

**Smoking Behavior in Canada:
Before and After the 2000 Tobacco Warnings**

**Report of Casey B. Mulligan
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I. Assignment and Summary of Opinions

Beginning in December 2000, the major cigarette brands in Canada were required to display new graphic health warnings on cigarette packages that occupied 50 percent of the principal display surfaces. After the year 2000, smoking rates and cigarette consumption fell in Canada. I was asked to provide Philip Morris International (Management S.A.) my opinion as to whether those reductions were attributable to the new 50 percent graphic warnings, or to other factors.

My report implements a residual method for detecting the effects, if any, of the 50 percent graphic warnings on various measures of smoking behavior. The residual method estimates the effects (separately, or combined) of determinants of smoking behavior other than warning labels. These effects are subtracted from the actual outcomes, and any remaining difference might be interpreted (with caveats mentioned in the body of my report) as the possible effect of the 50 percent graphic warnings.

I conclude that the 50 percent graphic warnings played no discernible role in the decreased smoking rates or in the reduced number of cigarettes smoked in Canada.

Rather, smoking rates and cigarette consumption in Canada fell because of seasonal factors, cigarette price increases, and an on-going trend for non-price factors. First, in the months immediately following the introduction of the 50 percent graphic warnings, cigarette demand and smoking prevalence fell sharply due to seasonal factors. Second, higher cigarette prices are known to reduce smoking, and prices increased significantly in the first half of 2001, and continued to increase over the subsequent years. Third, due to various factors aside from price changes and seasonality, cigarette smoking has exhibited a downward trend both before and after the introduction of the 50 percent graphic warnings. For all of these reasons, smoking prevalence and cigarette consumption in Canada would have continued to decline after December 2000 even if Canada had not changed the warnings on cigarette packages.

I find that prices and regular seasonal fluctuations can explain the time pattern of smoking prevalence and consumption in the four quarters after the 50 percent graphic warnings were introduced in the marketplace. I find that prices and a trend for non-price factors – such as the trend observed in Canada prior to the introduction of the warnings in 2000 or the trend observed in the United States during this period – can explain the entire decline in smoking prevalence and consumption in Canada between 2000 and 2002. For these reasons, I conclude that the 50 percent graphic warnings had no discernible effect on smoking behavior, even in the first two years after the warnings were introduced.

II. Qualifications

My name is Casey B. Mulligan. I am a Professor of Economics at the University of Chicago, where I have taught since 1993. I teach graduate and undergraduate level

economics courses that cover a variety of topics, including taxation, consumer behavior, international comparisons, and regulation.

In addition to my position at the University of Chicago, I have served as an economic consultant in regulatory matters, class action lawsuits, antitrust cases, and the Master Settlement Agreement between the major cigarette manufacturers and 46 of the U.S. states.

I earned a doctorate degree in economics from the University of Chicago in 1993. Prior to that, I received my bachelor's degree, also in economics, from Harvard College in 1991.

I have published a book and have authored or co-authored more than twenty-five articles on a variety of topics in economics. Those articles have been published in leading scholarly journals, including the *American Economic Review*, the *American Law and Economics Review*, the *Journal of Law and Economics*, the *Journal of Political Economy*, and the *Quarterly Journal of Economics*. I have also been awarded grants from the National Science Foundation, the Sloan Foundation, the Olin Foundation, the Smith-Richardson Foundation, and other foundations and research centers to support my academic research. My qualifications are more fully documented in my curriculum vitae, which is included as Attachment A to this report.

I was assisted by staff at Navigant Economics (formerly Chicago Partners) in preparing this report.

III. Health Warning Labels on Canadian Cigarette Packs Became Graphic and Larger Near the End of 2000

A number of studies have hypothesized that larger, graphic cigarette warning labels would reduce smoking rates by making warning labels more noticeable, more memorable, more salient, and by making smokers think more about quitting.¹ However, as noted by Gospodinov and Irvine (2004), these are not studies of actual smoker behavior: consumers might better recall graphic warnings but nonetheless continue smoking.^{2,3}

¹ See "FCTC Article 11 Tobacco Warning Labels: Evidence and Recommendations from the ITC Project," International Tobacco Control Policy Evaluation Project (2009) and D. Hammond, GT Fong, A McNeill et al., "Effectiveness of cigarette warning labels in informing smokers about the risks of smoking: findings from the International Tobacco Control (ITC) Four Country Survey," *Tobacco Control* 15 (2006).

² Nikolay Gospodinov and Ian J. Irvine, "Global Health Warnings on Tobacco Packaging: Evidence from the Canadian Experiment," *Topics in Economic Analysis & Policy* (2004).

³ Previous studies have also found that some smokers remember warnings less than other smokers do, and that the smokers with less recall are also less likely to quit, or attempt to quit, smoking (D Hammond, GT Fong, PW McDonald, R Cameron, and KS Brown, "Impact of the graphic Canadian warning labels on adult smoking behaviour," *Tobacco Control* 12 (2003): 391-395; Hammond et al., "Graphic Canadian Cigarette Warning Labels and Adverse Outcomes: Evidence from Canadian Smokers," *American Journal of Public Health* 94:8 (2004): 1442-1445; Borland et al., "How reactions to cigarette packet health warnings influence quitting: findings from the ITC Four-Country survey," *Addiction* 104 (2009): 669-675).

My analysis examines measures of smoking behavior in Canada and the United States before and after the year 2000 in order to determine whether the 50 percent graphic warnings in Canada caused a discernible reduction in smoking behavior.

Canadian warning labels were subjected to a series of changes after 1988. The first such change occurred in 1989 when the *Tobacco Products Control Act* and *Tobacco Products Control Regulations* mandated that warning labels occupy 20 percent of each of the two principal display panels, one side in English and one side in French. These regulations also obliged cigarette manufacturers to rotate four new warning label messages instead of using one standard message text.⁴

In 1994, an amendment to the *Tobacco Products Control Regulations* required that the warning labels occupy 25 percent or 12 cm² of each of the two principal display surfaces, whichever is greater, one side in English and one in French. The labels were also required to be surrounded by a border with thickness between 3mm and 4mm. The amendment also increased the number of rotating warning message texts from four to eight.⁵

In 2000/2001, Canadian warning labels were modified again by the *Tobacco Products Information Regulations*, which were pursuant to the 1997 *Tobacco Act*. These regulations required that warning labels occupy 50 percent of each of the two principal display surfaces, one in English and one in French. These regulations also increased the number of rotating warning texts from eight to sixteen. In addition to the changes in text, the *Tobacco Products Information Regulations* also introduced color graphics to warning labels in the form of pictures relating to the warning text.⁶ The major brands were required to display the new warnings by December 23, 2000, and the remaining brands to follow by June 26, 2001.⁷ I refer to the 2000/2001 warnings as the “50 percent graphic warnings.”

Those studies did not look at which warnings create more recall than others, or look at which warnings are associated with more quitting behavior, let alone whether larger warnings cause more quits than smaller warnings do. In addition, people who are quitting may be motivated to remember warnings, as opposed to the other way around, so we cannot conclude that the warnings themselves contribute to quitting. When it comes to measuring the effect of warnings on behavior, there is no substitute for comparisons of actual behavior associated with alternative warnings.

⁴ See “Tobacco Products Control Act” and Canada Gazette Part I, Volume 122 Number 47, 11/19/1988, pgs. 4608-4613.

⁵ See Canada Gazette Part I, Volume 127 Number 12, 3/20/1993, pgs. 795-805.

⁶ The rotating warnings were: “CIGARETTES ARE HIGHLY ADDICTIVE”; “CHILDREN SEE CHILDREN DO”; “CIGARETTES HURT BABIES”; “TOBACCO USE CAN MAKE YOU IMPOTENT”; “DON’T POISON US”; “TOBACCO SMOKE HURTS BABIES”; “CIGARETTES CAUSE STROKES”; “CIGARETTES CAUSE MOUTH DISEASES”; “EACH YEAR THE EQUIVALENT OF A SMALL CITY DIES FROM TOBACCO USE”; “CIGARETTES LEAVE YOU BREATHLESS”; “CIGARETTES ARE A HEARTBREAKER”; “CIGARETTES CAUSE LUNG CANCER” (2 versions); “IDLE BUT DEADLY”; “WHERE THERE’S SMOKE THERE’S HYDROGEN CYANIDE”; “YOU’RE NOT THE ONLY ONE SMOKING THIS CIGARETTE.” See Canada Gazette Part I, Volume 134 Number 14, 3/1/2000, pgs. 972-980 and accompanying source document “Health Warnings and Information for Tobacco Products,” Health Canada, 5/12/2000.

⁷ The regulations defined “major brand” as having more than 2 percent market share in 1999; by this definition a majority of sales were of major brands (<http://www.smoke->

Until very recently, no U.S. legislation regarding cigarette warning labels mandated the size of labels as a percentage of the pack's principal display area; however, U.S. warnings have typically occupied about 5 percent of the package's surface.⁸ Past legislation is also unclear as to the location of the warning label on the package, merely requiring that it be "in a conspicuous place."⁹ Most U.S. warning labels, however, appear on one of the side panels of a cigarette pack.¹⁰ The required size and location of U.S. warning labels did not change between 1971 and 2009, although the warning text did change in 1984.¹¹

IV. Canadian Smoking Rates and Cigarette Sales Fell after the Year 2000

During the last half of 2000, Canadian cigarette sales were 4.3 per person (including nonsmokers) per day. This figure dropped 4 percent over the next six months, dropped a total of 1 percent after one year, and dropped a total of 17 percent after two years.

During the same time period, 20.5 percent of the population smoked daily. This figure fell 8 percent over the next six months, dropped a total of 16 percent after one year, and dropped a total of 15 percent after two years.

Also during the same time period, 24.7 percent of the population smoked daily or occasionally. This figure fell 7 percent over the next six months, dropped a total of 17 percent after one year, and dropped a total of 14 percent after two years.¹²

[free.ca/warnings/WarningsResearch/Release_WarningLabels_20070320.pdf](http://www.fda.gov/oc/ohrt/warning_labels/WarningLabels_20070320.pdf)). The regulations for the major brands came into force 180 days after the regulations were registered; those 180 days ended December 23, 2000 (Tobacco Products Information Regulations SOR/2000-272 registered June 26, 2000). The regulations for the remaining brands came into force one year after the regulations were registered (June 26, 2001).

⁸ See "Smokescreen: Double Standards of U.S. Tobacco Companies in International Cigarette Labeling," Public Citizen's Health Research Group, 10/9/1998, pg. 18.

⁹ See "Public Health Cigarette Smoking Act," Public Law 91-222, 4/1/1970.

¹⁰ "FCTC Article 11 Tobacco Warning Labels – Evidence and Recommendations from the ITC Project," International Tobacco Control Policy Evaluation Project, May 2009.

¹¹ From 1971-84, the Public Health Cigarette Smoking Act required that all cigarette packs carry the warning "Warning: The Surgeon General Has Determined that Cigarette Smoking is Dangerous to Your Health" (http://www.cdc.gov/tobacco/data_statistics/by_topic/policy/legislation/index.htm). The 1984 *Comprehensive Smoking Education Act* required four rotating warning labels on cigarette packages. Each version of the warning text included a reference to the Surgeon General and the warnings were more explicit than their predecessors (See "Comprehensive Smoking Education Act," Public Law 98-474, 10/12/1984).

¹² Canadian cigarette sales and population data are from the CANSIM database. Smoking prevalence is from the Canadian Tobacco Use Monitoring Survey (CTUMS), a study conducted since 1999 for Health Canada.

By the last half of 2002, Canadian cigarette sales were 3.6 per person per day, 17.4 percent of the population smoked daily, and 21.4 percent of the population smoked daily or occasionally.

In order to determine how much, if any, of these reductions can be attributed to the 50 percent graphic warnings, other determinants of smoking behavior need to be considered and quantified. The remainder of my report quantifies other factors to determine whether the reductions cited above would have been expected even without the introduction of the 50 percent graphic warnings.

V. Cigarette Sales and Prevalence have a Sharp Seasonal Pattern

Chart 1 shows how domestic daily cigarette sales follow a regular seasonal pattern. From Q4 to Q1 of the following year (that is, the very next quarter), daily domestic cigarette sales in Canada increased only two times in the 40 years 1969-2008, with an average quarterly rate of decline of 13%. On average for those 40 years, daily cigarette sales *increased* 9 percent the very next quarter (from Q1 to Q2), and decreased only three of the forty times.

A regular beginning-of-year smoking dip is also evident in the eleven years that the CTUMS has measured smoking behavior, despite the fact that CTUMS does not conduct interviews in January.¹³ For the ten years that CTUMS permits a comparison of February-March daily smoking rates to rates in the prior quarter (that is, from Q4 to Q1), the prevalence of daily smoking had declined eight years, and the average decline for all ten years was 10.5 percent. The overall smoking rate (daily plus occasional) fell in nine of those ten years, with an average decline of 8.1 percent. In the subsequent quarter (from Q1 to Q2), prevalence of daily smoking *increased* in eight of these ten years, with an overall average increase of 4.3 percent. The overall smoking rate (daily plus occasional) rose in seven of those ten years, with an average increase of 5.4 percent.

Unless otherwise noted, I seasonally adjust cigarette sales and cigarette smoking rates, so that the resulting seasonally-adjusted time series more readily show changes in smoking behavior over and above the regular seasonal pattern.¹⁴

¹³ The CANSIM cigarette sales data for Canada show that, on a seasonal basis, January and February are the lowest sales months of the year. Cigarette sales data for the U.S. show a similar pattern (Chandra and Chaloupka. "Seasonality and Cigarette Sales: Patterns and Implications for Tobacco Control." *Tobacco Control*. 2003, pp. 105-7).

¹⁴ To make the adjustment, I regress the log of cigarette sales (or log smoking rate) on a linear time trend, log real cigarette prices, and quarter indicators, and obtain the seasonally adjusted log sales (or rate) by subtracting the estimated quarter indicator terms from the dependent variable.

VI. High Cigarette Prices Reduce Smoking

An extensive economic literature has shown that cigarette consumption and smoker prevalence falls when cigarettes become more expensive. For example, Professor Chaloupka and coauthors concluded:

“Well over 100 published studies ... clearly demonstrate that changes in cigarette prices, resulting from changes in cigarette taxes, manufacturers’ prices, and/or other factors, lead to changes in cigarette smoking. This research confirms one of the basic laws of economics—that of the downward sloping demand curve.”¹⁵

Canadian smoking behavior responds to cigarette prices. In their study of smoking behavior and cigarette warnings, Gospodinov and Irvine (2004) found that higher cigarette prices reduce Canadian smoking prevalence and smoking intensity in economically and statistically significant amounts. Hamilton et al. (1997) found that the excise tax cuts that reduced cigarette prices in the mid 1990s increased smoking relative to trend.¹⁶

Table 1 presents further results from regressions of annualized rates of quarterly changes of Canadian smoking behavior on seasonal indicators and the log change of real cigarette prices (the full regression results are shown in Appendix Table 1). The first column measures smoking behavior according to national cigarette sales per person per day. It shows a coefficient on the price term of -0.68, which can be interpreted as a price elasticity of demand: for each percentage point that real cigarette prices increase, Canadians will purchase 0.68 percent fewer cigarettes. The estimated elasticity is statistically different from zero at the usual significance levels, and is economically significant.

Columns 2-4 of Table 1 measure smoking behavior from various waves of the CTUMS, aggregated by province and quarter.¹⁷ The regressions in columns 2-4 include time effects indicators, and thereby control for nationwide changes in factors that might affect smoking, such as the nationwide introduction of new health warnings or a national business cycle. The regressions in columns 2-4 also control for fixed province effects on the level of smoking behavior – such as cultural differences between provinces that were constant during the sample period – because the regressions are estimated in first

¹⁵ Chaloupka, F.J., et al. “Tax, Price and Cigarette Smoking: Evidence from the Tobacco Documents and Implications for Tobacco Company Marketing Strategies,” *Tobacco Control*. Vol 11 Supplement 1: Discoveries and Disclosures in Corporate Documents (March 2002), pp. i63-i72.

¹⁶ “Although smoking rates are declining in Canada, tobacco tax cuts appear to have slowed the rate of decline by inducing more nonsmokers to take up smoking and leading fewer smokers to quit.” Hamilton, V.H. et al. “The Effect of Tobacco Tax Cuts on Cigarette Smoking in Canada.” *Canadian Medical Association Journal*. 156(2), 1997: 187-91.

¹⁷ The CTUMS does not conduct interviews in January, so the Q1 observations are the average for February and March.

differences.¹⁸ The price elasticities estimated for cigarette consumption and smoking prevalence in columns 2-4 are each economically significant, and the estimates shown in the middle two columns are statistically different from zero at the usual significance levels.

Canada has experienced episodes of considerable contraband sales, one of which was during the years 1991 – 1993, and another in the second half of the 2000s. Contraband sales are not expected to impact survey measures of smoking behavior, but are expected to create a gap between legal sales (measured in Table 1's column 1) and consumption by Canadians (the variable of ultimate interest). For this reason, Table 1's column 1 sample is limited to 1994Q3 – 2004Q4.^{19,20} The fact that the price elasticity estimated for cigarette sales per person per day (column 1) is not greater than the price elasticity of cigarettes consumed as measured by the survey (column 2) also may suggest that my cigarette sales results are not driven by contraband.

Given that the data used to build Table 1 are consistent with previous findings – based on data from many more years and regions – and confidence intervals for the price elasticity estimates shown in Table 1 all include -0.4 and -0.5, henceforth I refer to price-adjusted cigarette sales, cigarette consumption, or prevalence as an adjustment that assumes a price elasticity of -0.5 (sales and consumption) or -0.4 (prevalence).

The original price and smoking behavior data used to build Table 1 are not seasonally adjusted, but each of the regression models include quarter indicators to separate seasonal effects from price effects and a general trend. The second row of the Table estimates how much smoking behavior changes in the first quarter when real cigarette prices are constant. For example, an entry of -0.31 (first column) means that, on average, log cigarette sales per person per day decline at an annual rate of 31 percent in the first quarter of the year, holding real cigarette prices constant.²¹ Such a decline is

¹⁸ A first differenced regression is one estimated in changes: the annualized log smoking behavior *change* from the prior quarter is regressed on the annualized log real cigarette price *change*. See Appendix I for an alternative approach yielding similar results.

¹⁹ Canadian exports spiked in 1992 and 1993 when the practice (by Canadian consumers of obtaining cigarettes from the United States) was known to be especially common, and the export spikes are coincident with sharp drops in Canadian domestic sales (Advisory Committee on Population Health Working Group on Tobacco Control. “The National Strategy: Moving Forward The 2001 Federal Provincial Territorial Progress Report on Tobacco Control”). Exports remained high in January 1994, so I begin using domestic sales as a consumption proxy in 1994 Q2. Because I look at smoking behavior in one quarter as it compares to behavior in the prior quarter, the first consumption change I can measure is for 1994Q3.

²⁰ Physicians for a Smoke-Free Canada (PFSC), the Canadian Tobacco Manufacturers' Council, and the Royal Canadian Mounted Police (RCMP) all estimate that contraband cigarette volumes increased again in the late 2000s. The RCMP reports that seizures of contraband cigarettes increased sharply in 2005. PSFC estimates contraband cigarette volumes of no more than 10 percent of total sales for the years 2002-2005, and then 20-31 percent of sales for 2006-2008. For these reasons, legal Canadian cigarette sales are a poor proxy for consumption after 2004 or 2005, and I use Canadian cigarette sales only for the years prior to 2005.

²¹ Equivalently, log cigarette sales are in Q1 0.08 (= 0.31/4) below what they were in the prior quarter. Hereafter, and for brevity, I refer to log changes as “percentage” changes (the two are equivalent when the percentage changes are continuously compounded).

economically significant, and the estimate's t-statistic of 4.09 shows that the decline is statistically different from zero at the usual significance levels.

VII. 2001 Excise Taxes, but not Graphic Warning Labels, have an Evident Short Run Effect on Canadian Smoking Behavior

Beginning in December 2000, the major cigarette brands in Canada were required to display 50 percent graphic warnings on cigarette packages. Beginning in April 2001, at least 6 provinces comprising more than 2/3 of Canada's smoking population significantly increased their cigarette excise tax rates above what they were at the end of 2000.²²

The 50 percent graphic warnings appeared just as the perennially low smoking season began, and the excise tax hikes took effect just as the season was ending, so seasonally adjusted smoking measures are needed to detect short run effects, if any, of warning labels and excise taxes separately from seasonal effects.

Chart 2 displays quarterly time series for seasonally adjusted real cigarette prices and daily smoking rates. The vertical line separates 2000 Q4 from 2001 Q1, the latter of which was the first full quarter in which all major brands were required to display the new 50 percent graphic warnings.

During the year 2000 – prior to the introduction of the 50 percent graphic warnings – the seasonally-adjusted fraction of Canadians smoking daily ranged from 0.19 to 0.20, while the price index was essentially at 1.00, meaning that the cigarette price, adjusted for inflation and seasonality, during the year was essentially the same as it was in 2000 Q4 when it is 1.00 by definition. During the first full quarter with the 50 percent graphic warnings displayed on major brands (2001 Q1), the seasonally-adjusted daily smoking rate estimated from the CTUMS was actually somewhat greater – more than

²² See also The Working Group on Tobacco Control. "Moving Forward: The 2002 Progress Report on Tobacco Control," page 11.

Alberta: http://www.finance.alberta.ca/publications/tax_rebates/rates/hist1.html#cigarettes;

Manitoba: <http://www.gov.mb.ca/finance/taxation/bulletins.html#tobacco>

Nova Scotia: <http://www.gov.ns.ca/snsmr/pdf/ans-taxcomm-bulletin-5076.pdf>

Ontario: <http://www.rev.gov.on.ca/en/tax/tt/rates.html>

Prince Edward Island: <http://www.taxandland.pe.ca/index.php3?number=1005001&lang=E>

Quebec: <http://www.finances.gouv.qc.ca/documents/Bulletins/en/98-1-a-b.pdf>,

<http://www.finances.gouv.qc.ca/documents/Bulletins/en/98-2-a-b.pdf>,

<http://www.finances.gouv.qc.ca/documents/Bulletins/en/99-4-a-b.pdf>,

<http://www.finances.gouv.qc.ca/documents/Bulletins/en/2001-2-a-b.pdf>,

<http://www.finances.gouv.qc.ca/documents/Bulletins/en/2001-12-a-b.pdf>,

<http://www.finances.gouv.qc.ca/documents/Bulletins/en/2002-6-a-b.pdf>,

<http://www.finances.gouv.qc.ca/documents/Bulletins/en/2003-6-a-b.pdf>,

[http://www.revenu.gouv.qc.ca/en/ministere/centre_information/nf/2010/2010-12-15\(1\).aspx](http://www.revenu.gouv.qc.ca/en/ministere/centre_information/nf/2010/2010-12-15(1).aspx)

Saskatchewan: <http://www.finance.gov.sk.ca/taxes/tob/>

0.21. Thus, the CTUMS data for the first quarter of 2001 give no indication that the 50 percent graphic warnings were causing Canadian smokers to quit smoking daily or preventing people from becoming daily smokers.

A quarter later (2001 Q2), real cigarette prices were up to 1.08, eight percent above their 2000 Q4 value. Because high prices are known to reduce smoking rates, a price increase of this size is expected to substantially reduce smoking rates. Not surprisingly, the seasonally-adjusted daily smoking rate in 2001 Q2 was 0.18, which is below the smoking rates estimated for all five of the prior quarters. At the time the next substantial price increase occurred – from 2001 Q3 to 2001 Q4 – the daily smoking rate fell substantially once again.

Chart 3 shows that overall smoking rates – the fraction of people who smoke either daily or occasionally – follow a similar pattern. Seasonally adjusted rates range between 0.23-0.25 during 2000 and peak in the first quarter of 2001. The smoking rate declined sharply in the same quarter that prices increased, and declined again at the end of 2001 when prices increased again.

Chart 4 displays results for cigarettes smoked per person. Again, seasonally-adjusted smoking is higher in the first full quarter that the major brands were required to display the 50 percent graphic warnings. Cigarette consumption fell sharply in the same quarter that prices increased, and declined again at the end of 2001 when prices increased again.

Chart 5 displays results for cigarettes sales per capita per day. Again, seasonally-adjusted smoking is higher in the first full quarter that the major brands were required to display the 50 percent graphic warnings. Cigarette consumption fell sharply in the same quarter that prices increased.

Charts 2b, 3b, and 4b are analogous to Charts 2-4, except the population is limited to persons aged 30 and older for which changes in smoking rates are largely due to quitting rather than smoking initiation. Adjusting for seasonality, the charts show no evidence that more people quit in the quarter after the 50 percent graphic labels were introduced. The charts do suggest that, adjusting for seasonality, more quitting occurred in the second quarter when the new excise taxes went into effect.

During this period, it appears from the national data that the 50 percent graphic warnings had no discernible effect on smoking behavior, whereas higher prices did.

VIII. Adjusting for Prices, Canadian Smoking Rates and Cigarette Sales Declined No More in 2000-2002 than They did for the Rest of the Years 1994-2009

A rising retail price of cigarettes is not the only reason that smoking has generally fallen over time. Social change, health concerns, and various tobacco control measures are among the non-price factors that have been suggested.²³ However, the effects of non-price factors, if any, can sometimes be confused with the effects of prices when prices rise and non-price factors change at roughly the same time. In order to measure possible effects of non-price factors separately from price effects, I adjust both the time series for cigarette sales per person per day and the smoking rates for price effects.²⁴

In order to measure the trend for non-price factors, I estimated regressions with the log change of cigarette sales per person per day or the log smoking rate change as dependent variables, with each smoking behavior measure adjusted for prices as noted above. The independent variables in the regressions include a constant and, for the purposes of seasonal adjustment, indicators for calendar quarter. The regression coefficients are then used to calculate a trend for the non-price factors: the average annual rate of change of price-adjusted smoking behavior.

The left side of Table 2 measures smoking behavior as national cigarette sales per person per day for the quarters 1994 Q3 – 2004 Q4.²⁵ The first column of the Table shows that the sample average trend is -0.010, which means that price-adjusted cigarette sales per person per day decline about one percent per year. The second column adds to the first difference regression an indicator variable for the eight quarters 2001 Q1 through 2002 Q4. The “baseline trend” entry of -0.015 in that column is the average log change for all quarters except those eight quarters. The coefficient of 0.025 is the average annual rate of change from 2000 Q4 to 2002 Q4, expressed as a difference from the baseline trend. In other words, price-adjusted cigarette sales per person per day *increased* at a rate of 2.5 percent per year more during the 2000 Q4 to 2002 Q4 period than in the rest of the sample period, when it was declining at a rate of 1.5 percent per year. Thus, price adjusted cigarette sales per person per day did not fall more than usual in the eight quarters after the major brands displayed the 50 percent graphic warnings: in fact, they did not fall at all.

With the 50 percent graphic warnings introduced in December 2000, one might have expected cigarette sales to decline more than usual in the months and years afterward as additional smokers were induced to quit, and non-smokers discouraged from

²³ Chaloupka, F.J. and Kenneth E. Warner. “The Economics of Smoking.” *Handbook of Health Economics*. Elsevier, 2000.

²⁴ To price-adjust a smoking behavior variable, it is divided by the real cigarette price index raised to a power equal to the elasticity of that behavior with respect to price. An elasticity of -0.5 is assumed for sales and consumption. An elasticity of -0.4 is assumed for prevalence measures.

²⁵ As noted above, the change from the prior quarter can only be calculated beginning in 1993 Q3.

starting. But the results in Table 2 show no tendency for cigarette sales per person per day to decline more than usual in 2001 and 2002.

The third column of the table shows another indicator variable for the period after 2002 Q4, and sets the baseline period to be the part of the sample before 2001. Its coefficient is the annual average price-adjusted rate of change for that period, relative to the rate for the period before 2001: that rate of change was about 0.02 percentage points greater than before 2001.

The third column displays a coefficient on the eight-quarter indicator of 0.025, which means that the price-adjusted cigarette sales per person per day *increased* at a rate of 2.5 percent per year more than it did prior to 2001. Thus, price adjusted cigarette sales per person per day did not trend downward more in the eight quarters after the major brands displayed the 50 percent graphic warnings than it did in the years before.

The right side of the table measures smoking behavior by province using the CTUMS data for the available period 1999 Q2 through 2009 Q4. As in Table 2's columns 1 and 2, an overall trend is estimated and compared to the changes in the time period immediately after the 50 percent graphic warning labels were introduced. The point estimate on the "8 qtrs after" indicator variable is positive for cigarettes consumed per capita and smoking prevalence, and negative for daily smoking prevalence. A positive point estimate means that smoking behavior increased at a higher rate, or declined at a lesser rate, during those eight quarters than it did during the baseline period. However, for all three CTUMS smoking measures, the confidence interval for that coefficient includes zero, meaning that we cannot reject the hypothesis that the trend for non-price factors was the same in the eight quarters after the 50 percent graphic warnings were introduced as the trend during the baseline period.

Considering trends and prices, the time series for cigarette sales, cigarette consumption, and smoking prevalence (daily and total) offer no evidence of an additional reduction in smoking in the two years after the 50 percent graphic warnings were introduced.

IX. Adjusting for Prices, Cigarette Sales Declined at the Same Rate in Canada as They did in the U.S. 1994-2004

During the years 1994-2004, the United States did not change its cigarette warning label regulation, but it did experience changes in other non-price factors – social change, health concerns, and (aside from new warning labels) various tobacco control measures – that might contribute to reduce cigarette demand. Because the two countries are geographically proximate and similar in many ways,²⁶ the trend for price-adjusted

²⁶ The many similarities between the United States and Canada are a primary reason for directly comparing outcomes in the two countries (Ken Eng and David Feeny, "Comparing the Health of Low Income and Less Well Educated Groups in the United States and Canada," *Population Health Metrics*. 5:10 (2007)).

cigarette sales per person in the U.S. is another indicator of how Canadian cigarette demand might have shifted over time if the 50 percent graphic warnings had never been introduced. Using per capita cigarette sales data from International Smoking Statistics,²⁷ I find that price adjusted cigarette sales per person fell more than one percent per year in the United States from 1994-2004, where health warning labels on cigarette packs were unchanged.

The first column of Table 2 shows how price-adjusted Canadian cigarette sales per person declined at one percent per year, which is about the same rate it fell in the United States for the time period 1994-2004 as a whole. The second column shows how price-adjusted cigarette sales per person did not decline any faster during the eight quarters after the introduction of 50 percent graphic warnings than they did over the ten years 1994-2004 in either Canada or the United States (where they declined more than one percent per year).

If the 50 percent graphic warnings had a discernible effect, the price-adjusted cigarette sales per person in Canada should have fallen more in Canada than they did in the United States where the warning labels were not changing, and were not as large and graphic. Instead, I find no evidence of an additional reduction in price-adjusted Canadian cigarette sales per capita.

X. Gospodinov and Irvine's Estimated Warning Label Effects Are Exaggerated Because They Are Not Corrected for Trends or Seasonality

Gospodinov and Irvine (2004) use two seasonally-unadjusted semi-annual waves of the CTUMS to examine changes in smoking prevalence and intensity from July-December 2000 to February-June 2001. Using a regression analysis, they found that smoking prevalence (the percentage of respondents who were either daily or occasional smokers) fell 0.3 percentage points (about 1.4 percent) and smoking intensity fell 2.2 cigarettes per smoker per week (about 2.2 percent), after adjusting for price effects and for possible demographic differences. Neither of these changes were statistically distinguishable from zero, and they concluded that their "findings indicate that the warnings have not had a discernible impact on smoking prevalence. The evidence of their impact on quantity smoked is [in the direction of fewer cigarettes smoked], though only at a relatively low level of confidence."²⁸

In doing so, Gospodinov and Irvine attributed to warning labels any seasonally-unadjusted smoking behavior change from late 2000 to early 2001 that could not be attributed to demographics or prices, but suggested that future research needs to adjust for

²⁷ The ISS WEB edition can be accessed at: <http://www.pnlee.co.uk/ISS3.htm>

²⁸ The exact quote is "...impact on the quantity smoked is positive..." but their tables 2 and 3 and their concluding section clearly explain that their point estimate of the warnings effect is in the direction of fewer cigarettes smoked.

trends and for seasonality: "... trend factors are likely important, and that seasonality is an as-yet unexplored possibility" (p. 17; see also p. 14).

From seasonal patterns alone, the overall (daily plus occasional) smoking rate is 2.7 percent lower February-June than it is in July-December, so Gospodinov and Irvine's estimate of a seasonally-unadjusted -1.4 percent warning label effect on overall smoking prevalence can be adjusted for seasonality by subtracting -2.7 from -1.4. In other words, Gospodinov and Irvine's results imply that warning labels were associated with a 1.3 percent *increase* in the seasonally-adjusted overall smoking rate (see Table 3).²⁹

The seasonal pattern for smoking intensity is -4.6 percent, so Gospodinov and Irvine's estimate of a seasonally-unadjusted -2.2 percent warning label effect on smoking intensity can be adjusted for seasonality by subtracting -4.6 from -2.2. In other words, Gospodinov and Irvine's results imply that warning labels were associated with a 2.4 percent *increase* in the seasonally-adjusted smoking intensity, or about 2.4 cigarettes per smoker per week.

Gospodinov and Irvine (2004) did not, at conventional significance levels, reject the hypothesis that the 50 percent graphic warning labels had no effect on smoking prevalence or smoking intensity during the six months after the labels were introduced. The point estimates on their "warning label" variable were less than zero, which may give some readers the impression that warning labels had an effect that is at least in the direction of reducing smoking. However, Gospodinov and Irvine noted that more research was needed in order to correct their warning label point estimates for the fact that smoking behavior is seasonal.

As reported above, I conducted additional research regarding the seasonality of smoking in Canada, and corrected the Gospodinov and Irvine point estimates for seasonality. The seasonality correction changes their point estimates from negative to positive: the seasonally adjusted point estimates have the "wrong" sign from the perspective of the hypothesis that smoking prevalence and smoking intensity fell more than usual in the months after the 50 percent graphic warnings were introduced.

My research, and Gospodinov and Irvine's before me, found that the 50 percent graphic warnings had no discernible effect on smoking behavior, even in the first two years after the warnings were introduced. As shown in more detail in Appendix II of this report, these studies of actual smoking behavior contradict inferences about the effectiveness of the 50 percent graphic warnings drawn by Health Canada from claims by some smokers, over the same time frame, that the warnings were "very effective" at getting them to smoke less.

²⁹ An even greater seasonal adjustment is calculated without the data for 2001 (the first full year that major manufacturers had the graphic warning labels).

XI. Conclusions

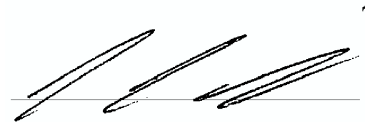
I find that the 50 percent graphic warnings introduced in December 2000 played no discernible role in the decline of smoking rates or reduction in cigarettes smoked in Canada.

Rather, smoking rates and cigarette consumption in Canada fell after December 2000 because of seasonal factors, cigarette price increases, and an on-going trend for non-price factors. These conclusions are supported by evidence on national cigarette sales since 1994, CTUMS survey evidence on smoking prevalence and cigarette consumption since 1999, and estimates of non-price factors in the United States over a time when its cigarette warning policy was unchanged.

My results confirm and strengthen the conclusions about the response of smoking prevalence and smoking intensity to the 50 percent graphic warnings stated by Gospodinov and Irvine in their study published in 2004.

For these reasons, I conclude that the 50 percent graphic warnings had no discernible effect on Canadian smoking behavior during the months and two years after they were introduced.

May, 4, 2011.

A handwritten signature in black ink, consisting of several fluid, overlapping strokes, positioned above a horizontal line.

Casey B. Mulligan

XII. Appendix I: Regression Details

Appendix Table 1 displays results for four smoking behavior log change regressions, differing according to the smoking behavior measure (sales per person per day, consumption per person per day, daily smoking prevalence, and overall smoking prevalence), and geographic aggregation (nation-by-quarter vs. province-by-quarter). The same results are reported in abbreviated form in Table 1.

Appendix Table 1L displays estimates of the levels version of the first difference regressions in Appendix Table 1. The levels model is

$$\ln S_{it} = \alpha_i + \alpha_t + \beta \ln p_{it} + \varepsilon_{it}$$

where S_{it} is a measure of smoking behavior in province i in quarter t , p_{it} is an index of the real price of cigarettes in province i in quarter t , α_t is a vector of national time effects, α_i is a vector of province fixed effects (time and province effects are necessarily omitted from the national model, which instead has quarter effects and a linear time trend), and ε_{it} is the regression error term. β is the price elasticity of smoking to be estimated.

Appendix Table 1L further confirms that cigarette prices have an economically and statistically significant effect on smoking behavior, in the direction of higher prices reducing smoking. Moreover, the estimated elasticities for cigarette sales and consumption are close to the -0.5 assumed for the purpose of price adjusting those series. Appendix Table 1L's confidence intervals for the price elasticities of prevalence (daily and overall) include the -0.4 assumed for price-adjusting prevalence measures.

Appendix Table 1L summarizes the time effects by quarter. The "1st quarter row" is four times the difference between the average time effect for all of the Q1's and the average time effect for all of the Q4's,³⁰ and is therefore comparable to the annual rates of change Q4-Q1 shown in Appendix Table 1.³¹ The quarter effects shown in Appendix Table 1L further confirm my conclusion that smoking behavior is significantly less in Q1 than in the prior quarter.

³⁰ The national specification includes a linear time trend and quarter effects rather than time effects, with Q4 as the omitted quarter. The coefficient on the Q1 effect, multiplied by four, is entered in Appendix Table 1L. That entry is the average annualized rate of change from Q4 to Q1, holding real cigarette price constant, and is therefore comparable to the corresponding entry in Appendix Table 1.

³¹ The results shown for Q3 and Q4 are not directly comparable between Appendix Table 1 and Appendix Table 1L because they have different benchmark quarters.

Appendix Table 2L displays estimates of the levels version of the first difference regressions in Appendix Table 2. The three piecewise continuous models estimated are

$$(\ln S_{it} - \beta \ln p_{it}) = \alpha_i + \alpha_q + \gamma t + \varepsilon_{it}$$

$$(\ln S_{it} - \beta \ln p_{it}) = \alpha_i + \alpha_q + \gamma t + \delta_w \left[(t - 2000Q4)I_w + 8I_{post} \right] + \varepsilon_{it}$$

$$(\ln S_{it} - \beta \ln p_{it}) = \alpha_i + \alpha_q + \gamma t + \delta_w \left[(t - 2000Q4)I_w + 8I_{post} \right] + \delta_{post} (t - 2002Q4)I_{post} + \varepsilon_{it}$$

$$I_w \equiv I(t \in \{2001Q1, \dots, 2002Q4\}), \quad I_{post} \equiv I(t > 2002Q4)$$

where the dependent variable (shown in parentheses to the left) is price-adjusted smoking behavior, α_q is a vector of (seasonal) quarter effects, α_i is a vector of province fixed effects (province effects are necessarily omitted from the national model), and ε_{it} is the regression error term. t is time measured in quarters and I_w and I_{post} are indicator variables for the 8 quarters after the warnings were introduced and the period after 2002Q4, respectively. The coefficients δ_w and δ_{post} are the quarterly rates by which the time trend for price-adjusted smoking behavior, during the 8 quarters after the warnings and the time after 2002Q4, respectively, exceed the time trend γ prior to the introduction of the warnings. The quarterly rates were multiplied by 4 and entered into Appendix Table 2L as annual rates.

Appendix Table 2L's results are like those from the first difference specification (Table 2): the baseline trend for smoking behavior is negative and the trend is not any more negative during the eight quarters after the 50 percent graphic warnings were introduced.

XIII. Appendix II - Contrary to Health Canada Claims, The 50 Percent Graphic Warnings Were Never “Effective” at Reducing Smoking

I was provided with a copy of the recent Regulatory Impact Analysis Statement authored by Health Canada,³² which is based on an “Economic Evaluation” report it commissioned from the consulting company Industrial Economics (the “evaluation report”).³³

Health Canada proposes tobacco regulations in a number of dimensions, such as increasing the size of warnings, changing and rotating the warning text, changing warning images and colors, and having warnings offer quit assistance information. The evaluation report attempts to quantify the aggregate benefits of the proposed regulations, but does not quantify the benefits of only increasing warning size.

The evaluation report does not present any evidence that Canadian warnings would reduce smoking more if they occupied 75 percent of the principal display surface, rather than the 50 percent that they currently occupy. Instead, it claims that the 50 percent graphic warnings already in place did in fact reduce smoking in the mid 2000s, and merely conjectures that the “proposed changes will restore the effectiveness of warning labels ... to levels that the current labels once achieved.”³⁴

As shown in this report, the 50 percent graphic warnings did not have a discernible effect on Canadian smoking rates, cigarette sales, or cigarette consumption in the two years following their introduction. Thus, even if the proposed regulations did restore the one-time effectiveness of the 50 percent graphic warnings, that effectiveness was essentially zero.

The evaluation report never indicates that the 50 percent graphic warnings might have had no discernible effect on Canadian smoking rates, cigarette sales, or cigarette consumption, yet I am aware of only one published study attempting to estimate the impact of warnings by examining smoking rates and consumption before and after the 50 percent graphic warnings were introduced, and that study found no discernible effect (Gospodinov and Irvine, 2004).³⁵

Instead, the evaluation report gives an impression that the 50 percent graphic warnings were effective (at reducing smoking) by summarizing the results of surveys in which smokers comment on how they think health warnings have affected their behavior. Some of those results are shown in the evaluation report’s Exhibit 6-10 indicating that in all years between 2001 and 2008, a minimum of 12 percent of smokers claimed the 50

³² <http://canadagazette.gc.ca/rp-pr/p1/2011/2011-02-19/html/reg3-eng.html>

³³ Industrial Economics, Incorporated. *Economic Evaluation of Health Canada’s Proposal to Amend the Tobacco Product Information Regulations*. December 2009.

³⁴ Industrial Economics (2009, p. 6-28).

³⁵ The evaluation report fails to cite the study.

percent graphic warning labels were “very effective” at getting them to smoke less. The same exhibit indicates that, by the end of 2002, 16 percent of smokers claimed the 50 percent graphic warning labels were “very effective” at getting them to smoke less. The report’s Appendix D Exhibit 10 indicates that, by the end of 2002, 43 percent of smokers claimed the 50 percent graphic warning labels were “very effective” or “somewhat effective” at getting them to smoke less.

Given surveyed smokers’ claims of warning effectiveness, readers of the evaluation report might conclude that, over the course of the two years after the 50 percent graphic warnings were introduced, about 800,000 to 2,150,000 Canadians were smoking substantially less as a result, depending on whether or not we include smokers who found the warnings to be merely “somewhat effective” at getting them to smoke less.³⁶ However, these comments by the surveyed smokers are vividly contradicted by actual cigarette sales in Canada and by cigarette consumption as measured by the Canadian Tobacco Use Monitoring Survey (CTUMS).³⁷

If a “very effective” smoking cessation measure is one that leads to cutting back by ten cigarettes per day,³⁸ the warning-effectiveness claim is contradicted by actual cigarette sales in Canada. With 16 percent of Canadians smoking ten cigarettes per day less as a result of the warnings, 8,000,000 fewer daily cigarettes would be sold than would have been sold absent the warning introduction (unless the warnings were causing many of the other 84 percent of smokers to smoke *more* thereby offsetting the reductions among the 16 percent), not to mention the reduced smoking by those smokers who found the warnings to be merely “somewhat effective.” However, Table 2 and Appendix Table 2L show that cigarette sales and cigarette consumption measured by the CTUMS were actually slightly above what would have been expected on the basis of prior smoking behavior, smokers’ responsiveness to prices, etc., and much above what they would have been if 16 percent of Canadian smokers had reduced their smoking by ten cigarettes a day over the course of the two years following the introduction of the 50 percent graphic warnings.

I conducted a t-test of the statistical significance between the trend, from 2000 Q4 through 2002 Q4, for actual cigarettes sales per person per day, and the sales trend that likely would have occurred if the 50 percent graphic warnings had in fact been very effective at getting 16 percent of smokers to smoke less by the 10-cigarettes criterion.³⁹ The actual sales data reject the effectiveness claim with 95% confidence.

³⁶ During the year 2002, more than 5,000,000 Canadian adults were smokers (800,000 = 16 percent of 5 million and 2,150,000 = 43 percent of 5 million). I assume that, as of the year 2000, no Canadian was smoking less as a result of the 50 percent graphic warnings because those warnings were not yet introduced.

³⁷ Another possibility is that the survey respondents were accurate, but their reduced smoking was offset by increased smoking elsewhere in the Canadian population.

³⁸ 10 cigarettes is half a 20-pack, or 40 percent of a 25-pack.

³⁹ The latter trend is calculated as the baseline trend from Appendix Table 2L plus the log of [1 minus the ratio of (.16x10) to actual 2002 Q4 daily sales (or consumption)], divided by two to be on an annualized basis.

I conducted a t-test of the statistical significance between the trend, from 2000 Q4 through 2002 Q4, for cigarette consumption per person per day, and the consumption trend that likely would have occurred if the 50 percent graphic warnings had in fact been very effective at getting 16 percent of smokers to smoke less by the 10-cigarettes criterion. The actual consumption data reject the effectiveness claim with 95% confidence.

If, alternatively, a “very effective” smoking cessation measure is one that leads to cutting back by 5 cigarettes per day, the effectiveness claim is contradicted by actual cigarette sales and consumption in Canada. With 16 percent of Canadian smokers smoking five cigarettes per day less as a result of the warnings, 4,000,000 fewer daily cigarettes would be sold than would have been sold absent the warning introduction. The actual sales and consumption data both reject this version of the effectiveness claim with 95% confidence.

If a smoking cessation measure that is “very effective” or “somewhat effective” is one that leads to cutting back by at least one cigarette per day, the effectiveness claim is contradicted by actual cigarette sales and consumption in Canada. With 43 percent of Canadian smokers smoking one cigarette per day less as a result of the warnings, at least 2,150,000 fewer daily cigarettes would be sold than would have been sold absent the warning introduction. The actual sales and consumption data both reject this version of the effectiveness claim with 95% confidence.

Chart 6’s circles display quarterly Canadian cigarette sales per capita from 1994 through the end of 2004, adjusted for seasonality and real cigarette prices. The colors of the circles indicate, among other things, whether the observations were before the introduction of the 50 percent graphic warnings (black) or after (blue and yellow).

Chart 6’s black line displays the average trend for the period. Many of the observations before the introduction of the 50 percent graphic warnings lie near that line, as do many of the observations after the introduction. This alone suggests that smoking behavior trends might not have changed when the 50 percent graphic warnings were introduced.

Chart 6’s green line models cigarettes sales (adjusted for prices and seasonality) under the assumption that 16 percent of smokers had cut their smoking by an average of ten cigarettes per day by the end of 2001, as a reader of the evaluation reports Exhibit 6-10 might be led to believe. All but one of the 16 observations since the introduction of the 50 percent graphic warnings appear above this line, and some of them appear far above the line.

The systematic deviation between the green-line-model and actual behavior contradicts the claim that the introduction of the 50 percent graphic warnings was “very effective” at getting 16 percent of smokers to smoke less by the 10-cigarettes criterion.

Chart 6's red line models cigarettes sales (adjusted for prices and seasonality) under the assumption that 16 percent of smokers had cut their smoking by an average of five cigarettes per day by the end of 2001. Again, all but one of the 16 observations since the introduction of the 50 percent graphic warnings appear above this line. The observations contradict the claim that the introduction of the 50 percent graphic warnings was "very effective" at getting 16 percent of smokers to smoke less by the 5-cigarettes criterion.

Of the three models shown in Chart 6, the model assuming a single trend before and after the introduction of 50 percent graphic warnings (the black line) fits the observations better than the other two.⁴⁰

The evaluation report also relies on a publication⁴¹ by Hammond et al. finding that more than 35 percent of smokers who "demonstrated a strong knowledge of the warnings" reduced their smoking between late 2001 and early 2002, as compared to less than 15 percent of smokers who did not demonstrate "strong knowledge." They also found the "strong knowledge" group to have quit smoking outright 5 percentage points more than the other smokers. Hammond et al. interpret their findings as evidence that the 50 percent graphic warnings caused about 20 percent of smokers to reduce smoking and 5 percent of smokers to actually quit in a time frame of just a few months.

Hammond et al. did not look at which warnings create more recall than others, or which warnings are associated with more quitting behavior, let alone whether larger warnings cause more quits than smaller warnings do. In addition, people who are quitting may be motivated to remember warnings, as opposed to the other way around, so we cannot conclude that the warnings themselves contribute to quitting. When it comes to measuring the effect of warnings on behavior, there is no substitute for comparisons of actual behavior associated with alternative warnings.

I already explained how the data on actual cigarette sales and cigarette consumption reject the hypothesis that, in a two year time frame, 16 percent of smokers substantially reduced their smoking as a result of the introduction of the 50 percent graphic warnings. Therefore, the data reject with even more confidence the hypothesis from Hammond et al. that, in a two year time frame, 20 percent of smokers substantially reduced their smoking as a result of the introduction of the 50 percent graphic warnings.

I conducted a t-test of the statistical significance between the trend, from 2000 Q4 through 2002 Q4, for smoking prevalence that likely would have occurred if the Hammond et al. study could really be interpreted as a 5 percentage point impact of warnings on prevalence. As shown by Table 2 and Appendix Table 2L, smoking

⁴⁰ The average squared deviation for the model where smoking is reduced by 5 cigarettes a day is more than double the squared deviation for the no impact model; for the model where smoking is reduced by 10 cigarettes a day the squared deviation is more than three times as large as the squared deviation for the no impact model.

⁴¹ D Hammond, GT Fong, PW McDonald, R Cameron, and KS Brown, "Impact of the graphic Canadian warning labels on adult smoking behaviour." *Tobacco Control*. 12, 2003: 391-395

prevalence actually fell less during 2000-2002 than would be expected based on prices and prior trends – far from falling the extra 5 percentage points that might have been expected from the Hammond et al. study. The CTUMS measures of smoking prevalence reject the 5 percentage point prevalence impact with 95% confidence.

A key premise of Health Canada's proposed changes in cigarette labeling is that the 50 percent graphic warnings substantially reduced smoking among Canadians for a time period, but now their effects have worn off and they need to be refreshed. My report shows that this key premise is contradicted by measures of actual tobacco use in Canada: the 50 percent graphic warnings did not have a discernible effect on Canadian smoking rates, cigarette sales, or cigarette consumption in the two years following their introduction. Thus, even if the proposed regulations did restore the one-time effectiveness of the 50 percent graphic warnings, that effectiveness was essentially zero.

Table 1. Smoking in Canada is Price Sensitive and Seasonal

Displayed are results for four smoking behavior log change regressions, differing according to the smoking behavior measure (sales per person per day, consumption per person per day, daily smoking prevalence, and overall smoking prevalence), and geographic aggregation (nation-by-quarter vs. province-by-quarter). All four regressions show that increased cigarette prices reduce smoking and that smoking is typically less in Q1 than in the prior quarter.

	Regressions for Quarter-to-Quarter Log Smoking Behavior Changes, Annualized			
	National	by Province		
	Per Capita Cigarette Sales	Per Capita Cigarettes Consumed	Prevalence of Daily Smoking	Smoking Prevalence
<u>Independent Variables</u>				
Price: Real Cigarette Price, annualized log change from prior quarter	-0.68 (2.81)	-0.87 (3.06)	-0.66 (2.42)	-0.41 (1.48)
Seasonality: 1st Quarter's average annualized change from the prior quarter	-0.31 (4.09)	-0.46 (4.89)	-0.36 (4.55)	-0.29 (4.03)

Notes: The absolute values of robust t-statistics are shown in parentheses. Seven of the eight coefficients shown are statistically significant at conventional significance levels. Further statistics from, and description of, these regressions are reported in the Appendix.

A coefficient of -0.68 on real cigarette price indicates that for each percentage point that real cigarette price increase, Canadians will purchase 0.68% fewer cigarettes. A coefficient of -0.31 on the "Seasonality: 1st Quarter" indicator means that, on average, log cigarette sales per person per day decline at an annual rate of 31 percent in the first quarter of the year, holding real cigarette prices constant.

Table 2. Did 50 Percent Graphic Warnings Change Smoking Behavior Trends?

Each column of the Table displays results from a price-adjusted smoking behavior log change regression, differing in terms of smoking behavior measure and indicator variables for sub-periods. The first regression for each indicator has only a constant and quarter indicators (deviated from 0.25), and thereby indicates the average annualized seasonally adjusted change over the entire sample period. The other columns add an indicator(s) for a sub-period(s), especially the 8 quarters following the introduction of 50 percent graphic warnings, thereby indicating how smoking behavior changed in those 8 quarters relative to a baseline sub-period. A price row appears in the table to show the magnitude of the price adjustment.

Average Annualized Log Changes in Price-Adjusted Smoking Behavior									
	National			by Province					
	Cigarette Sales per capita			Cigarettes Consumed per capita		Daily Smoking Rate		Smoking Prevalence per capita	
	1994 Q3 - 2004 Q4			1999 Q2 - 2009 Q4					
Sample Period:	Entire Sample	Qtrs except 2001-2	Pre-2001	Entire Sample	Qtrs except 2001-2	Entire Sample	Qtrs except 2001-2	Entire Sample	Qtrs except 2001-2
Baseline Trend	-0.010 (0.549)	-0.015 (0.871)	-0.015 (0.805)	-0.031 (1.346)	-0.037 (1.408)	-0.017 (0.838)	-0.014 (0.609)	-0.013 (0.729)	-0.016 (0.821)
8 qtrs after warnings, relative to baseline		0.025 (0.381)	0.025 (0.377)		0.032 (0.588)		-0.016 (0.316)		0.016 (0.344)
Trend after 2002, relative to baseline			0.0002 (0.003)						
Real Cigarette Price, annualized log change	-0.500	-0.500	-0.500	-0.500	-0.500	-0.400	-0.400	-0.400	-0.400
Adjusted R-squared	0.76	0.75	0.75	0.12	0.12	0.07	0.07	0.04	0.04
s.e.	0.167	0.169	0.171	0.69	0.691	0.593	0.594	0.53	0.53
Smoking behavior source	CANSIM			CTUMS					
Number of Quarters	42			43					
Number of Regions	1			10					

Notes: All regressions include indicator variables for quarter (deviated from 0.25). The absolute values of t-statistics are shown in parentheses.

Regressions are estimated with the Prais-Winsten correction for first-order serial correlation.

CTUMS regressions exclude January from Q1.

The 8 quarters after the warnings were introduced are 2001 Q1 - 2002 Q4.

A coefficient of -0.010 for the baseline trend means that price-adjusted cigarette sales per person per day decline about one percent per year. A coefficient of 0.025 for the "8 quarters after the warnings, relative to baseline" indicator variable means that price-adjusted cigarette sales per person per day increased about 2.5 percent per year more during the 2000Q4-2002Q4 period than in the rest of the sample period.

Table 3. Seasonally Adjusting Gospodinov & Irvine's Warning Label Effect Estimates Changes Their Sign

The Table's first column displays Gospodinov & Irvine's estimates of the "warning label effect" on smoking prevalence and smoking intensity. Each estimate is expressed in both levels and logs. The middle column shows the (log) seasonal adjustment discussed in my report. The final column makes the seasonal adjustment to each log smoking measure as the difference between the prior two columns, and converts the log effect estimates to level effect estimates (0.003 for smoking prevalence and 2.4 for smoking intensity).

	<u>Seasonally Unadjusted</u>	<u>Seasonal Adjustment</u>	<u>Seasonally Adjusted</u>
<i>Smoking Prevalence</i>			
share of population	-0.003		0.003
log share	-0.014	-0.027	0.013
<i>Smoking Intensity</i>			
cigarettes per smoker per week	-2.200		2.400
log	-0.022	-0.046	0.024
Sources:	Gospodinov & Irvine, Table 2	CTUMS 1999-2009	Columns 1 & 2

Appendix Table 1L. Smoking in Canada is Price Sensitive and Seasonal

Displayed are results for four log smoking behavior regressions, differing according to the smoking behavior measure (sales per person per day, consumption per person per day, daily smoking prevalence, and overall smoking prevalence), and geographic aggregation (nation-by-quarter vs. province-by-quarter).

Independent Variables	Dependent Variable = Log Smoking Behavior			
	National	by Province		
	Per Capita Cigarette Sales	Per Capita Cigarettes Consumed	Prevalence of Daily Smoking	Smoking Prevalence
Real Cigarette Price, log	-0.49 (7.27)	-0.46 (3.35)	-0.26 (2.14)	-0.27 (2.39)
1st Quarter's average annualized change from the prior quarter	-0.30 (4.61)	-0.48 (5.48)	-0.37 (5.05)	-0.29 (4.35)
2nd Quarter, rel. to 4th, annualized	0.12 (2.01)	-0.13 (1.76)	-0.16 (2.49)	-0.10 (1.77)
3rd Quarter, rel. to 4th, annualized	0.22 (4.12)	-0.03 (0.32)	-0.15 (2.12)	-0.13 (2.05)
Time and Province Effects?	N/A	Yes	Yes	Yes
Adjusted R-squared	0.93	0.76	0.71	0.67
s.e.	0.0357	0.141	0.12	0.109
Smoking behavior source	CANSIM	CTUMS		
Sample Period	1994 Q2 - 2004 Q4	1999 Q1 - 2009 Q4		
Number of Quarters	43	44	44	44
Number of Regions	1	10	10	10

Notes: The absolute value of robust t-statistics are shown in parentheses.

Regressions are estimated with the Prais-Winsten correction for first-order serial correlation.

Regressions include a constant, time effects, and province fixed effects, except the national specification which instead has indicators for quarters Q1 - Q3; the dependent variables are not otherwise seasonally adjusted.

1st quarter average changes shown in columns 2-4 are the average of the time effects for all of the Q1's in the sample, with Q4 as the omitted quarter.

CTUMS regressions exclude January from Q1.

Appendix Table 2L. Did 50 Percent Graphic Warnings Change Smoking Behavior Trends?

Each column of the Table displays results from a log price-adjusted smoking behavior regression, differing in terms of smoking behavior measure and indicator variables for sub-periods. The first regression for each indicator has only a constant, time trend (measured in years), province fixed effects (except for national specification), and quarter indicators, and thereby indicates the average annualized seasonally adjusted change over the entire sample period. The other columns add an indicator for the 8 quarters following the introduction of 50 percent graphic warnings interacted with the time trend (see the text for the exact functional form of the interaction), thereby indicating how smoking behavior trended in those 8 quarters relative to a baseline sub-period. A price row is appears in the table to show the magnitude of the price adjustment.

	Log Price-Adjusted Smoking Behavior							
	National		by Province					
	Cigarette Sales per capita		Cigarettes Consumed per capita		Daily Smoking Rate		Smoking Prevalence	
	1994 Q2 - 2004 Q4		1999 Q1 - 2009 Q4					
Sample Period:	Entire Sample	Qtrs except 2001-2	Entire Sample	Qtrs except 2001-2	Entire Sample	Qtrs except 2001-2	Entire Sample	Qtrs except 2001-2
Baseline Period:								
Baseline Trend	-0.005 (2.75)	-0.007 (1.85)	-0.027 (12.84)	-0.030 (7.79)	-0.015 (8.55)	-0.015 (4.92)	-0.008 (4.97)	-0.012 (4.56)
trend 8 qtrs after warnings, relative to baseline trend		0.008 (0.60)		0.012 (0.79)		0.000 (0.03)		0.020 (1.81)
Real Cigarette Price, log	-0.500	-0.500	-0.500	-0.500	-0.400	-0.400	-0.400	-0.400
Adjusted R-squared	0.69	0.68	0.64	0.64	0.58	0.58	0.52	0.53
s.e.	0.0353	0.0355	0.143	0.143	0.121	0.121	0.11	0.11
Smoking behavior source	CANSIM			CTUMS				
Number of Quarters	43			44				
Number of Regions	1			10				

Notes: All regressions include a time trend (in years) and indicator variables for quarter. Province regressions also include province fixed effects.

The absolute value of robust t-statistics are shown in parentheses.

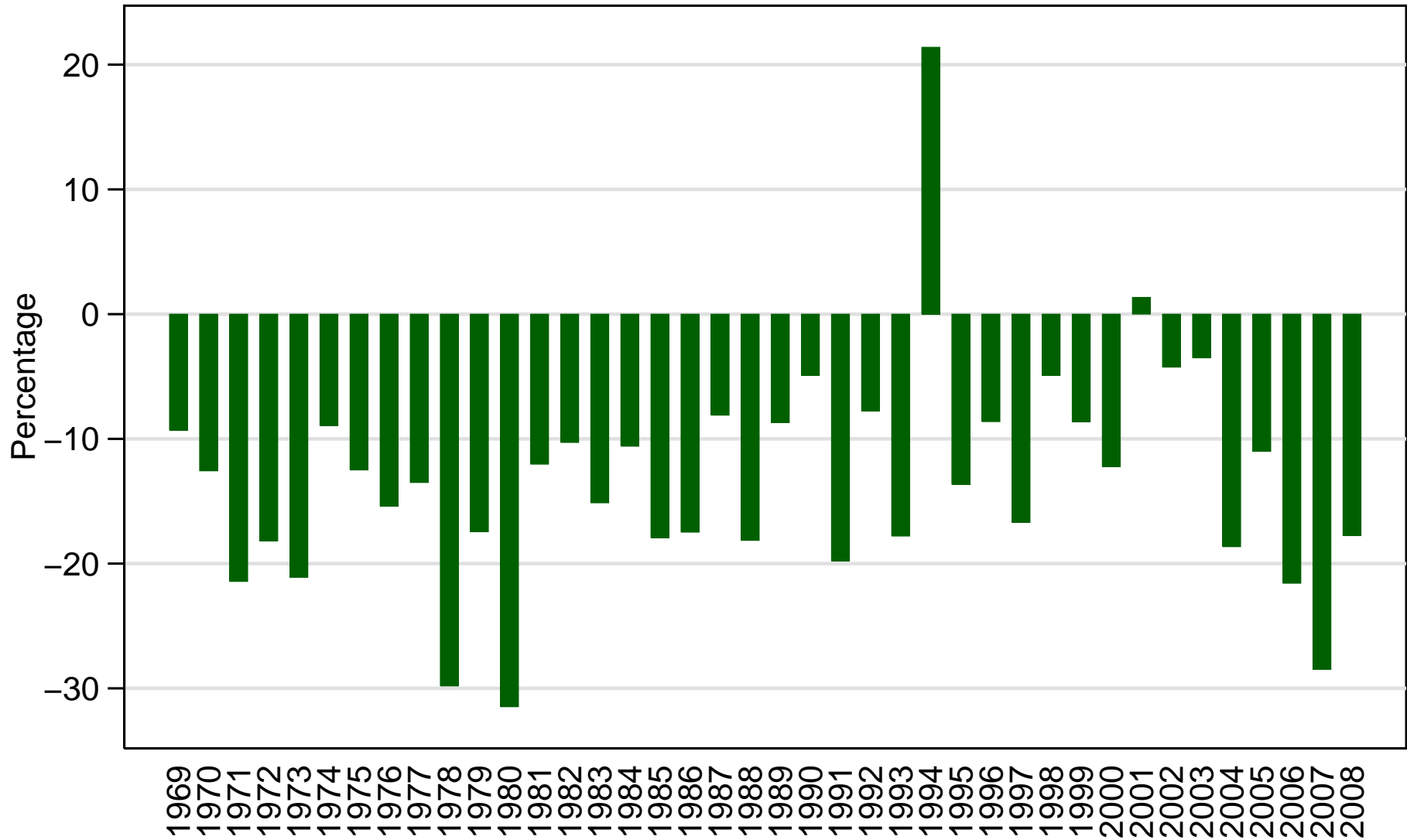
Regressions are estimated with the Prais-Winsten correction for first-order serial correlation.

CTUMS regressions exclude January from Q1.

The 8 quarters after the warnings were introduced are 2001 Q1 - 2002 Q4

Chart 1

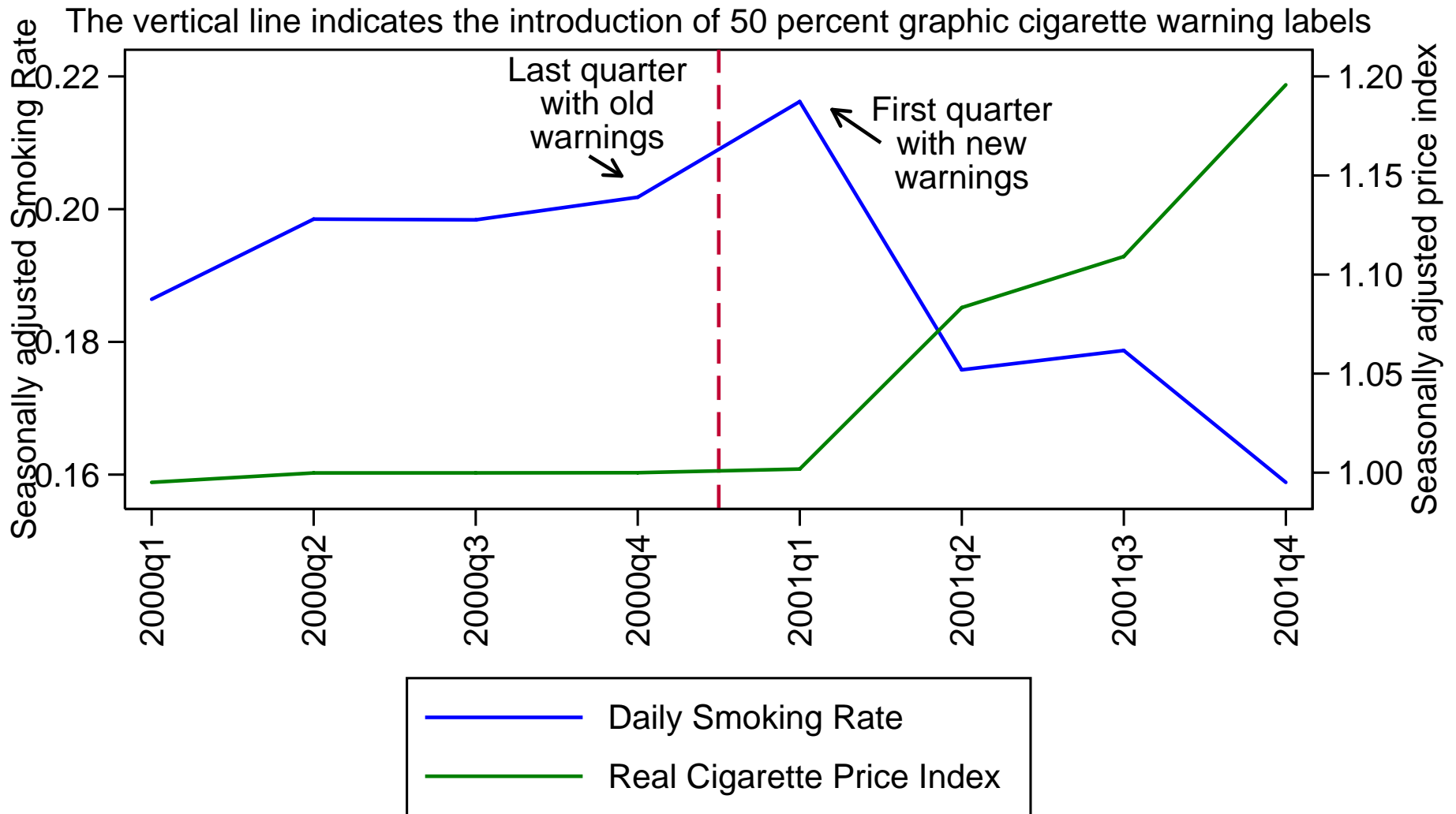
Cigarette Sales Per Week
Change from Last Quarter of Year to First Quarter of Following Year



Source: Statistics Canada

Chart 2

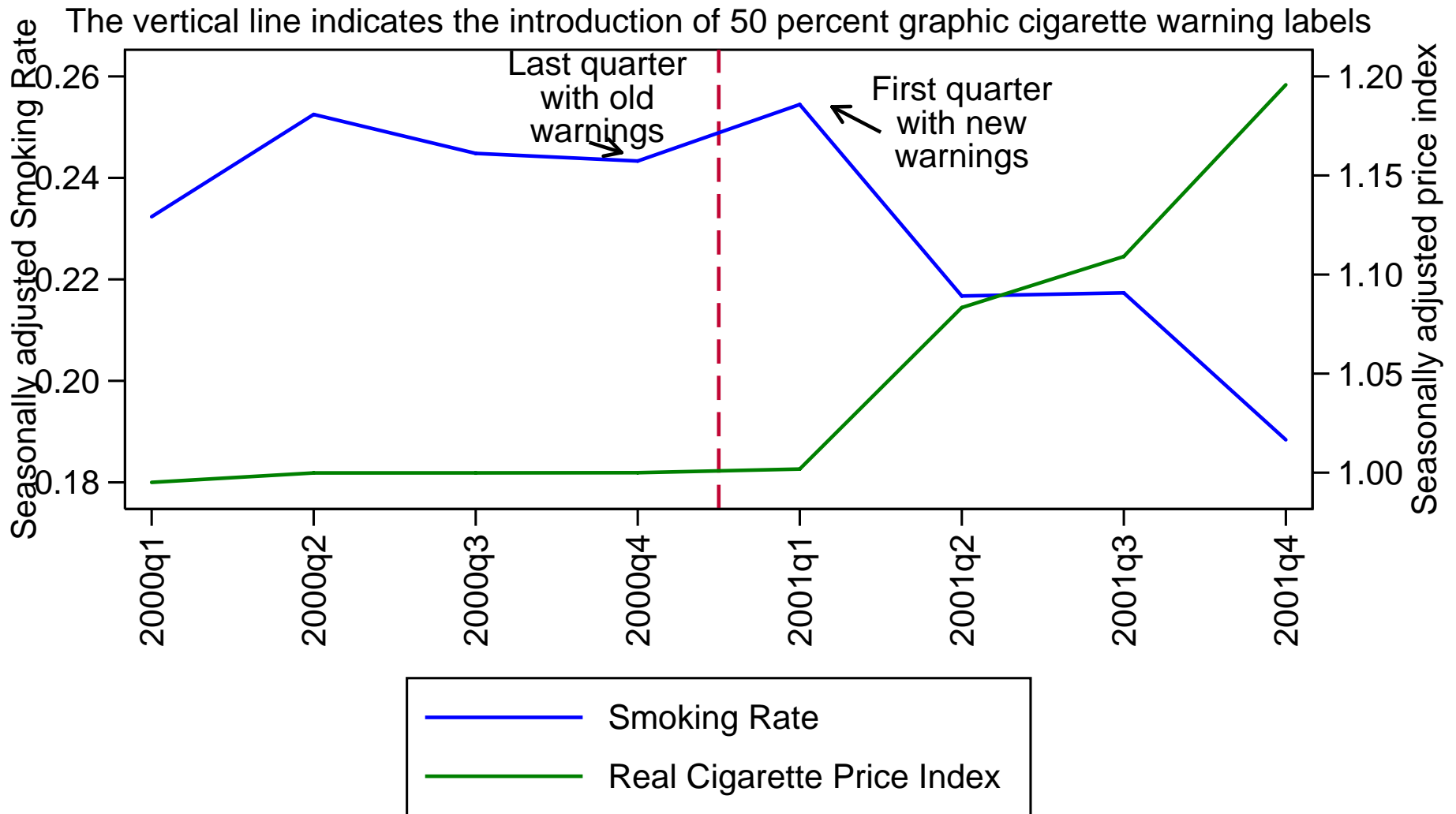
The prevalence of daily smoking and an index for real cigarette prices are shown for the time period 2000 Q1 – 2001 Q4



Source: Statistics Canada, CTUMS.

Chart 3

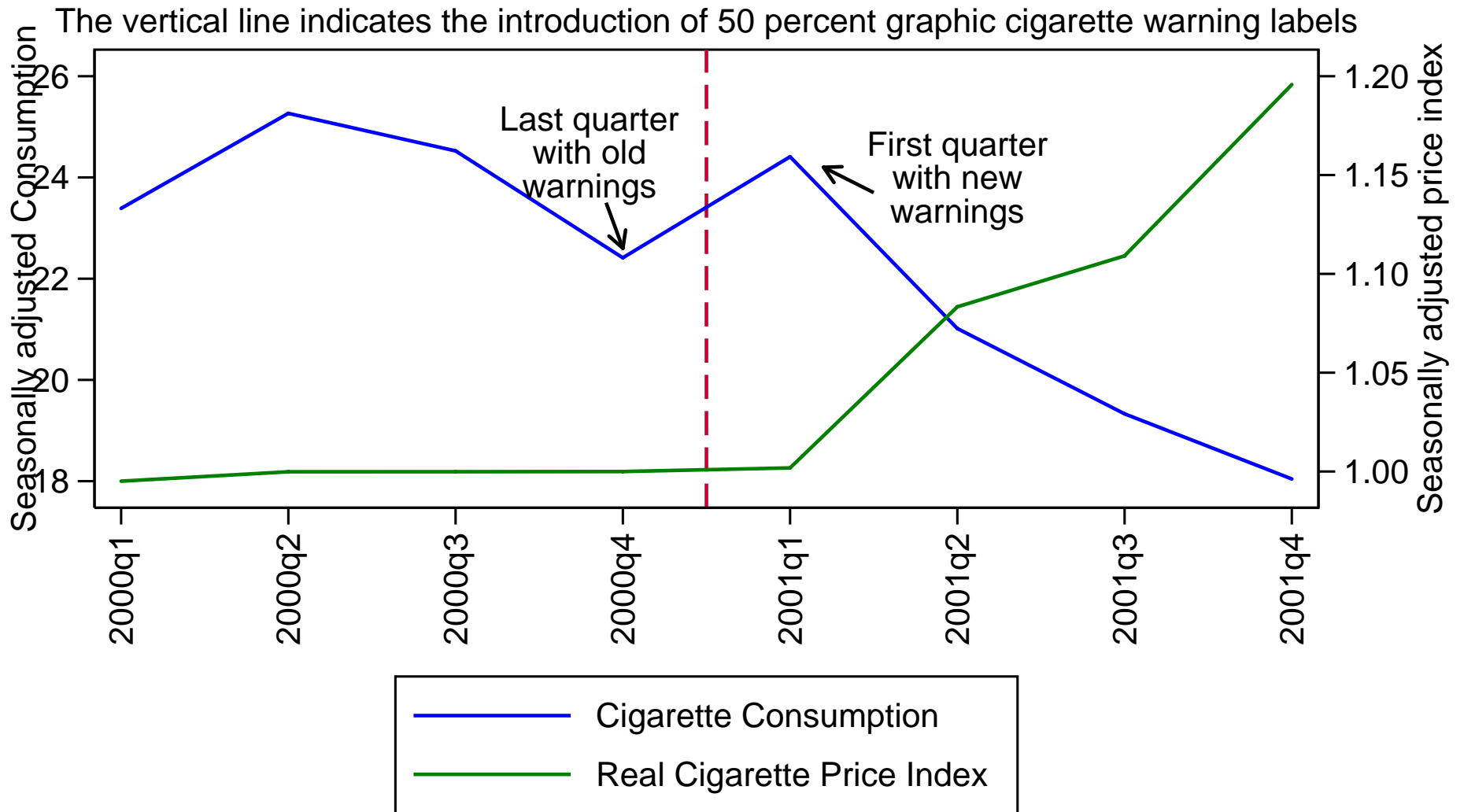
Smoking prevalence and an index for real cigarette prices are shown for the time period 2000 Q1 – 2001 Q4



Source: Statistics Canada, CTUMS.

Chart 4

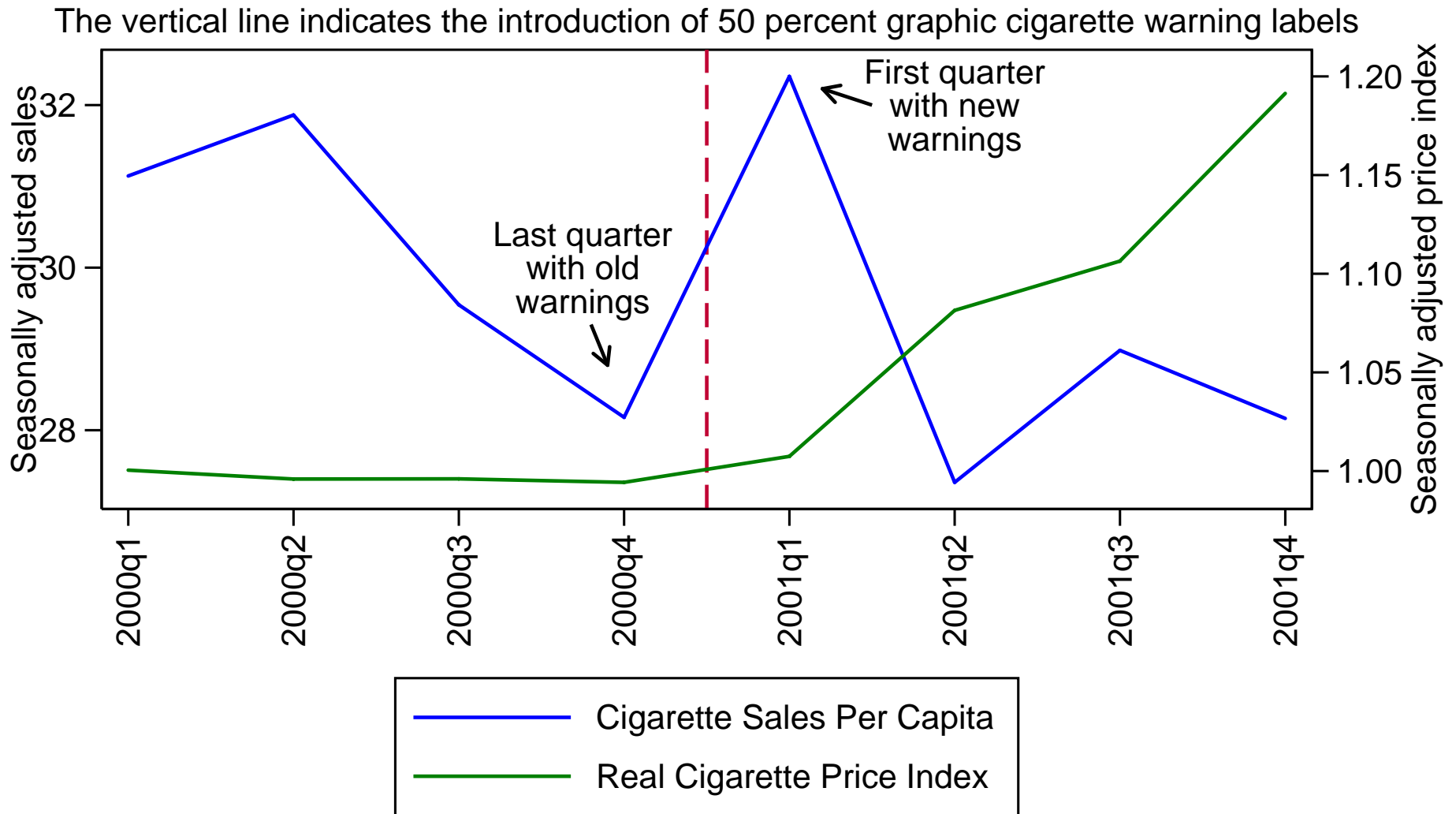
Cigarettes consumed per person per week and an index for real cigarette prices are shown for the time period 2000 Q1 – 2001 Q4



Source: Statistics Canada, CTUMS.

Chart 5

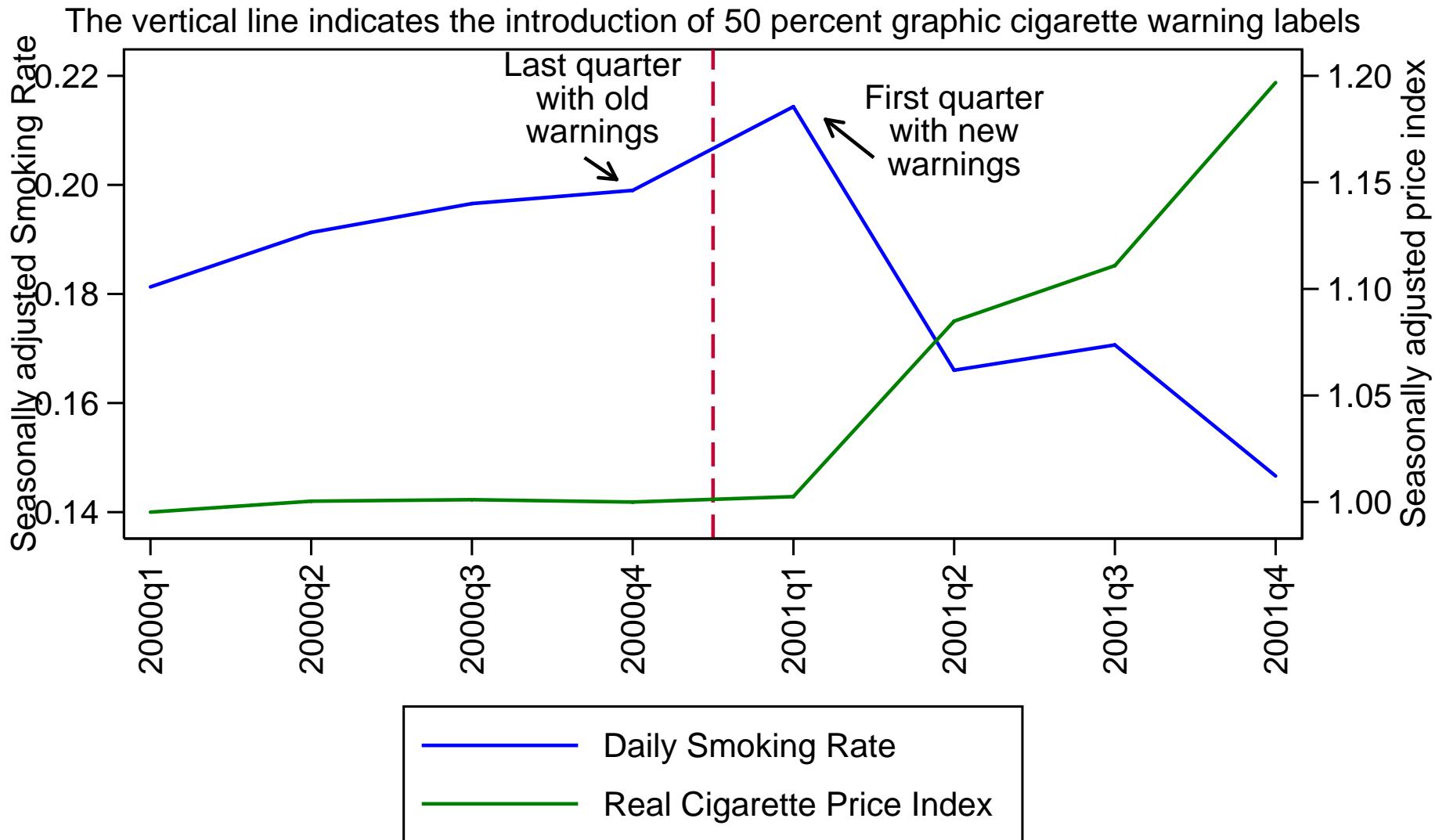
Cigarette sales per person per week and an index for real cigarette prices are shown for the time period 2000 Q1 – 2001 Q4



Source: Statistics Canada.

Chart 2 B

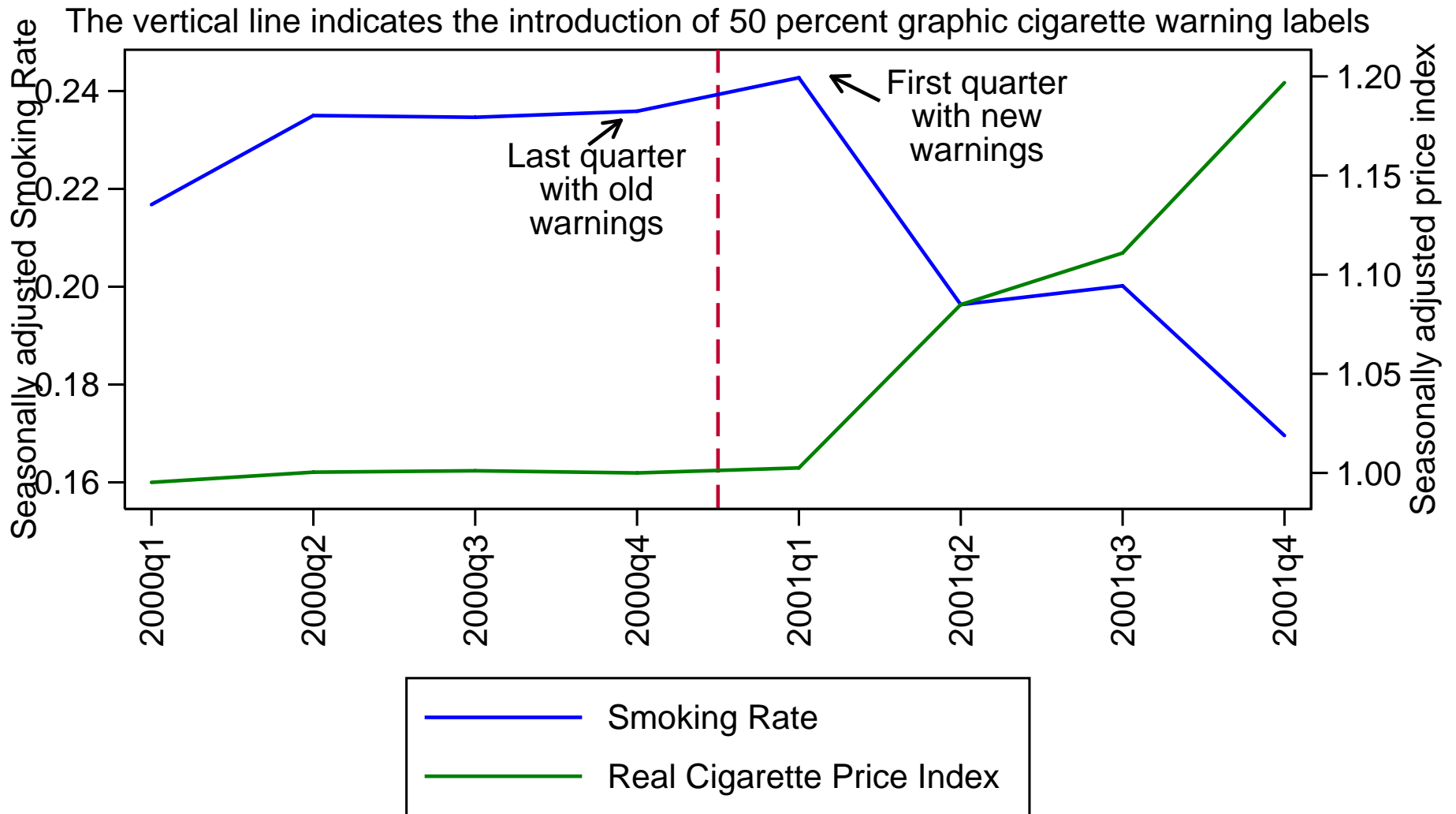
The prevalence of daily smoking and an index for real cigarette prices are shown for the time period 2000 Q1 – 2001 Q4



Source: Statistics Canada, CTUMS. Restricted to persons age 30 and above

Chart 3 B

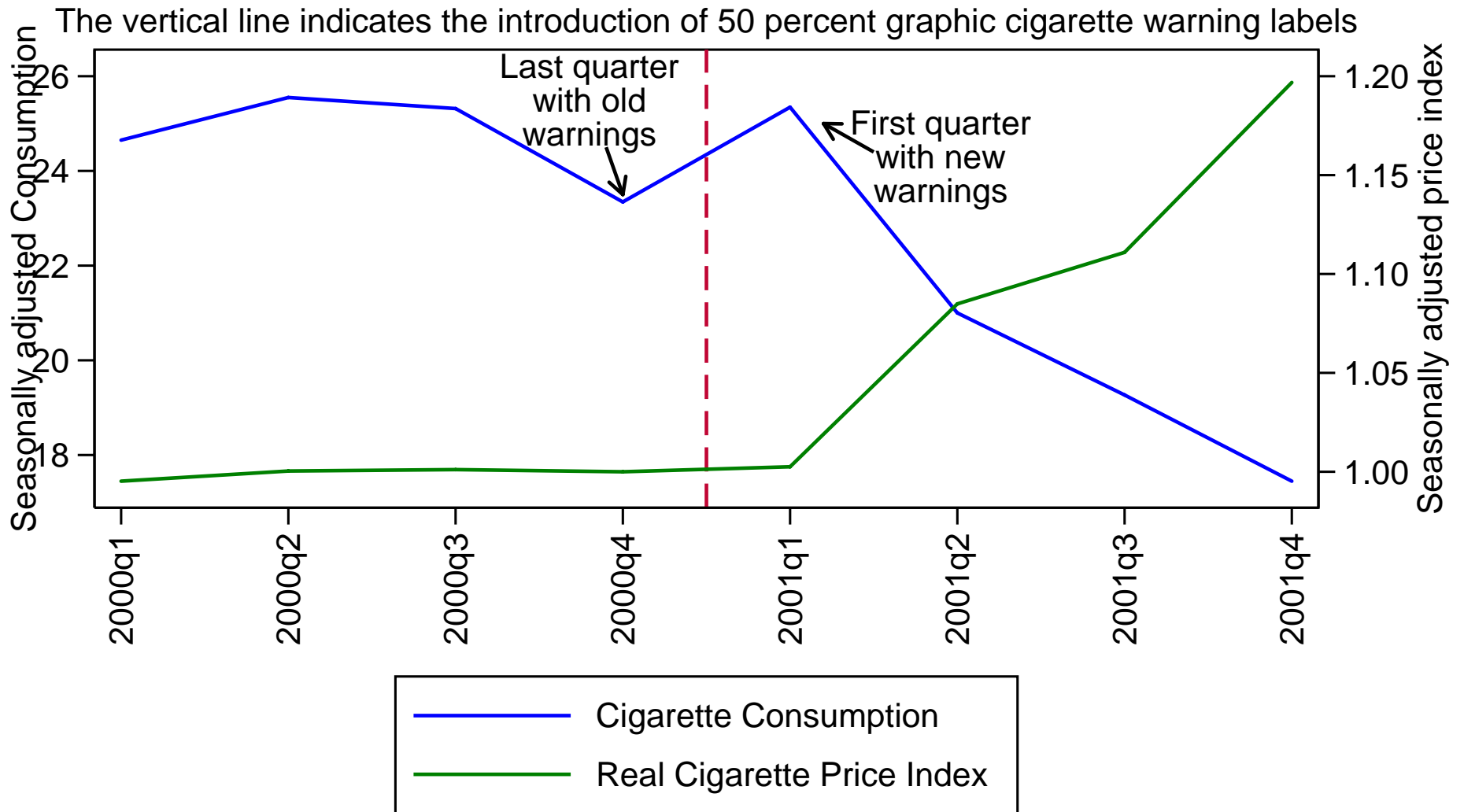
Smoking prevalence and an index for real cigarette prices are shown for the time period 2000 Q1 – 2001 Q4



Source: Statistics Canada, CTUMS. Restricted to persons age 30 and above

Chart 4 B

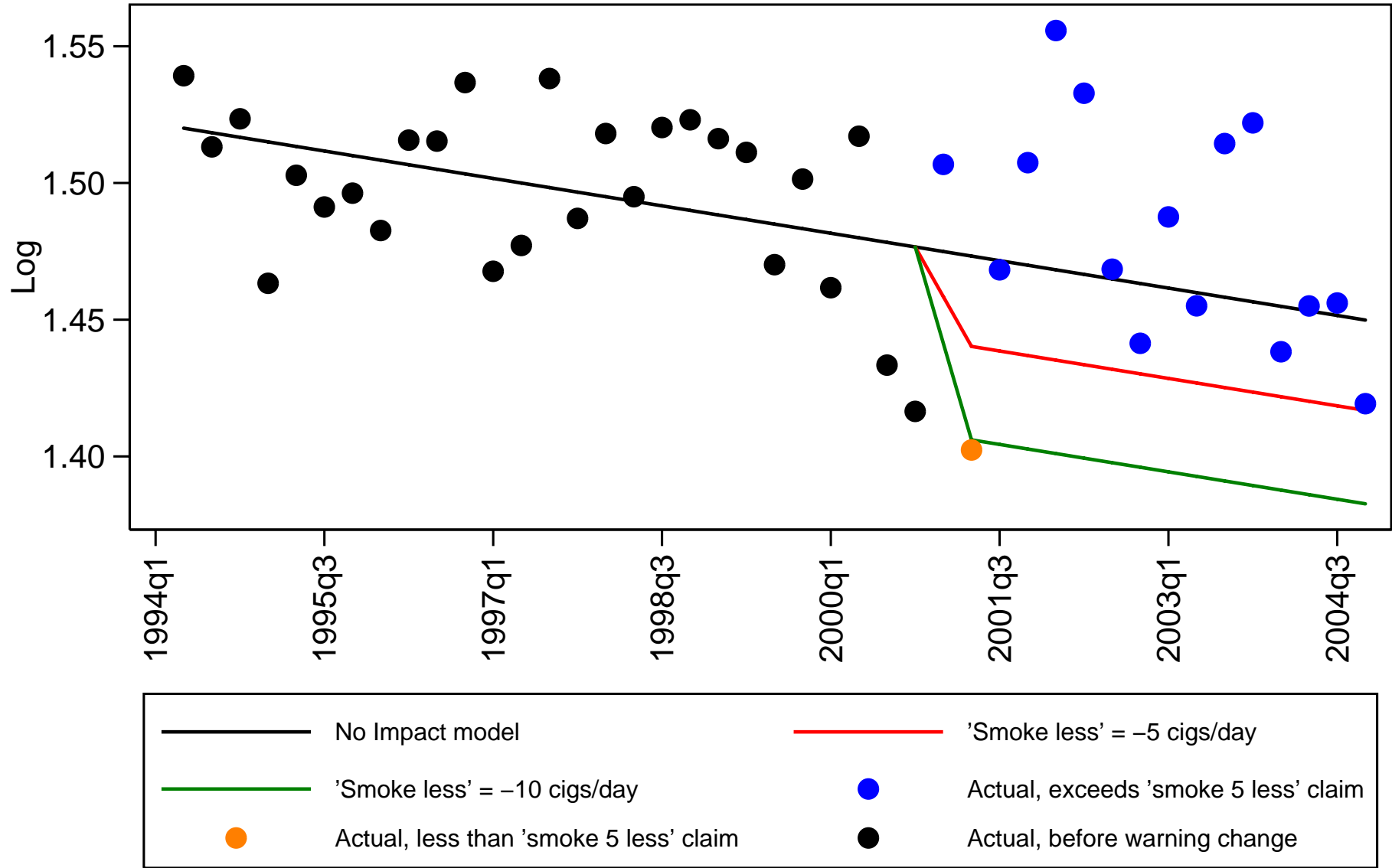
Cigarettes consumed per person per week and an index for real cigarette prices are shown for the time period 2000 Q1 – 2001 Q4



Source: Statistics Canada, CTUMS. Restricted to persons age 30 and above.

Chart 6

Canadian Cigarette Sales Per Capita Adjusted for Prices and Seasonality



Source: Statistics Canada.

Attachment A

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4/11

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Education

Harvard College

B.A. in Economics, June 1991

Magna Cum Laude & Phi Beta Kappa

University of Chicago

Ph.D. in Economics, August 1993

N.S.F. Graduate Fellow and University of
Chicago Century Fellow

Academic Positions Held

07/03 - present	Professor of Economics, Univ. of Chicago
08/99 - present	Research Associate, National Bureau of Economic Research
08/03 - 09/03	Macaulay Distinguished Visiting Professor, Clemson University
07/98 - 06/03	Associate Professor of Economics with Tenure, Univ. of Chicago
07/02 - 12/02	Visiting Associate Professor, Harvard University
01/01 - 04/01	Visiting Associate Professor, Harris School of Public Policy
09/98 - 09/02	Alfred P. Sloan Research Fellow
04/97 - 08/99	Faculty Research Fellow, National Bureau of Economic Research
07/97 - 06/98	Olin Faculty Fellow, Univ. of Chicago.
07/94 - 06/98	Assistant Professor of Economics, Univ. of Chicago.
10/93 - 06/94	Postdoctoral Fellow, Department of Economics, Univ. of Chicago.

Consulting Positions and Affiliations

06/07 - present	Academic Consultant
06/03 - 05/07	Principal, LEAF Group, Chicago, IL.

Books

- *Parental Priorities and Economic Inequality*. University of Chicago Press, 1997.

Published or Forthcoming Academic Papers

- “Social Security and Democracy.” *Contributions to Economic Analysis & Policy*. 10(1), 2010:
Article 18. (with Ricard Gil and Xavier Sala-i-Martin).

- “Is Macroeconomics Off Track?” *Economists’ Voice*. 2009.
- “Is the Treasury Impotent?” *Economists’ Voice*. 5(7), 2008: Article 4.
- “Selection, Investment, and Women’s Relative Wages over Time.” *Quarterly Journal of Economics*. 123(3), August 2008: 1061-1110. (with Yona Rubinstein).
- “Inflation and the Size of Government.” Federal Reserve Bank of St. Louis *Review*. 90(3, Part 2), May/June 2008. (with Song Han).
- “Gary S. Becker (born 1930): Economics’ Iron Man.” *New Palgrave Dictionary of Economics*, 2nd edition, 2008.
- “The Extent of the Market and the Supply of Regulation.” *Quarterly Journal of Economics*. 120(4), November 2005: 1445-73. (with Andrei Shleifer).
- “Conscription as Regulation.” *American Law and Economics Review*. 7(1), Spring 2005: 85-111. (with Andrei Shleifer).
- “Political and Economic Perspectives on Taxes’ Excess Burden.” In Alan J. Auerbach and Kevin Hassett, eds. *Toward Fundamental Tax Reform*. Washington, DC: AEI Press, 2005: 95-105.
- “Public Policies as Specification Errors.” *The Review of Economic Dynamics*. 8(4), October 2005: 902-926.
- “Non-response and Population Representation in the Sloan Study of Adolescent Time Use.” *Electronic International Journal of Time Use Research*. 2(1), 2005: 33-53. (with Barbara Schneider and Rustin Wolfe).
- “Estimating and Imputing Incomes for Middle-Class Families.” in Barbara Schneider and L. J. Waite, eds. *Being Together, Working Apart*. Cambridge: Cambridge University Press, 2005: 491-503. (with Yona Rubinstein)
- “What do Aggregate Consumption Euler Equations Say about the Capital Income Tax Burden?” *American Economic Review: Papers and Proceedings*, May 2004: 166-70.
- “Do Democracies have Different Public Policies than Nondemocracies?” *Journal of Economic Perspectives*. 18(1), Winter 2004: 51-74. (with Ricard Gil and Xavier Sala-i-Martin)
- “Labor Market Search and Optimal Retirement Policy.” *Economic Inquiry*, 42(4), October 2004: 560-71. (with Joydeep Bhattacharya and Robert R. Reed III). Winner of the 2005 Best Article Award.
- “Internationally Common Features of Public Old-Age Pensions, and Their Implications for Models of the Public Sector.” *Advances in Economic Analysis and Policy*. 4(1), 2004: Article 4. (with Xavier Sala-i-Martin)
- “Political and Economic Forces Sustaining Social Security.” *Advanced in Economic Analysis & Policy*. 4(1), 2004: Article 5.
- “Deadweight Costs and the Size of Government.” *Journal of Law and Economics*. 46(2), October 2003: 293-340. (with Gary S. Becker).
- “The Empirical Frequency of a Pivotal Vote.” *Public Choice*. 116(1-2), July 2003: 31-54. (with Charles G. Hunter).
- “Social Spending and Democracy: Some Evidence from South America.” *Estudios de Economica*. 29(1), June 2002: 5-33. (with Ricard Gil)

- “Economic Interpretations of Intergenerational Correlations.” *Journal of Economic Perspectives*. 16(3), Summer 2002: 45-58. (with Nathan D. Grawe)
- “Aggregate Implications of Indivisible Labor.” *Advances in Macroeconomics*. 1(1), 2001: Article 4.
- “Human Capital, Heterogeneity, and Estimated Degrees of Intergenerational Mobility.” *The Economic Journal*. 111, April 2001: 207-43 (with Song Han). Winner of the 2001 *Royal Economic Society Prize* for the “best (non-solicited) article in The Economic Journal.”
- “Extensive Margins and the Demand for Money at Low Interest Rates.” *Journal of Political Economy*. 108(5), October 2000: 961-91 (with Xavier Sala-i-Martin).
- “Measuring Aggregate Human Capital.” *Journal of Economic Growth*. 5(3), September 2000: 215-52 (with Xavier Sala-i-Martin).
- “Galton vs. the Human Capital Approach to Inheritance.” *Journal of Political Economy*. 107(6), Part 2, December 1999: S184-S224.
- “Substitution over Time: Another Look at Life Cycle Labor Supply.” *NBER Macroeconomics Annual 1998*. Volume 13. Cambridge, MA: MIT Press, 1999: 75-134.
- “Pecuniary Incentives to Work in the United States during World War II.” *Journal of Political Economy*. 106(5), October 1998: 1033-77.
- “The Optimum Quantity of Money: Theory and Evidence.” *Journal of Money, Credit and Banking*, November 1997, Part 2: 687-715. (with Xavier Sala-i-Martin)
- “Scale Economies, the Value of Time, and the Demand for Money: Longitudinal Evidence from Firms.” *Journal of Political Economy*. 105(5), October 1997: 1061-79.
- “The Endogenous Determination of Time Preference.” *Quarterly Journal of Economics*. 112(3), August 1997: 729-58. (with Gary S. Becker)
- “A Labor-Income-Based Measure of the Value of Human Capital: An Application to the States of the United States.” *Japan and the World Economy*, 9(2), May 1997: 159-91. (with Xavier Sala-i-Martin).
- “A Structural Analysis of Money Demand with Cross-Section Evidence from Japan.” *Monetary and Economic Studies*, 14(2), December 1996: 53-78 (with Hiroshi Fujiki).
- “Production, Financial Sophistication, and the Demand for Money by Households and Firms.” *Monetary and Economic Studies*. 14(1), July 1996: 65-103 (with Hiroshi Fujiki).
- “Transitional Dynamics in Two-Sector Models of Endogenous Growth.” *Quarterly Journal of Economics*, 108(3), August 1993: 739-73. (with Xavier Sala-i-Martin)
- “U.S. Money Demand: Surprising Cross-Sectional Estimates.” *Brookings Papers on Economic Activity*, 2:1992, 285-343 (with Xavier Sala-i-Martin).

Newspaper Editorials

- “Stop the Stimulus!” *New York Post*. August 9, 2009.
- “Don’t Forgive that Way!” *Chicago Tribune*. December 5, 2008.
- “Fundamental Origins of the Housing Boom and Bust.” *Cato Unbound*. December 5, 2008.
- “An Economy You Can Bank On.” *New York Times*. October 10, 2008. Opinion page.

- “Vote Republican if You Want Equal Pay.” *Wall Street Journal*. September 12, 2008. Opinion page.
- “Trust or Antitrust the AMA?” *Chicago Tribune*. June 15, 2000. Page 29 (with Tomas J. Philipson).
- “Let's Revamp the Tax Code - But How?” *Wall Street Journal*. April 15, 1998. Page A22 (with Gary S. Becker).
- “Government Gets Fat on the Flat Tax.” *Chicago Sun Times*. May 4, 1996. Page 14.
- “Pornography, Profits, and the Internet.” *Chicago Tribune*. Wednesday, June 28, 1995. Section 1, page 19, column 4.
- “Daley, Bears Sack U.S. Treasury.” *Chicago Tribune*. December 13, 1995. Section 1, page 27, columns 2 and 3.
- a weekly column at economix.blogs.nytimes.com since December 2008.

Book Reviews and Published Comments

- Discussion of Gruber and Rauh’s “How Elastic is the Corporate Income Tax Base?” forthcoming in Alan Auerbach, James Hines and Joel Slemrod, eds., *Taxing Corporate Income in the 21st Century*. Cambridge: Cambridge University Press, 2006.
- Review of Laurence S. Seidman’s “Funding Social Security.” *Journal of Economic Literature*. 38(3), September 2000: 659-60.
- Review of Manfred Neumann's “The Rise and Fall of the Wealth of Nations.” *Journal of Economic Literature*. 36(2), June 1998: 953-54.
- Review of Robert E. Hall and Alvin Rabushka's “The Flat Tax,” 2nd edition. *The Money Review*. November 1996: 22-24.

Litigation Expert Testimony and Reports

- Expert Report of Casey B. Mulligan, Ph. D. In RE Public Consultation on the Possible Revision of the Tobacco Products Directive of the European Parliament. December 15, 2010.
- Expert Report of Casey B. Mulligan, Ph. D. In RE Proceedings of the Standing Senate Committee on Social Affairs, Science and Technology, meetings on Bill C-32, An Act to amend the Tobacco Act. September 30, 2009.
- Expert Testimony of Casey B. Mulligan, Ph. D. In RE Enbridge Pipeline Illinois LLC. Illinois Commerce Commission Docket no. 07-0446. July 10, 2008.
- Expert Testimony of Casey B. Mulligan, Ph. D. In RE Enbridge Pipeline Illinois LLC. Illinois Commerce Commission Docket no. 07-0446. April 7, 2008.
- Expert Testimony of Casey B. Mulligan, Ph. D. In RE Enbridge Pipeline Illinois LLC. Illinois Commerce Commission Docket no. 07-0446. January 7, 2008.
- Expert Report of Casey B. Mulligan, Ph. D. In the class action Matter of *Shirley “Rae” Ellis et al. v. Costco Wholesale Corp.* United States District Court, Northern District of California, June 22, 2006.

Non-testifying Expert Consulting

- Modeling of the competitive compensation of creative inputs in the cable television and radio industries for Paul, Weiss, Rifkind, Wharton & Garrison LLP as their counsel to American Society of Composers, Authors and Publishers.
- Declarations of Kevin M. Murphy in the class action *Craft, et al., v. Philip Morris Companies, Inc.* I was a consultant to Professor Murphy on the economics of the cigarette market and excise taxes, for the purpose of preparing his series of declarations and reports in this ongoing matter.
- Expert report of Professor Kevin M. Murphy in the Mechanical and Digital Phonorecord Delivery Rate Adjustment Proceeding. United States Library of Congress, Copyright Royalty Judges, Docket No. 2006-3 CRB DPRA. I was a consultant to Professor Murphy on the economics of the music recording industry, for the purpose of preparing his report.
- Expert reports of Professors Kevin M. Murphy and Robert Topel in the *Dynamic Random Access Memory Antitrust Litigation*. United States District Court, Northern District of California. I was a consultant to Professors Murphy and Topel on the economics of the digital memory chip market, for the purpose of preparing their reports.
- Expert reports of Professor Kevin M. Murphy in the matter of *Novelis Corp. v. Anheuser-Busch, Inc.* United States District Court, Northern District of Ohio. I was a consultant to Professor Murphy on the economics of the aluminum market, for the purpose of preparing his series of reports in this matter.
- Expert reports of Professor Kevin M. Murphy in the in the class action *In Re New Motor Vehicles Canadian Export Antitrust Litigation*. United States District Court, Northern District of Maine. I was a consultant to Professor Murphy on the economics of the automobile market, for the purpose of preparing his series of reports in this matter.
- Expert reports of Professor Kevin M. Murphy in the 2006 NPM Adjustment Proceeding Pursuant to Section IX(d)(1)(C) of the Master Settlement Agreement. I was a consultant to Professor Murphy on the economics of the cigarette market and excise taxes, for the purpose of preparing his series of reports in this matter.
- Expert reports of Professor Kevin M. Murphy in the 2005 NPM Adjustment Proceeding Pursuant to Section IX(d)(1)(C) of the Master Settlement Agreement. I was a consultant to Professor Murphy on the economics of the cigarette market and excise taxes, for the purpose of preparing his series of reports in this matter.
- Expert reports of Professor Kevin M. Murphy in the 2004 NPM Adjustment Proceeding Pursuant to Section IX(d)(1)(C) of the Master Settlement Agreement. I was a consultant to Professor Murphy on the economics of the cigarette market and excise taxes, for the purpose of preparing his series of reports in this matter.
- Expert reports of Professor Kevin M. Murphy in the 2003 NPM Adjustment Proceeding Pursuant to Section IX(d)(1)(C) of the Master Settlement Agreement. I was a consultant to Professor Murphy on the economics of the cigarette market and excise taxes, for the purpose of preparing his series of reports in this matter.
- Declarations of Kevin M. Murphy in the class action *Barbara Schwab et al v. Philip Morris*

USA, Inc., et al. I was a consultant to Professor Murphy on the economics of the cigarette market and excise taxes, for the purpose of preparing his series of declarations and reports in this matter.

- *Work Ethic and Family Background.* A Report prepared for the Employment Policies Institute. April, 1997.
- Other confidential litigation matters related to the automobile, health care, consumer packaged goods, finance, petroleum, and tobacco industries.
- Other confidential matters related to the labor market, computer software industry, and the finance industry.

Other Public Sector Consulting

- *Central Bank of the Dominican Republic.* A series of public lectures on public policy reform. A series of training lectures for Central Bank economists on modern macroeconomic theory. September 2001.
- *Congressional Budget Office.* Lecture on the “Capital Income Tax Incidence” and consulting on CBO modeling of the economics effects of corporate taxes. November 2004.