Heavier smokers are more likely to quit. This is true for both daily and occasional smokers, as shown previously.

If the respondents are answering truthfully and accurately, this will bias the intensive margin elasticity, overstating actual sensitivity to taxes. It is plausible that respondents are answering inaccurately or untruthfully. Perhaps "quitters" misremember their true smoking behaviour. Alternatively, current smokers could be misreporting their current consumption levels. It is difficult to know, but researchers should at least be aware of this potential bias.

Figure 9: Smoking Intensity



Source: Canadian Tobacco Use Monitoring Survey
Former Smokers is how much an individual smoked before quitting, if they quit in past 12 months
t=0 corresponds to January 2000, t=132 corresponds to December 2010
Values weighted with probability weights

Estimation Strategy for Salience Effects

Sales taxes are *ad valorem* taxes whereas the excise taxes are a specific tax, therefore they must be made comparable in order to test for differences in their effects. To do so, Chetty et al. (2009) and Goldin and Homonoff (2013) divide the excise tax by the national average wholesale cost. The national average is used because state-level supply prices are endogenous to tax rates. In the Canadian case, there is no data on national average wholesale cost. The closest available is the national average retail price which implicitly includes excise taxes. Therefore I use a different approach – I convert sales taxes, which apply to total retail prices including the excise tax, to dollar terms, as shown in equation 7 and 8. The dollar amount of the sales tax on cigarettes is estimated by applying it to the estimated retail price of each province.

$$Converted\ Sales\ Tax_{it} = \frac{Sales\ Tax_{it}}{100} \times (National\ Supply\ Price_t + Total\ Excise\ Tax_{it}) \quad (7)$$

where,

$$National\ Supply\ Price_t = National\ Average\ Retail\ Price_t - National\ Average\ Excise\ Tax_t \quad (8)$$

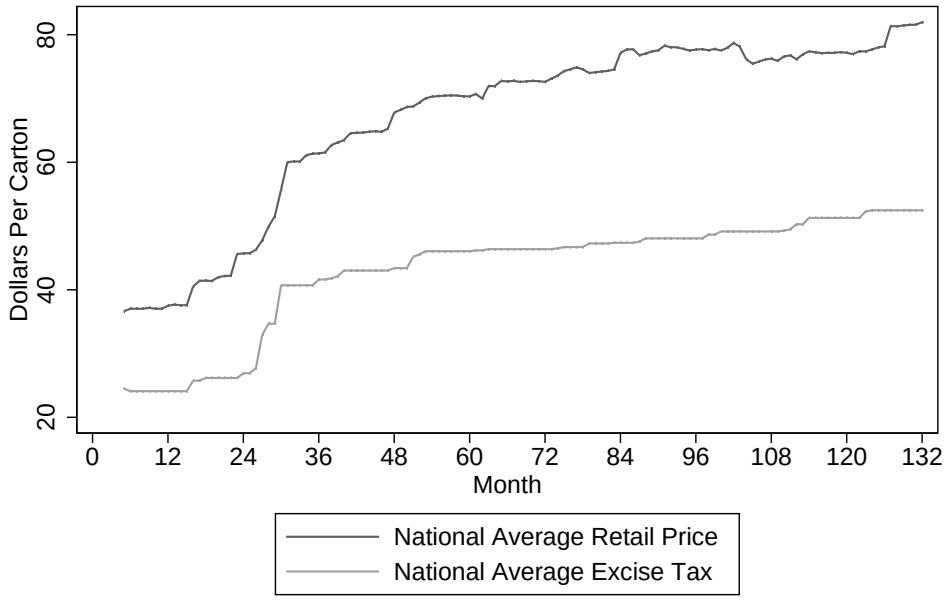
The advantage of this approach is that it incorporates the influence of the excise tax on the effective size of the sales tax. Excise taxes are roughly 200 percent larger than supply prices, and therefore the effective dollar amount of the sales tax is highly dependent upon movements in the excise tax. In the approach by Chetty et al. (2009) and Goldin and Homonoff (2013), their estimations do not account for this dependency. If excise taxes in their models rose substantially, the sales tax rate would remain unchanged. Using the national average supply price removes any remaining endogeneity with taxes, and is also necessary because there is no supply price data on a provincial level.

Figure 10 shows co-movement of national average prices and national average excise tax rates. A cursory glance suggests that tax changes are entirely passed through to prices. Figure 11 shows the converted non-exempt sales taxes, and Figure 12 shows the converted exempt rates which are used in the robustness check. The upward trend is due to the upward trend in excise taxes. However some of the variation is due to sales tax variation over time, and cross-sectional variation.

The baseline model for testing whether excise and sales tax have the same salience is equation 9, where β_1 and β_2 are the elasticities with respect to excises taxes and converted sales taxes respectively. I test the equality of β_1 and β_2. I expect β_1 to be larger in absolute terms, implying the sales taxes have less salience. This is the finding of Chetty et al. (2009) andGoldin and Homonoff (2013).

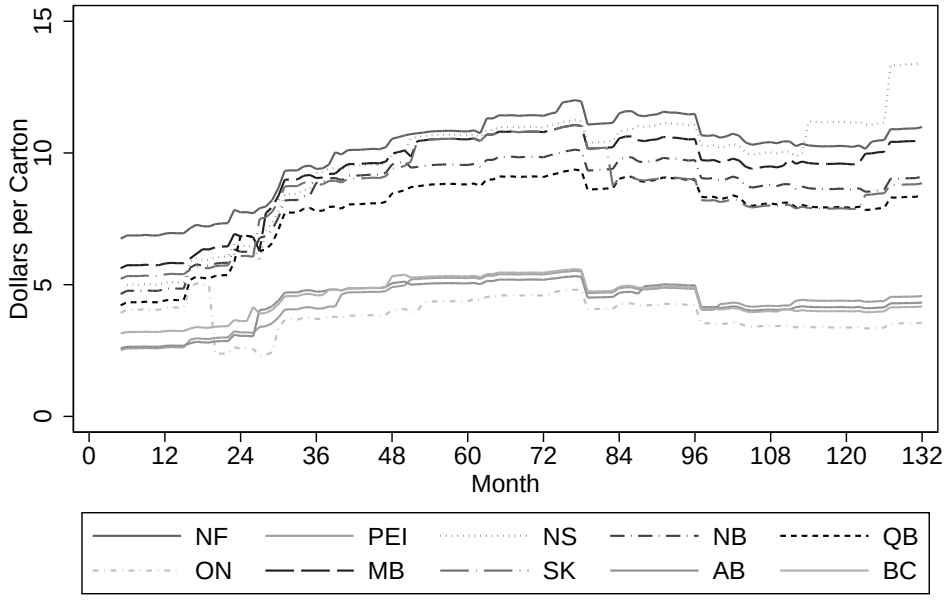
$$E[ln(y)] = \beta_o + \beta_1 \times ln(\tau^e)_{it} + \beta_2 \times ln(\tau^s) + \gamma_{it} + \alpha_{it} + X\omega_{it} \quad (9)$$

Figure 10: National Average Price versus National Average Excise



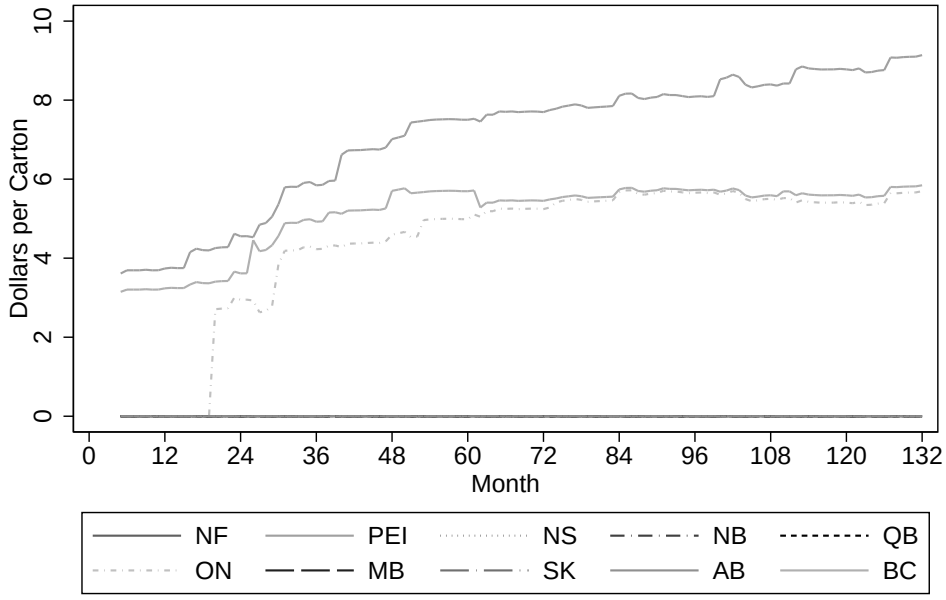
Source: Finances of the Nation, Years 2000 through 2010
t=0 corresponds to January 2000. t=132 corresponds to December 2010
Values displayed in nominal terms

Figure 11: Converted Non-Exempt Sales Tax



Source: Finances of the Nation, Years 2000 through 2010
t=0 corresponds to January 2000. t=132 corresponds to December 2010
Values displayed in nominal terms

Figure 12: Converted Exempt Sales Tax



Source: Finances of the Nation, Years 2000 through 2010
t=0 corresponds to January 2000. t=132 corresponds to December 2010
Values displayed in nominal terms

What this model does not capture is the indirect income and cross-substitution effects driven by the sales tax affecting the entire consumption basket, not just cigarettes. As a robustness check to measure the size of the indirect effects, I identify them directly using the four provinces with sales tax tobacco exemptions. Any movement in cigarette consumption attributable to sales tax variation in these four provinces constitutes indirect effects. Goldin and Homonoff (2013) perform the same robustness check for cigarette consumption using U.S. data. They find evidence of near-zero indirect effects.

In my baseline model there are no heterogeneous salience effects across education groups. All demographics have the same salience, or put differently, pay the same attention. Goldin and Homonoff (2013) were the first, and only, to incorporate heterogeneous effects. They ask whether low-income consumers are particularly attentive to register taxes. I follow the same procedure but ask whether attentiveness differs

by education group.

As they note, some demographics have different sensitivities to taxes either because they have different price elasticities or because they are more (or less) attentive. To distinguish these two mechanisms, I estimate equation 10 which allows for each education group to have different elasticities for the excise and sales taxes respectively. For instance, with four educational groups and two tax types, there are eight different slope estimates.

$$E[ln(y_{it})] = \beta_0 + \beta_1 \times ln(\tau^e_{it}) + \beta_2 \times ln(\tau^s_{it}) + \rho_1 \times EC_{it} ln(\tau^e_{it}) \tag{10}$$

$$+\rho_2 \times EC_{it} ln(\tau^s_{it}) + \lambda \times EC_{it} + \gamma_{it} + \alpha_{it} + X\omega_{it},$$

Where τ^e and τ^s are excise and sales taxes, and EC represents education indicator variables. When there are more than two categories, ρ_1 and ρ_2 become vectors. The difference in salience between excise and sales taxes is referred to as the attention gap. For the baseline group, the attention gap is $\beta_2 - \beta_1$. The attention gap for the second group is $(\beta_2 + \rho_2 - \beta_1 - \rho_1)$. The difference in attention gap between them is:

$$\Delta attentiongap = (\beta_2 + \rho_2 - \beta_1 - \rho_1) - \beta_2 - \beta_1 = \rho_2 - \rho_1 \tag{11}$$

I test differences in the attention gaps across educational groups, including those without high school diplomas, high school graduates, college graduates, and university graduates. The data set, and consequently the model specification, does not include income information. This presents a very clear omitted variable bias. If elasticities are dependent on income, which is almost certainly the case, then excluding income will bias the education coefficients, because of the positive correlation between education

and income.

Does it matter? From a policy perspective, what matters most is the implication for the regressivity of tobacco taxes, rather than the actual causality behind differing elasticities. Therefore, the omitted variable bias is less relevant. Knowing how elasticities differ across education groups, and how education groups correlate to income, tells us information about regressivity, regardless of whether its income or education actually affecting the elasticities.

IV. Results

Baseline elasticities

Baseline estimates are reported below for multiple specifications. Column 5 is my preferred specification as it controls for year fixed effects, removing the downward time trend in smoking prevalence and intensity. Demographic characteristics, calendar month and province fixed effects, and province-specific economic controls are also included. [17] Provincial economic controls help control for economic fluctuations that affect both cigarette consumption and government budget pressures that could move tobacco taxes up or down.[18]

My elasticity estimates for the intensive and extensive margins respectively are -.0871 and -.0306. These are consistent with tobacco consumption being inelastic.

Have elasticities changed over time? Table 4 interacts excises taxes with a linear

[17]The survey does not include household or personal income characteristics which would be an obvious control variable otherwise. However, the lack of income control seems unlikely to bias the elasticity estimates

[18]The province-specific economic controls include the unemployment rate, employment rate, retail sales transactions, and housing starts. These all fluctuate monthly, the same as the tobacco survey data

time trend to test this. The results for the intensive margin suggest declining elasticities but lack statistical significance. The extensive margin also shows declining elasticities which are very statistically significant.

This could be attributable to a wide range of legislative factors and shifting cultural attitudes towards smoking. It could also be that the smokers most responsive to taxes have already left the market, causing the less-responsive smokers to comprise a larger share of the market. Declining participation rates partially support this argument. Regardless of the cause, tobacco taxes are becoming less effective as a deterrent.

Heterogeneous Elasticities by Demographics and Region

I investigate two sources of heterogeneity in elasticities: 1) regional differences arising from contraband tobacco availability, and 2) individual demographics including age, education, and marital status. Regional disparities arising from tobacco contraband have implications for the revenue-raising ability of tobacco taxes, and the health benefits arising from smoking disincentives. Demographic disparities have implications for the regressivity of tobacco taxes which is an oft cited public policy concern.

I begin with regional disparities. Specifically, I ask whether elasticities in Ontario and Quebec are affected by tax-evaded tobacco. To understand why Quebec and Ontario may be disproportionately affected by contraband tobacco, one needs to understand the sources of tax-evasion. The RCMP (2008) identifies three main sources:

1. Tobacco products that are illegally smuggled in from the United States, largely

Table 2: Intensive Margin Elasticities: Baseline Model

	(1)	(2)	(3)	(4)	(5)
Ln(Excise Tax)(Elasticity)	-0.228***	-0.192***	-0.200***	-0.217***	-0.0871*
	(0.0586)	(0.0469)	(0.0411)	(0.0346)	(0.0432)
No High School		0.633***	0.633***	0.625***	0.621***
		(0.0428)	(0.0434)	(0.0446)	(0.0448)
High School		0.461***	0.460***	0.456***	0.456***
		(0.0163)	(0.0168)	(0.0168)	(0.0172)
College		0.310***	0.305***	0.304***	0.308***
		(0.0277)	(0.0278)	(0.0279)	(0.0282)
Marital Status: Married		-0.106***	-0.107***	-0.105***	-0.0892***
		(0.0186)	(0.0185)	(0.0175)	(0.0161)
Marital Status: Not Stated		-0.111***	-0.108***	-0.100***	-0.0627
		(0.0288)	(0.0267)	(0.0304)	(0.0424)
Age		0.133***	0.133***	0.132***	0.134***
		(0.0287)	(0.0300)	(0.0297)	(0.0271)
Age Squared		-0.00362***	-0.00361***	-0.00356***	-0.00363***
		(0.000894)	(0.000942)	(0.000928)	(0.000845)
Num. of Years Smoking		0.0329***	0.0329***	0.0328***	0.0328***
		(0.00169)	(0.00162)	(0.00166)	(0.00167)
French Speaking		0.0534*	0.0481*	0.0552	0.0506
		(0.0245)	(0.0229)	(0.0400)	(0.0380)
English and French		-0.0346	-0.0403	-0.0405	-0.0430
		(0.0735)	(0.0722)	(0.0630)	(0.0730)
Other Primary Language		-0.264***	-0.264***	-0.252***	-0.256***
		(0.0410)	(0.0402)	(0.0417)	(0.0372)
Province Economic Controls	No	Yes	Yes	Yes	Yes
Month FE	No	No	Yes	Yes	Yes
Province FE	No	No	No	Yes	Yes
Year FE	No	No	No	No	Yes
Observations	38513	37341	37341	37341	37341
Adjusted R^2	0.004	0.117	0.118	0.119	0.123

Standard errors in parentheses, clustered at province level. Outcome variable: Ln(Cigarettes per week). Fourth degree polynomials of Age are included but omitted from output. Baseline group is English speaking, single, university graduates (degrees from undergraduate or graduate programs).
* $p < .1$, ** $p < .05$, *** $p < .01$

Table 3: Extensive Margin Elasticities: Baseline Model

	(1)	(2)	(3)	(4)	(5)
Ln(Excise Tax)(Elasticity)	-0.0610***	-0.0367**	-0.0371**	-0.0436***	-0.0306*
	(0.0205)	(0.0167)	(0.0171)	(0.0137)	(0.0174)
No High School		0.204***	0.204***	0.201***	0.200***
		(0.0113)	(0.0115)	(0.00952)	(0.00983)
High School		0.138***	0.138***	0.137***	0.137***
		(0.00528)	(0.00527)	(0.00404)	(0.00414)
College		0.0847***	0.0847***	0.0844***	0.0845***
		(0.00440)	(0.00437)	(0.00354)	(0.00356)
Marital Status: Married		-0.0889***	-0.0889***	-0.0897***	-0.0898***
		(0.00466)	(0.00467)	(0.00477)	(0.00543)
Marital Status: Not Stated		-0.0199*	-0.0199*	-0.0209**	-0.0213**
		(0.0108)	(0.0112)	(0.00920)	(0.0104)
Age		0.109***	0.109***	0.108***	0.107***
		(0.00639)	(0.00639)	(0.00664)	(0.00677)
Age Squared		-0.00321***	-0.00321***	-0.00317***	-0.00316***
		(0.000211)	(0.000212)	(0.000217)	(0.000222)
French Speaking		0.0128*	0.0125*	-0.0264***	-0.0269***
		(0.00685)	(0.00702)	(0.00532)	(0.00533)
English and French		0.0163	0.0158	-0.00556	-0.00733
		(0.0204)	(0.0206)	(0.0305)	(0.0305)
Other Primary Language		-0.0931***	-0.0932***	-0.0927***	-0.0928***
		(0.00976)	(0.00975)	(0.00799)	(0.00801)
Province Economic Controls	No	Yes	Yes	Yes	Yes
Month FE	No	No	Yes	Yes	Yes
Province FE	No	No	No	Yes	Yes
Year FE	No	No	No	No	Yes
Observations	195597	195338	195338	195338	195338

Standard errors in parentheses, clustered at province level. Outcome variable: 1 if smoker (daily or occasional), 0 otherwise. Fourth degree polynomials of Age are included but omitted from output. Probit used for estimation; marginal effects reported at means. Baseline group is English speaking, single, university graduates (degrees from undergraduate or graduate programs). * $p < .1$, ** $p < .05$, *** $p < .01$

Table 4: Intensive Margin: Time Varying Elasticities

	Intensive Margin			Extensive Margin
	All Smokers	Daily	Occasional	All Smokers
Excise Tax (Elasticities)	-0.0300	0.00616	-0.260	-0.0346***
	(0.0283)	(0.0288)	(0.263)	(0.00801)
Excise Tax × Time Trend	0.00584	0.0116*	0.0104	0.00901***
	(0.0114)	(0.00586)	(0.0717)	(0.00168)
Linear Time Trend	-0.0448	-0.0571**	-0.0576	-0.0351***
	(0.0425)	(0.0230)	(0.286)	(0.00602)
Observations	37341	30762	6579	195338
Adjusted R^2	0.121	0.106	0.107	

Standard errors in parentheses, clustered at province level. Intensive Margin Outcome: Ln(Cigarettes per week). Extensive margin outcome: 1 if smoker (daily or occasional), 0 otherwise. All specifications include year, calendar month, and province fixed effects, province-specific economic controls, and demographic characteristics. OLS used for intensive margin estimates. Probit used for extensive margin – marginal effects reported at means. * $p < .1$, ** $p < .05$, *** $p < .01$

through four Aboriginal communities that straddle the US-Canada border. [19] The largest proportion of seizures of illegal tobacco originate from the US-side of the Akwesasna community, which are smuggled through the Cornwall area in Ontario. These products avoid all excise and sales taxes.

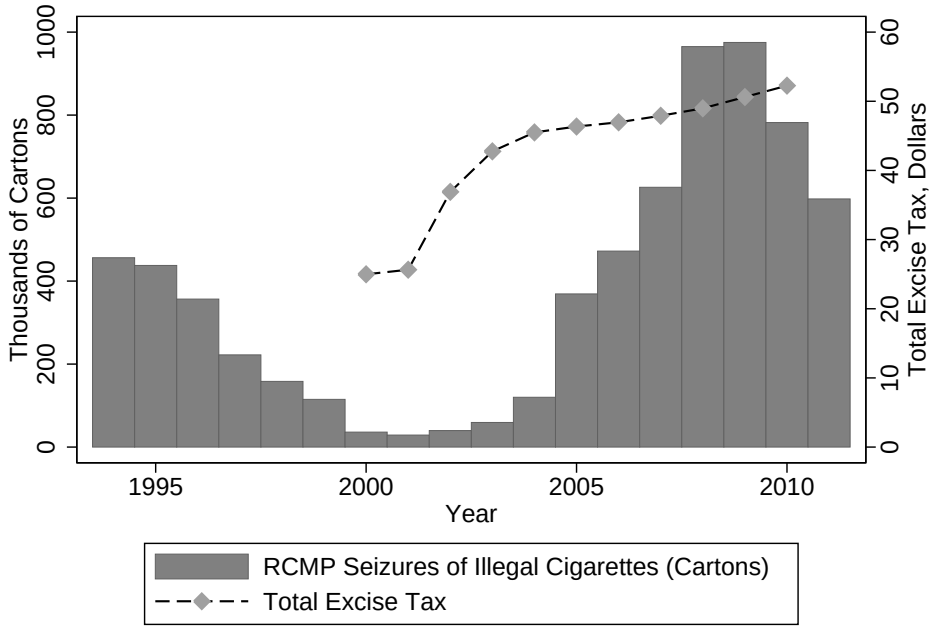
2. Counterfeit and international tobacco products, which primarily enter the country through sea containers on in British Columbia. In 2007, these accounted for 22 percent of illegal seizures.

3. Diverted GST/HST-relieved and provincial tax-exempt tobacco products. These are products that are legally tax-exempt for status-Indians, but are illegally redistributed to non-status consumers. For status-Indians, tobacco products are exempt from GST/HST, and some provinces exempt the provincial excise tax as well.

The RCMP claims that the central region (Ontario and Quebec) has the highest

[19] Six Nations, Tyendinaga, Akwesasne, and Kahnawake

Figure 13: RCMP Seizures of Illegal Cigarettes



Source: RCMP Contraband Tobacco Statistics.
There are 200 cigarettes per carton. In 2009, there were 195 million cigarettes seized

proportion of illegal tobacco consumption – they cite one estimate of 31 percent of total consumption being tax-evaded – however there are very clear challenges to estimating precise quantities. Given this estimate, and the fact that the largest source of tax-evaded tobacco originates from Aboriginal communities along the US borders of Ontario and Quebec, it is possible that tobacco consumption in these provinces is less responsive to taxes, resulting in lower elasticities. In fact, Gruber et al. (2003) find substantially different elasticities between the central region and the rest of Canada in the 1990s.

Furthermore, RCMP seizures of contraband tobacco have been highly correlated with excise taxes historically, as shown in Figure 13, which supports the claim that consumers respond to higher taxes by switching to tax-evaded products. To evaluate the possibility that Ontario and Quebec are disproportionately affected by tax evasion, Table 5 estimates separate elasticities for those two provinces, and the rest of Canada.

Historical evidence suggests that elasticity estimates were lower (in absolute terms) in those two provinces because consumers had greater access to tax-evaded products (Gruber et al., 2003), however this seems to no longer be true. On the intensive margin, Ontario and Quebec elasticities are not statistically different than the rest of Canada. Furthermore, on the extensive margin, Quebec shows larger elasticities, the opposite of the hypothesis. Ontario does not. This suggests that Quebec's differences are due to other institutional or cultural factors, rather than the availability of tax-evaded cigarettes.

This estimation strategy is clearly imperfect. There are other potential institutional factors that could make Quebec and Ontario different, and the interaction terms capture the average of all these effects. Nonetheless, it is a good baseline. If Ontario and Quebec did show significantly less responsiveness, the most identifiable cause would be tax evasion opportunities.[20]

I speculate two main reasons for why Gruber et al. (2003) results are not reflected in post-2000 data. First, during the high smuggling period in the 1990s, there was no federal tax on exported cigarettes, making export/re import schemes more attractive. However, in 2001-02 a two-tiered export tax system came into effect. For exports up to 1.5 percent of a tobacco manufacturers annual production, a $10 per carton tax applies. This amount is refundable upon proof of payment of taxes in a foreign jurisdiction to which Canadian product is destined. On exports that exceed the 1.5 percent threshold, an additional $22 per carton tax is applied.[21] This reduced the profitability of export and re-import schemes.

[20] A more precise estimation strategy is to identify households' distance to lower-tax provincial borders, and their distance to the major origins of contraband tobacco. If the distance to the origins of contraband tobacco (Cornwall for instance) is irrelevant, then the implication is that there are strong and cost-effective distribution networks throughout the country. This is currently a working paper by Hicks (2015).

[21] These changes were introduced under the Tobacco Tax Amendments Act 2001.

Table 5: Elasticities by Region

	Intensive Margin			Extensive Margin
	All Smokers	Daily	Occasional	All Smokers
Excise Tax Baseline	-0.211	-0.106	0.0314	-0.0293
	(0.131)	(0.104)	(0.205)	(0.0222)
Excise Tax × Quebec	0.0771	-0.000105	0.00111	-0.0259***
	(0.0642)	(0.0413)	(0.130)	(0.00528)
Excise Tax × Ontario	0.0994	0.0436	-0.326***	-0.00104
	(0.0893)	(0.0629)	(0.0636)	(0.00868)
Observations	37341	30762	6579	195338
Adjusted R^2	0.123	0.107	0.111	

Standard errors in parentheses, clustered at province level. Intensive Margin Outcome: Ln(Cigarettes per week). Extensive margin outcome: 1 if smoker (daily or occasional), 0 otherwise. All specifications include year, calendar month, and province fixed effects, province-specific economic controls, and demographic characteristics. OLS used for intensive margin estimates. Probit used for extensive margin – marginal effects reported at means. * $p < .1$, ** $p < .05$, *** $p < .01$

Second, state excise taxes on tobacco in New York State rose by 1100 percent from 1993 to 2010, in nominal terms, far more than taxes levied in Ontario and Quebec (or anywhere in Canada for that matter).[22] By 2003 the price of cigarettes in New York State had already surpassed that of Ontario. [23] This made the illegal importation of New York cigarettes far less profitable.

There are other likely factors including increased border protection[24], the establishment of law enforcement task forces dedicated to combating contraband tobacco[25], and tax treatment changes of Canadian duty free shops on the US side of the border.

Next I examine demographic heterogeneity – across educational levels, marital status, and age. Individuals fall into four educational categories: No high school diploma, only high school diploma, college graduates, and university graduates. Individuals fall

[22]State Excise tax rates for New York State collected from *The Tax Burden on Tobacco: Historical Compilation 47, 2012.*

[23]Source: Ontario Campaign for Action on Tobacco.

[24]Notably after the terrorist attacks of September 2001.

[25]For instance, the Contraband Tobacco Enforcement Strategy, launched in 2008.

into three marital categories: Married, single, and undisclosed. Married individuals represent all non-single couples regardless of whether they are actually married. Age is measured in years.

In regards to education, the results are mixed. On the intensive margin, university graduates have substantially larger elasticities than the other three groups, and those with no high school diplomas are the least responsive – although the estimates lack precision. On the extensive margin, there are no clear differential effects.

There are two implications for regressivity. First, as lower educational levels corresponds to lower income, and these groups are less responsive, it follows that tobacco taxes are additionally regressive. Second, despite finding differences on the extensive margin, smoking is still more prevalent among lower education groups, which also contributes to regressivity.

As mentioned previously, elasticities have been shown to depend on income as well.[26] Since education and income are positively correlated, its unclear if education actually affects elasticities, independently of income. However, as previously argued, it does not matter if our primary concern is the regressivity of tobacco taxes. Knowing how elasticities differ across education groups, and how education groups correlate to income, tells us information about regressivity, regardless of whether its income or education actually affecting elasticities.

Marital status presents an interesting and intuitive result. On the extensive margin, married couples have price elasticities almost six times higher than single individuals. The first obvious reason is that married couples make joint financial decisions – one

[26]Most recently by Harding et al. (2012) and Goldin and Homonoff (2013). These studies suffer from the same problem however - they fail to simultaneously measure income and education's affect on elasticities.

spouse may not support the continuation of the other's smoking habit if taxes continue to rise. Second, the smoking spouse may be more primed to quit due to concerns over second hand smoke. Third, non-smoking spouses could provide critical support during any cessation attempts. To my knowledge, previous literature has not examined this.

Table 6: Elasticities by Demographic Group

	Intensive Margin			Extensive Margin
	All Smokers	Daily	Occasional	All Smokers
Excise Tax	-0.0946	-0.0134	0.0652	-0.00829
(Baseline: Single, University Grad)	(0.155)	(0.0658)	(0.294)	(0.0476)
Tax × Age	-0.00880	-0.00260	-0.0176	0.000311
	(0.00990)	(0.00446)	(0.00970)	(0.000658)
Tax × No High School	0.117	0.0184	-0.0505	-0.00477
	(0.128)	(0.0442)	(0.133)	(0.0224)
Tax × High School Grad	0.175*	0.0220	0.242	0.00252
	(0.0822)	(0.0330)	(0.138)	(0.0154)
Tax × College Grad	0.170	0.0760***	0.308*	-0.0103
	(0.110)	(0.0154)	(0.147)	(0.0214)
Tax × Married	-0.0244	0.0234	-0.224	-0.0543***
	(0.0343)	(0.0275)	(0.249)	(0.00798)
Tax × Undisclosed Marital Status	-0.0814	-0.0156	0.209	-0.0102
	(0.124)	(0.0274)	(0.299)	(0.0298)
Observations	37341	30762	6579	195338
Adjusted R^2	0.100	0.080	0.101	

Standard errors in parentheses, clustered at province level. Intensive Margin Outcome: Ln(Cigarettes per week). Extensive margin outcome: 1 if smoker (daily or occasional), 0 otherwise.Fourth degree polynomials of Age are included but omitted from output. All specifications include year, calendar month, and province fixed effects, province-specific economic controls, and demographic characteristics. OLS used for intensive margin estimates. Probit used for extensive margin – marginal effects reported at means.* $p < .1$, ** $p < .05$, *** $p < .01$

Posted-Price versus Register-Tax Salience

I begin by testing whether converted sales taxes have different marginal effects than excise taxes for the whole sample. At the end of the section, I provide a robustness check for the indirect income and substitution effects of sales taxes. I estimate

equation 12 and test for equality of β_1 and β_2, which represent the elasticities of excise and sales taxes respectively. Recall that I convert sales taxes to dollar terms, in a way that reflects their effective dollar amount levied on cigarettes, and to make them comparable to excise taxes. The results are shown in Table 7. I use only sales taxes that do not exempt tobacco products.

$$E[ln(y)] = \beta_o + \beta_1 \times ln(\tau^e)_{it} + \beta_2 \times ln(\tau^s) + \gamma_{it} + \alpha_{it} + X\omega_{it} \tag{12}$$

First, the excise tax elasticity estimate is almost identical to the baseline case reported in column five of Table 2. This implies that elasticity estimates were not biased by excluding sales taxes.

The sales tax coefficients from equation (12) are not statistically significant on either the extensive or intensive margins. Nor are they statistically different than excise tax elasticities on the intensive margin. The difference is however robust on the extensive margin.

Despite being positive, the sales tax coefficient on the extensive margin is not statistically significant. However, it is useful to understand what would cause a positive coefficient on sales taxes. It could be indirect income effects if tobacco is an inferior good – sales taxes reduce real incomes significantly by raising the price of all commodities. It could also be indirect substitution effects – if sales taxes increase the price of substitute goods, and the cross-substitution effects are strong, this could cause tobacco consumption to increase. Third, it could be that year fixed effects do not entirely account for the time trend in tobacco consumption, and this un-captured component is correlated with sales taxes. Regardless, the point estimate is not statistically distinguishable from zero.

Table 7: Sales versus Excise Taxes

	(1) Intensive	(2) Extensive Margin
Excise Tax (β_1)	-0.0887*	-0.0299
	(0.0464)	(0.0194)
Non-Exempt Sales Tax (β_2)	-0.0236	0.0236
	(0.0678)	(0.0189)
Observations	37188	194591
Adjusted R^2	0.123	
P-Value for $\beta_1 = \beta_2$	0.378	0.0000103

Standard errors in parentheses, clustered at province level. Intensive Margin Outcome: Ln(Cigarettes per week). Extensive margin outcome: 1 if smoker (daily or occasional), 0 otherwise. All specifications include year, calendar month, and province fixed effects, province-specific economic controls, and demographic characteristics. Probit used for extensive margin – marginal effects reported at means. * $p < .1$, ** $p < .05$, *** $p < .01$

Next I examine whether different education groups have differing attention gaps (salience gaps) by estimating equation 13, and testing the equality of ρ_1 and ρ_2. "Uni" is an indicator variable for university graduates.

$$E[ln(y_{it})] = \beta_0 + \beta_1 \times ln(\tau^e_{it}) + \beta_2 \times ln(\tau^s_{it}) + \rho_1 \times Uni_{it} \times ln(\tau^e_{it}) \tag{13}$$
$$+\rho_2 \times Uni_{it} \times ln(\tau^s_{it}) + \lambda \times Uni_{it} + \gamma_{it} + \alpha_{it} + X\omega_{it},$$

It is important to clarify exactly what is being tested. The difference in attention gaps between university graduates and non-university graduates is $\rho_2 - \rho_1$. If $\rho_2 - \rho_1 > 0$, then university students have a larger attention gap (i.e. their difference in salience between excise and sales taxes is larger than the same difference for university graduates). Alternatively, if $\rho_2 - \rho_1 < 0$, then non-university students have a larger attention gap. Given that Goldin and Homonoff (2013) find that high-income consumers have *higher* attention gaps than low-income consumers, I hypothesize that university graduates will have the higher attention gaps than lower education groups

(given the correlation between education and incomes).

Table 8: Sales versus Excise Taxes: By Education Group

	Intensive Margin	Extensive Margin
Excise Tax (Non-University) (β_1)	-0.0533	-0.0309*
	(0.0524)	(0.0164)
Non-Exempt Sales Tax (Non-University) (β_2)	-0.0570	0.0259
	(0.0613)	(0.0217)
University $\times$ Excise (ρ_1)	-0.288**	0.00525
	(0.0903)	(0.0208)
University $\times$ Non-Exempt Sales Tax (ρ_2)	0.274**	-0.0135
	(0.112)	(0.0172)
Observations	37188	194591
Adjusted R^2	0.124	
P=value for $\rho_1 = \rho_2$	0.0186	0.597

Standard errors in parentheses, clustered at province level. Intensive Margin Outcome: Ln(Cigarettes per week). Extensive margin outcome: 1 if smoker (daily or occasional), 0 otherwise. All specifications include year, calendar month, and province fixed effects, province-specific economic controls, and demographic characteristics. Probit used for extensive margin – marginal effects reported at means. * $p < .1$, ** $p < .05$, *** $p < .01$

The results are reported in Table (8). On the intensive margin, $\rho_2 - \rho_1$ is equal to $(.274 + .288) = .562$, and is statistically different than zero. This indicates that university graduates have a larger attention gap than those without a university education. Furthermore, the attention gap for non-university graduates ($\beta_2 - \beta_1$) is practically zero. These results suggest that non-university graduates fully account for sales taxes, whereas university graduates do not, at least on the intensive margin.

On the extensive margin, $\rho_2 - \rho_1$ is not statistically different than zero. For the non-university graduates, the attention gap ($\beta_2 - \beta_1$) is $.0259 + .0309 = .0568$. These two facts suggests that, on the extensive margin, sales taxes are less salient for both groups.

Next I disaggregate education into a) those without a high school diploma, b) high school graduates, c) college graduates, and d) university graduates. The results are

in Table (9). The base group is university graduates. The P-values associated with testing $\rho_2 - \rho_1$, $\rho_4 - \rho_3$, and $\rho_6 - \rho_5$ equal to zero are testing whether each level of education has a statistically different attention gap than university graduates. The attention gaps are also displayed for each education level.

Table 9: Sales versus Excise Taxes: By Education Group

	Intensive Margin		Extensive Margin	
	Coef.	Att. Gap	Coeff.	Att. Gap
Excise Tax (University) (β_1)	-0.343***		-0.0261	
	(0.0744)		(0.0350)	
Non-Exempt Sales Tax(University) (β_2)	0.214	.557	0.0116	.0377
	(0.143)		(0.00872)	
No Highschool × Excise Tax (ρ_1)	0.298**		0.00457	
	(0.104)		(0.0257)	
No Highschool × Non-Exempt Sales Tax (ρ_2)	-0.353**	-.094	0.00726	.0404
	(0.130)		(0.0208)	
High School Grad × Excise Tax (ρ_3)	0.287***		-0.000509	
	(0.0845)		(0.0181)	
High School Grad × Non-Exempt Sales Tax (ρ_4)	-0.239**	.031	0.00898	.0472
	(0.0930)		(0.0111)	
College Grad × Excise Tax (ρ_5)	0.281**		-0.0262	
	(0.0983)		(0.0233)	
College Grad × Non-Exempt Sales Tax (ρ_6)	-0.246	.03	0.0306	.0945
	(0.140)		(0.0275)	
Observations	37188		194591	
Adjusted R^2	0.124			
P - value ($\rho_2 - \rho_1$)	0.0190		0.948	
P - value ($\rho_4 - \rho_3$)	0.0137		0.725	
P - value ($\rho_6 - \rho_5$)	0.0382		0.250	

Standard errors in parentheses, clustered at province level. Intensive Margin Outcome: Ln(Cigarettes per week). Extensive margin outcome: 1 if smoker (daily or occasional), 0 otherwise. All specifications include year, calendar month, and province fixed effects, province-specific economic controls, and demographic characteristics. Probit used for extensive margin – marginal effects reported at means. * $p < .1$, ** $p < .05$, *** $p < .01$

The results mirror the previous findings. University graduates have larger and statistically different attention gaps relative to the other education levels. Non-high school, high school, and college graduates all have similar attention gaps. On the

extensive margin, university attention gaps are not statistically different than the other education groups.

Robustness Check of Indirect Income and Substitution Effects

As discussed previously, the sales tax could have indirect income and substitution effects. I use the tobacco exempt portion of sales taxes to identify these effects. Figure 11 shows the variation in the exempt portions – three provinces had exemptions for the entire sample period, and a fourth (Ontario) instituted an exemption on June 18th, 2002. I estimate the following model, including excise taxes, non-exempt sales taxes, and exempt sales taxes, and allow for differing slopes for university and non-university graduates. Rather than using converted sales taxes, I leave them in unconverted form. Converted exempt sales taxes would show increases in sales tax attributable to increases in excises taxes, but this is not what would drive indirect income and substitution effects. And to make the estimates comparable, I leave non-exempt sales taxes in percentage point form as well. The results are in Table 10.

$$E[ln(y_{it})] = \beta_0 + \beta_1 \times Excise_{it} + \beta_2 \times FedSales_t + \beta_3 \times Exempt_{it} + \tag{14}$$
$$\beta_4 \times Uni_{it} + \beta_5 \times ProvSales_{it} + \beta_6 \times ProvSales_{it} \times Uni_{it} +$$
$$\beta_7 \times ProvSales_{it} \times Exempt_{it} + \beta_8 \times ProveSales_{it} \times Exempt_{it} \times Uni_{it}$$

As sales taxes are in percentage point units, the coefficients are expected to be far smaller. The results are mixed. The federal sales tax, which is not exempt, is insignificant. But there have been only three changes in the federal sales tax rate over the sample period, and it is equally applied to all provinces, so the variation is very minimal.

Exempt provincial sales taxes for non-university graduates are statistically insignificant on both margins. This suggests that there are no indirect effects, or that the indirect effects offset each other. In fact, the only statistically non-zero coefficient on exempt-sales-taxes is for university graduates on the intensive margin. They have negative elasticities. This suggests that for higher-education individuals, smoking is more of a normal good, or that rising prices of complements reduces smoking consumption.

Table 10: Robustness Check

	Intensive Margin	Extensive Margin
Federal Sales Tax	-0.00320	-0.0181
	(0.0711)	(0.0167)
Non-exempt Provincial Sales Tax	0.000732	0.00532*
	(0.0130)	(0.00275)
Non-exempt Provincial Sales Tax	0.0141*	0.00162**
× University	(0.00756)	(0.000823)
Exempt Provincial Sales Tax	0.00539	-0.0159
	(0.0524)	(0.00991)
Exempt Provincial Sales Tax	-0.0231**	0.00306**
× University	(0.00887)	(0.00139)
Observations	37143	194264
Adjusted R^2	0.123	

Standard errors in parentheses, clustered at province level. Intensive Margin Outcome: Ln(Cigarettes per week). Extensive margin outcome: 1 if smoker (daily or occasional), 0 otherwise. Excise taxes are included in estimation but omitted from output. All specifications include year, calendar month, and province fixed effects, province-specific economic controls, and demographic characteristics. Probit used for extensive margin – marginal effects reported at means. * $p < .1$, ** $p < .05$, *** $p < .01$

If university graduates do indeed have negative indirect sales tax effects, how would this bias our heterogeneous salience results? Recall, university graduates were less responsive to sales taxes than to excise taxes, implying a noticeable attention gap. So negative indirect effects would make their attention gap seem smaller than it truly is – which means the estimates of the attention gap is conservative, and therefore the difference in attention gaps between education groups is also a conservative estimate.

Therefore, the potential indirect effects do not challenge the heterogeneous salience results.

Finally, in the robustness check, the coefficients on non-exempt sales taxes are expected to be biased upwards, because in un-converted form, they do not account for the effective sales tax amount which is influenced by the size of excise taxes. Recall the discussion on converting sales taxes to effective dollars. When sales taxes are applied to retail prices, they are implicitly being applied to excise taxes in addition to the supply price. Consequently, increasing excises taxes also increases the effective amount of sales taxes.

VI. Policy Implications and Conclusion

This paper has investigated multiple aspects of the behavioural response to tobacco taxation, making novel contributions to the broader literature on tobacco taxation. Furthermore, the paper provides a much needed update to the Canadian literature on tobacco taxation elasticities. The cultural and legislative landscape surrounding smoking behaviour has changed significantly over the past fifteen years, and research on behavioural responses to taxation in Canada has failed to keep up.

First, I demonstrate that heavier smokers appear to be more likely to quit smoking. From a technical perspective, this implies that intensive margin elasticities are upward bias, leading policy makers to think that smokers are more responsive to taxes than they actually are. No previous papers have examined this. The finding is also interesting from a behavioural perspective on its own. Perhaps heavier smokers are more addicted, making them more prone to cold-turkey responses, rather than incremental decreases in smoking consumption.

Second, I demonstrate how the Canadian literature has fallen out-of-date. First, elasticities have been decreasing over time in Canada. This could be due to a wide range of legislative factors and cultural influences. It could also be that the smokers most responsive to tax increases have already quit, causing the less-responsive smokers to comprise a larger share of the market. Declining participation rates partially support this argument. Regardless of why, tobacco taxes are becoming less effective as a tool to discourage smoking. Second, using the same methodology that Sen et al. (2010) used to show that Quebec and Ontario were disproportionately affected by contraband tobacco in the 1990s, I show this is not the case in the 2000s. This contradicts the widely-held belief that Ontario and Quebec have different elasticities because of contraband tobacco. Its not that smuggling has gone away, but rather it does not appear to cause elasticities in Ontario and Quebec to be different than the rest of Canada.

Third, I examine demographic heterogeneity in elasticities, most notably across educational groups. University graduates are significantly more responsive on the intensive margin than college graduates, high school graduates, and those without a high school diploma. Those without high school diplomas are the least responsive. This adds an additional source of regressivity to tobacco taxes, as education is positively correlation with income. Furthermore, smoking participation rates are significantly higher amongst lower educational groups, meaning the tax burden is even more concentrated amongst lower income individuals. If tobacco taxes are highly and increasingly regressive, and becoming less effective as deterrent to smoking, policy makers should think twice about the legitimacy of further tax increases.

Finally, this paper adds to the growing literature on tax salience. It is only the second paper to examine heterogeneity in salience, and the first to do so across educa-

tional groups. I find that sales taxes are far more salient for low educational groups. In fact, consumers without a university degree fully internalize sales taxes. University graduates fail to do so.

What are the policy implications? If register taxes are less salient, how then should governments design tobacco taxes? If revenue maximization is the goal, taxes should be levied inconspicuously. If reducing smoking is the priority, taxes should be made as salient as possible. One could argue that reducing smoking is the priority, and therefore sales taxes should be included in the price tag. Such an inclusion could happen in two ways. First, sales taxes could be included in the price tags of all goods and services, not just tobacco products. However, the implications of this across-the-board change are unclear, given the varying nature of different products. The second option is to require sales tax be included in the posted-price of just tobacco (and other harmful) products.

What are the implications of differing salience between educational and income groups? When lower-income/lower-education groups are more attentive to sales taxes than their high-income, high-education counterparts, the register tax becomes less regressive. If governments' primary concern is to reduce the regressivity, they could conceivably shift a larger portion of the commodity tax to the register. However, in practice, this would be difficult for tobacco because excise taxes are so large compared to the supply price – imagine grabbing a six dollar carton of cigarettes, walking to the register, and being asked to pay fifty dollars. Governments will have to decide which priorities, or combination of, are most important to them: revenue raising, discouraging harmful consumption, or tailoring regressivity. This lesson applies to any commodity taxation, not just cigarettes.

Bibliography

Adda, J. and Cornaglia, F. (2006). Taxes, cigarette consumption, and smoking intensity. *American Economic Review*, 96(4):1013 – 1028.

Canadian Tax Foundation (2000-2010). *Finances of the Nation*. Canadian Tax Foundation.

Chaloupka, F. J. and Warner, K. E. (2000). The economics of smoking. *The Handbook of Health Economics*.

Chetty, R., Looney, A., and Kroft, K. (2009). Salience and taxation: Theory and evidence. *American Economic Review*, 99(4):1145 – 1177.

Chiou, L. and Muehlegger, E. (2014). Consumer response to cigarette excise tax changes. *National Tax Journal*, 67(3):621 to 650.

Farrelly, M. C., Bray, J. W., Pechacek, T., and Woolery, T. (2001). Response by adults to increases in cigarette prices by sociodemographic characteristics. *Southern Economic Journal*, 68(1).

Goldin, J. and Homonoff, T. (2013). Smoke gets in your eyes: Cigarette tax salience and regressivity. *American Economic Journal: Economic Policy*, 5(1):302–336.

Gruber, J., Sen, A., and Stabile, M. (2003). Estimating price elasticities when there is smuggling: the sensitivity of smoking to price in canada. *Journal of Health Economics*, 22:821–842.

Harding, M., Leibtag, E., and Lovenheim, M. F. (2012). The heterogenous geographic and socioeconomic incidence of cigarette taxes: Evidence from nielsen homescan data. *American Economic Journal: Economic Policy*, 4.

McDonald, J. F. and Moffitt, R. A. (1980). The uses of tobit analysis. *The Review of Economics and Statistics*, 62(2):318–321.

Merriman, D. (2010). The micro-geography of tax avoidance: Evidence from littered cigarette packs in chicago. *American Economic Journal: Economic Policy*, 2(May 2010):61–84.

Poterba, J. M. (1999). Tobacco taxes and public policy to discourage smoking. *NBER: Tax Policy and the Economy*, 13.

RCMP (2008). 2008 contraband tobacco enforcement strategy. http://www.rcmp-grc.gc.ca/pubs/tobac-tabac/tobacco-tabac-strat-2008-eng.htm.

Sen, A., Entezarkheir, M., and Wilson, A. (2010). Obesity, smoking, and cigarette taxes: Evidence from the canadian community health surveys. *Health Policy*.

Sen, A. and Wirjanto, T. (2010). Estimating the impacts of cigarette taxes on youth smoking participation, initiation, and persistence: empirical evidence from canada. *Health Economics*, 19:1264 – 1280.

Appendix

Table 11: Intensive Margin Levels: Baseline Model

	(1)	(2)	(3)	(4)	(5)
Excise Tax	-0.00806***	-0.00682***	-0.00706***	-0.00878***	-0.00596*
	(0.00170)	(0.00133)	(0.00114)	(0.00112)	(0.00272)
No High School		0.635***	0.634***	0.624***	0.621***
		(0.0429)	(0.0436)	(0.0448)	(0.0448)
High School		0.462***	0.461***	0.456***	0.456***
		(0.0163)	(0.0168)	(0.0169)	(0.0172)
College		0.311***	0.306***	0.305***	0.308***
		(0.0274)	(0.0276)	(0.0278)	(0.0281)
Marital Status: Married		-0.106***	-0.106***	-0.102***	-0.0891***
		(0.0195)	(0.0194)	(0.0181)	(0.0161)
Marital Status: Not Stated		-0.110***	-0.107***	-0.0942**	-0.0627
		(0.0287)	(0.0268)	(0.0295)	(0.0422)
Age		0.133***	0.133***	0.132***	0.134***
		(0.0287)	(0.0301)	(0.0297)	(0.0271)
Age Squared		-0.00362***	-0.00362***	-0.00357***	-0.00364***
		(0.000897)	(0.000945)	(0.000929)	(0.000848)
Num. of Years Smoking		0.0329***	0.0329***	0.0328***	0.0328***
		(0.00170)	(0.00163)	(0.00166)	(0.00167)
French Speaking		0.0438	0.0382	0.0550	0.0503
		(0.0260)	(0.0241)	(0.0400)	(0.0380)
English and French		-0.0392	-0.0447	-0.0390	-0.0428
		(0.0767)	(0.0754)	(0.0631)	(0.0730)
Other Primary Language		-0.267***	-0.266***	-0.252***	-0.256***
		(0.0403)	(0.0396)	(0.0418)	(0.0373)
Province Economic Controls	No	Yes	Yes	Yes	Yes
Month FE	No	No	Yes	Yes	Yes
Province FE	No	No	No	Yes	Yes
Year FE	No	No	No	No	Yes
Observations	38513	37341	37341	37341	37341
Adjusted R^2	0.004	0.117	0.119	0.120	0.123

Standard errors in parentheses, clustered at province level. Outcome variable: Cigarettes per week. Fourth degree polynomials of Age are included but omitted from output. * $p < .1$, ** $p < .05$, *** $p < .01$