

**An Economic Analysis of Health Warning Labels on Cigarette Packets in Hong Kong**

Report of Kevin K. Tsui, Ph.D. and Kwok Ping Tsang, Ph.D.

June 25, 2015

**I. Executive Summary**

The size of health warnings displayed on cigarette packets sold in Hong Kong has been increasing over time. Given the lack of studies that examine the statistical relationship between the size of health warning labels and smoking behavior in Hong Kong, we have examined publicly available data on smoking prevalence in Hong Kong over 1982-2012.

If larger warning labels affected smoking prevalence, then all else equal smoking rates should decline faster after the size of warning labels is increased. The data suggest otherwise. The pre-existing trend of smoking rates — the percentage of people of a given age group who smoke daily — did not change after the size of warning labels was first mandated in 1994, became larger in 2000, and then larger and graphical in 2007. We have also compared changes in smoking prevalence in Hong Kong and the U.S. over the period when there was no U.S. legislation mandating the size of health warning labels. Once again, we find no significant difference between the trend in smoking prevalence in Hong Kong and that in the U.S.

While regulations on health warning labels are ineffective in reducing smoking prevalence, standard economic analysis suggests that large health warning labels may have an unintended consequence of creating market entry barriers. A close-to-100% warning label makes it harder for consumers to distinguish one brand from another. As a result, the regulation may lead to down-trading because it discourages non-price competition, and hence in the long run more smokers may be induced to switch to relatively lower quality, lower price, or even illicit products.

## II. Qualifications

The authors of this report are economists who specialize in the statistical analysis and interpretation of data, among other things. Our curricular vitae are presented in Attachment A, and we briefly describe our qualifications here.

Dr. Kevin K. Tsui is an Associate Professor of Economics at the Clemson University, where he has taught since 2006. He teaches graduate and undergraduate level economics courses that cover a variety of topics, including taxation, regulation, consumer behavior, industrial organization, and environmental economics. In addition to his position at Clemson University, Tsui is also the Director of ECON3.0 Limited, a consulting company that provides economic advice on regulatory matters and pricing strategies. Tsui earned a doctorate degree in economics from the University of Chicago in 2006. Prior to that, he received his bachelor's degree in mathematics from the Hong Kong University of Science and Technology in 1995. Tsui has published more than ten articles on a variety of topics in economics. Those articles have been published in leading scholarly journals, including the *American Economic Journal: Macroeconomics*, the *Economic Journal*, the *Economic Theory*, the *Energy Policy*, the *Journal of Financial Intermediation*, the *Journal of Public Economics*, and the *Journal of Law and Economics*. He was a visiting fellow of the Hong Kong Institute for Monetary Research. Recently, Tsui was awarded the Lone Mountain Fellowship from the Property and Environmental Research Center, and the Krutilla Fellowship from the Resource for the Future.

Dr. Kwok Ping Tsang is an Associate Professor of Economics at Virginia Tech, where he has taught since 2008. He teaches graduate and undergraduate level economics courses on macroeconomics and managerial economics. In addition to his position at Virginia Tech, Tsang is also the Director of ECON3.0 Limited, a consulting company that provides economic advice on regulatory matters and pricing strategies. Tsang earned a doctorate degree in economics from the University of Washington in 2008, with a focus on time series and macroeconomics. Prior to that, he received his bachelor's degree in economics and finance from the University of Hong Kong in 2003. Tsang has published more than ten articles on several empirical topics in economics. Those articles have been published in leading scholarly journals, including the *Review of Economics and Statistics*, *Journal of Money, Credit and Banking*, *China Economic Review*, *Journal of Housing Economics*, and *Pacific Economic Review*. He is also the co-editor

of a top policy journal *Contemporary Economic Policy*. He was a visiting fellow of the Hong Kong Institute for Monetary Research and a visiting scholar at Academia Sinica (Taipei).

### **III. Assignment and Summary of Opinions**

We were asked to provide the Coalition on Tobacco Affairs with our opinion on the statistical effects of a larger health warning on smoking prevalence in Hong Kong and the recent proposal by the Department of Health that “the area of the graphic health warning shall be of a size that covers at least 85% of two largest surfaces of the packet and of the retail container.”

The current Smoking (Public Health) Ordinance stipulates that the size of the health warnings and messages should cover at least 50% of the surface of packet or retail container of cigarettes, cigar, pipe tobacco and cigarette tobacco. Recently, Hong Kong’s Department of Health has proposed to increase the size of health warnings to at least 85%, a figure significantly higher than the “no less than 30%” required by the WHO Framework Convention on Tobacco Control.<sup>1</sup>

Scientific evidence accumulated since the 1950s shows that cigarette smoking causes serious health problems, and we agree that society can delegate power to the government to promote public health. However, using data collected by the Census and Statistics Department, our empirical analysis suggests that larger graphic cigarette warning labels are ineffective in reducing smoking prevalence in Hong Kong. As such, attempts to regulate the size of health warnings displayed on cigarette packets are likely to distract policy attention from other potentially more effective means of improving public health.

In addition, an unintended consequence of such an ineffective regulation, according to a standard economic argument, is to create entry barriers to the industry that reduce non-price competition in the long run, because a close-to-100% warning label makes it harder for consumers to distinguish one brand from another. When it is increasingly difficult for more innovative products to enter the market as the size of health warning labels expands significantly

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<sup>1</sup> According to the WHO Framework Convention on Tobacco Control, “[t]hese warnings and messages should be 50% or more of the principal display areas but shall be no less than 30% of the principal display areas.” Indeed, among all 34 OECD countries, more than 85% of them have mandated warning labels smaller than what is currently required in Hong Kong.

beyond 50%, smokers are more likely to switch to consume relatively lower quality, lower price, and/or illicit products.

#### **IV. An Examination of the Effect of Health Warning Labels in Hong Kong Confirms that the Pre-existing Trend of Smoking Rates Did Not Change After Health Warning Labels Became Larger**

In the recent *R.J. Reynolds Tobacco Co. v. FDA* case, the court said, “FDA claims that Canadian national survey data suggest that graphic warnings may reduce smoking rates. But the strength of the evidence is underwhelming, making FDA’s claim somewhat misleading.” Indeed, after a careful review of the literature, we find that diverse studies from other countries on the impact of health warning labels on smoking behavior may not directly apply to Hong Kong. We are not aware of any statistical analysis conducted by the Department of Health on the relationship between the size of health warning labels and smoking prevalence. To predict whether a further increase in the size of health warning labels from 50% to 85% of the front and back of cigarette packet can help reduce smoking prevalence in Hong Kong, we first examine the effects of similar policy changes in the past.

Although warning labels were required on cigarette packets in Hong Kong before the 1990s, it was not until 1994 that legislation began to mandate the size of warning labels as a certain percentage of the cigarette packet surface. According to Paragraph 3(5) of the Smoking (Public Health) (Notices) Order 1982, for example, “[t]he area within which any health warning or tar group designation is displayed shall be rectangular in shape, as indicated in the Schedule and, although reasonable variations in the dimensions of the area shall be permissible, the sides of the area, and any line demarcating such sides shall not touch any letter or character within the area.”

In 1992, an amendment to the Smoking (Public Health) (Notices) Order required that the warning labels occupy no less than 20% of the surface of the area. The amendment was put into effect on 1 January 1994.

In 1999, another amendment was introduced so that “[t]he area containing the health warning and indication of tar and nicotine yields referred to in sub-subparagraph (a) or (b) shall measure 50 mm x 24 mm.” Accordingly, we estimate that the size of health warning mandated

by the order effective on 16 July 2000 to occupy 25-30% of the packet, depending on the size of the packet.

In 2006, the size of the warning labels was modified again according to the following: “The Chinese or English version of the health warning and indication of tar and nicotine yields shall be of a size that covers at least 50% of the area of the surface on which that version appears.” The 50% graphic warnings requirement came into effect on 27 October 2007. There has been no change in the requirement since then.

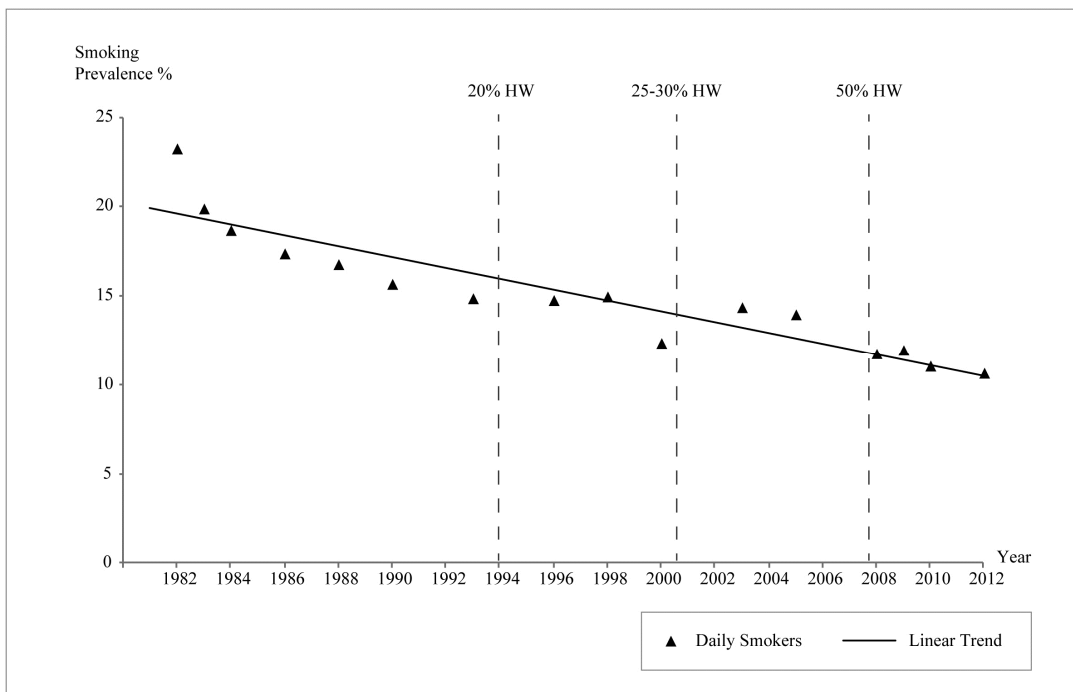
We use data from various issues of the Thematic Household Survey Reports and General Household Surveys to study how smoking prevalence changed over the 1982-2012 period. Figure 1 shows how daily smoking rates — the percentage of population of age 15 and above who smoke daily — declined gradually over time. It is interesting to note that some of the most significant drops in smoking prevalence occurred in the absence of changes in the health warnings requirement. For example, one possible explanation of the decrease in smoking prevalence from 23.3% in 1982 to 19.9% in 1983 is perhaps the drastic 300% increase in tobacco exercise tax in 1983, although we should emphasize that a more detailed analysis needs to be conducted before we can give a definitive answer to the true underlying causes of the decline in smoking rates.

Note that smoking prevalence essentially remained constant over the 1993-1996 period, despite the “20% health warnings” regulation that was mandated in 1994. Given the overall downward trend in smoking prevalence, the relatively stable daily smoking rates before and after the introduction of mandated size of warning labels on cigarette packets suggest that the requirement did not help reduce smoking prevalence in Hong Kong. Interestingly, even four years after the introduction of the regulation, smoking prevalence still failed to decline, which also refutes the argument that there may be a few years time lag for smokers to respond.

At first glance, one may suspect the decline of smoking rates from 15% in 1998 to 12.4% in 2000 may be explained by the increase in the size of warning labels from 20% to 25-30% in

2000.<sup>2</sup> However, even if we ignore the possibility that the dip was driven by sampling error, we think the slowdown of the economy during the late 1990s may provide a more plausible explanation, because smoking prevalence gradually rebounded with the economy.

**Figure 1: Smoking Prevalence and Health Warning Labels in Hong Kong**



Source: Thematic Household Survey Reports and General Household Surveys

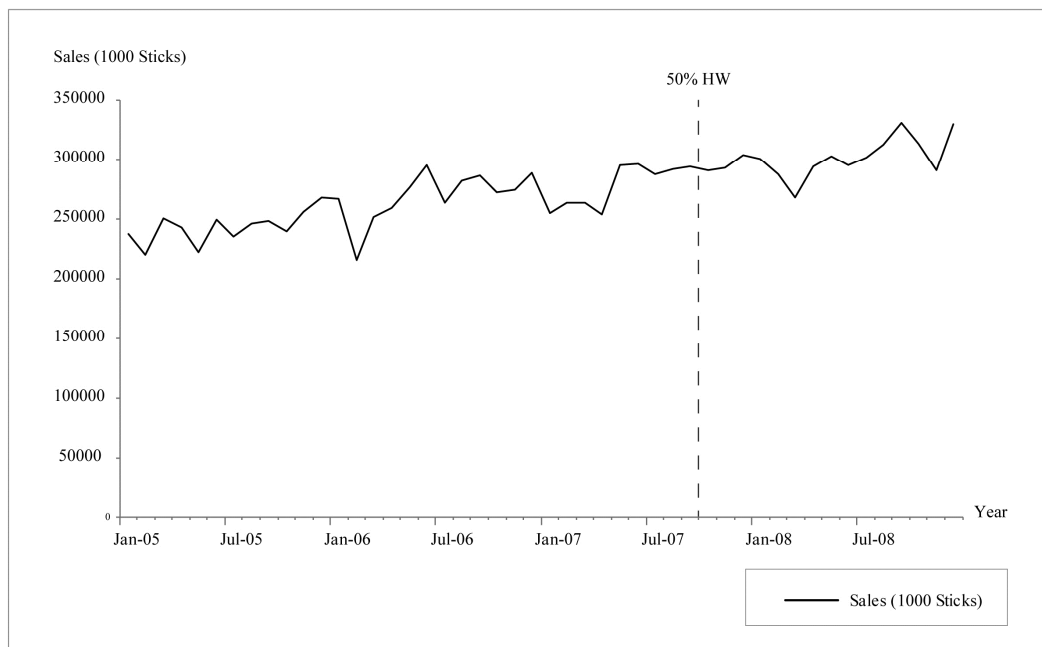
One may also suspect that the increase in the size of warning labels from 20% to 50% in 2007 explains the decline in smoking rates from 14% in 2005 to 11.8% in 2008. We do not think this is a plausible explanation. First, it should be noted that the 2008 smoking data were collected between December 2007 and March 2008, which is only about between one to four months after the “50% health warnings” was enforced. Second, we conjecture a more plausible explanation for the decline observed in the 2008 data may be the significant expansion of the smoking ban to include indoor workplaces and most public places (including restaurants, Internet cafés, public lavatories, beaches and most public parks) that came into force on 1 January 2007, more than 10

<sup>2</sup> Note that this increase in the size of health warning came into effect on 16 July 2000, whereas the smoking prevalence data were collected during October and November of 2000, only a few months after the new regulation became effective.

months before the increase in the size of warning labels. Third, allowing for two years to observe any impact of the “50% health warnings” rule, the data show that between the beginning of 2008 and the end of 2009 daily smoking rates essentially remained unchanged. Fourth, in Appendix A, our regression analysis provides estimates that are consistent with the conclusion that there is no evidence of the three changes in health warnings requirement having any discernable effects on smoking prevalence in Hong Kong.

To further strengthen our analysis, we also examine monthly cigarette sales data compiled by the tobacco manufacturers over the period of 2005-2008. Once again, Figure 2 shows that no structural break is observed immediately before and after the “50% health warnings” rule was enforced. The increase in the size of warning labels also did not appear to change the slight upward trend in cigarette sales, which may be driven by the increase in the number of tourists visiting Hong Kong over the sample period. Given that sales of cigarettes did not decline after the change in regulation, and population changes aside, some smokers had to increase their consumption significantly after the change if the regulation induced some smokers to quit!

**Figure 2: Monthly Sales of Cigarette Before and After the 50% Health Warnings**



Source: Industrial data provided by PMI, BAT, JT and Nanyang Brothers

Overall, time series evidence based on data on smoking prevalence and cigarette sales do not support the hypothesis that larger health warning labels discourage smoking.

#### **V. Comparing the Data of Hong Kong with Those of the U.S. Indicates That There is No Significant Difference Between the Trend in Smoking Prevalence in the Two Markets After Health Warning Labels Became Larger in Hong Kong But Not in the U.S.**

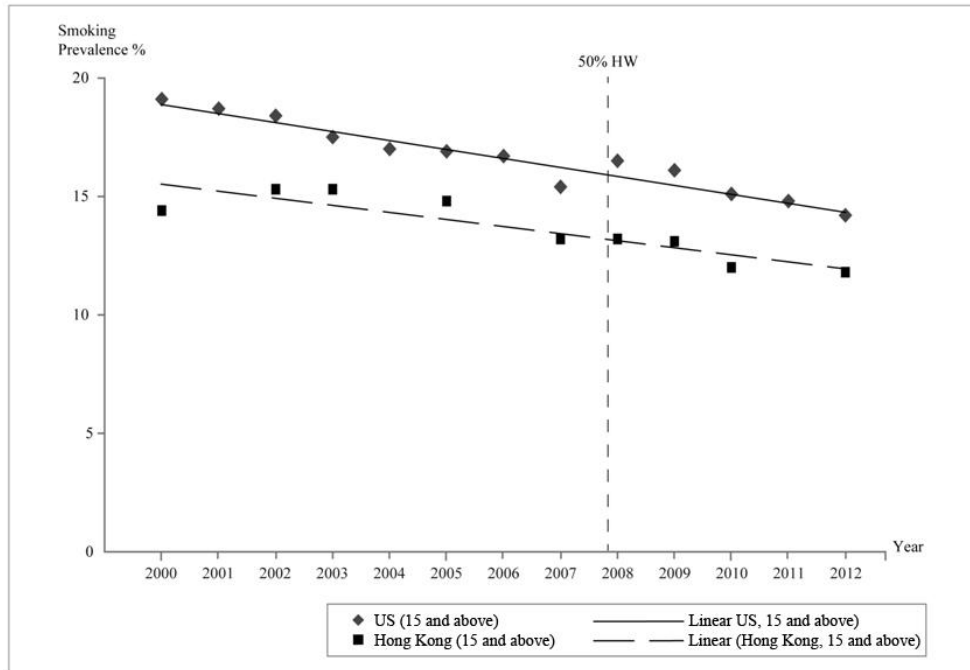
Even though there are intrinsic difficulties in comparisons across markets, the differences between warning labels on cigarette packets in Hong Kong and the United States provide another basis for understanding how the “50% health warnings” rule affected smoking prevalence in Hong Kong.

As early as the 1980s, warning messages were mandated in the U.S., but there was no regulation on the size of the warning labels. Indeed, until 2009, no U.S. legislation regarding warning labels mandated the size of the labels as a percentage of the surface of the cigarette packet, and the warnings typically have occupied about 5% of the surface on the side of the packet. Graphic health warnings of 50% of the surface of the cigarette packet are required under the Family Smoking Prevention and Tobacco Control Act passed by Congress in June 2009. The passage of the new regulation was followed by a series of lawsuits. Throughout our sample period, therefore, the mandatory warning labels had not been enforced.

Figure 3 illustrates that, despite the significant increase in the size of warning labels in Hong Kong during late 2007, the downward trend in smoking prevalence in Hong Kong is strikingly similar to the one in the U.S. over the period 2000-2012. In Appendix B when we compare the smoking rates between Hong Kong and the U.S. over the entire period from 1980 to 2012, the downward trend is indeed more pronounced in the U.S. than in Hong Kong. According to the tobacco price index data (relative to general CPI), the real price of cigarettes in Hong Kong has increased relative to that of the U.S. over the sample period, which makes it even less plausible that the health warnings requirement sped up the long-term declining trend.



**Figure 3: Smoking Prevalence in Hong Kong and the U.S. Before and After the 50% Health Warnings**



Sources: OECD health statistics; Hong Kong Census and Statistics Department

Finally, in Appendix B, we also provide additional statistical analysis that compares the smoking prevalence in the U.S. and Canada, with the latter country having much more restrictive legislation on health warning labels similar to Hong Kong over the 2001-2012 period. We find that smoking prevalence is somewhat higher in Canada than in the U.S., despite having a higher real price of cigarettes and stricter requirements on health warning labels. Over the sample period, the Canadian regulations on health warnings are similar to those in effect in Hong Kong today: 50% of the packet must be covered with warning messages and graphic images. Once again, the empirical evidence casts doubt on the health impact of the current regulation on health warnings.

**VI. Standard Economic Analysis suggests that a Close-to-100% Warning Label Tends to Reduce Competition and Hence Smokers are Likely Switch to Relatively Lower Quality, Lower Price, and/or Illicit Products in the Long Run**

Our empirical analysis indicates that increasing the size of warning labels did not help reduce smoking prevalence in Hong Kong. Given the limited resources of the government, such an ineffective policy is likely to distract policy attention from other potentially more effective means of public health improvement. Worse still, according to standard economic theory, a close-to-100% warning label may have an unintended consequence of creating entry barriers to the industry, which hurt consumers in the long run. One major difference between a 50%- and an 85%- graphic warnings is that the space to display the branding is shrunk dramatically. In practice, it makes it harder for consumers to distinguish one brand from another when they look from a distance at packets of cigarettes in a display.

It is well known that consumers are willing to pay a higher price for brand-name products than for products that do not carry an established brand name. Such a brand-name premium for a seemingly identical product may appear to be economically wasteful. However, the elimination of all product differentiation in the Soviet Union following the 1917 Communist revolution and the significant decline in product quality afterwards reminds economists that branding is one of the factors that affects quality maintenance in a seller's market (Marshall, 1960). Economists now understand that the price premium paid for branded products facilitates market exchange, because a company that creates an established brand for which it can charge higher prices knows that if it supplies low-quality products it will lose the stream of income from the future price premium it would otherwise have earned (Klein and Leffler, 1981). As a corollary, one consequence of increasing the cost of consumers to distinguish one brand from another is down-trading — consumers switching to relatively lower quality, lower price, and/or even illicit products.

Firms with strong brand reputation can deter the entry of competitors (Schmalensee, 1978). New firms, on the other hand, could be deterred by high costs of establishing their brand and therefore would not enter the market at all (Sutton, 1991). When consumers can no longer distinguish one brand from another, incumbent firms with strong brand reputation remain unchallenged, because the costs of establishing a new brand become prohibitive. In general, firms that invest more in branding also invest more in innovation. For instance, brand capital provides incumbent firms in beer, soft drink, and coffee industries strong incentives to innovate when they are facing threats of entry (Thomas, 1995). When regulations weaken the entry threat

in the cigarette industry, economic analysis suggests that some incumbent firms may have less incentive to innovate higher-quality products. In our case, therefore, a further increase in the size of warning labels may eventually result in down-trading — smokers switching to consume relatively lower quality, lower price, or even illicit products.

Finally, we also note that competition authorities around the world see trademark protection as complementary to and supportive of innovation and competition. As the size of warning labels keeps increasing, regulations of cigarettes could eventually result in legal disputes regarding limiting or prohibiting the use of trademarks and geographical indications on tobacco products.<sup>3</sup>

## **VII. Conclusion: Our Analysis does not Support the Hypothesis that an Increase in the Warnings Displayed on Cigarette Packets Discourages Smoking in Hong Kong**

We have found that neither the introduction of regulation that mandates the size of the health warnings at the beginning of 1994 nor the later expansions around the middle of 2000 and near the end of 2007 played any discernible role in the decline of smoking rates in Hong Kong. Rather, a careful examination of the evidence available has led us to conclude that perhaps a more plausible explanation for the fall in smoking prevalence observed in the late 1990s may be the economic downturn, because smoking rates rebounded back to the trend as the economy recovered. Similarly, we think the drop in smoking prevalence observed in early 2008 may have been driven by partly the long-term downward trend in smoking prevalence and partly the implementation of smoking ban in all indoor workplaces and public areas in early 2007, rather than the increase in the size of warning labels. More rigorous econometrics analysis confirms our interpretation of the data. Furthermore, similar downward trend in smoking prevalence is also observed in the U.S., where the size of warning labels was not regulated over the same period.

Our analysis does not support the hypothesis that an increase in the size of warnings displayed on cigarette packets discourages smoking in Hong Kong. Understanding the true determinants of smoking prevalence in Hong Kong is important, because a misguided policy direction is likely to distract policy attention from other potentially more effective tobacco

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<sup>3</sup> [https://www.wto.org/english/news\\_e/news14\\_e/timelinetobacco\\_e.pdf](https://www.wto.org/english/news_e/news14_e/timelinetobacco_e.pdf)

control policies that actually improve public health. Even worse, an unintended consequence of expanding the size of health warning labels significantly beyond 50% will be creating entry barriers to the industry, because it makes it harder for consumers to distinguish one brand from another. As a result, the regulation will discourage non-price competition, and the lack of non-price competition may eventually induce consumers to switch to illicit products.

For these reasons, we conclude that the proposal that “the area of the graphic health warning shall be of a size that covers at least 85% of two largest surfaces of the packet and of the retail container” will bring no health benefit to the society, and it is likely to hurt competition and reduce what economists call “consumer benefit” in the long run.

### VIII. Appendix A: Regression Analysis Using Hong Kong Data

We obtain smoking prevalence data from the General Household Surveys and Thematic Household Survey Reports for 15 years over the period 1982-2012 (the survey was not carried out every year). We divide the data into 12 groups for age 15-19, 20-29, 30-39, 40-49, 50-59, and 60 and above, separately for male and female. Indexing the group by  $i$  and year by  $t$ , we run the following regressions:

$$Prevalence_{it} = \alpha_i + \beta_1 20\%_Rule_t + \beta_2 30\%_Rule_t + \beta_3 50\%_Rule_t + \theta Year_t + \gamma Price_t + \epsilon_{it}$$

For the purpose of the regression analysis, the variable  $20\%_Rule$  has a value of 0 for the years before the change in the health warnings requirement in 1994 and has a value of 1 on and after 1996 (we do not have data for 1994 and 1995); the variable  $30\%_Rule$  has a value of 0 for the years before the change in health warnings requirement in 2000 and has a value of 1 on and after 2000; the variable  $50\%_Rule$  has a value of 0 for the years before the change in health warnings requirement in 2006 and has a value of 1 on and after 2008 (we do not have data for 2006 and 2007). The three parameters  $\beta_1$ ,  $\beta_2$  and  $\beta_3$  measure the permanent impact of the warning labels regulations on smoking prevalence. The variable  $Year_t$  is a linear time trend, and  $Price_t$  is log real price of tobacco (the price index of tobacco deflated by the general CPI). Each group is allowed to have its own intercept  $\alpha_i$ .

As we can see from column 1 of the Table below, when using only a linear time trend, all the three health warnings regulations have the “wrong” sign, although only the one that raises the size of the warning labels from 20% to 25-30% is statistically significant. For example, the positive point estimate of 0.740 for the “50% health warnings” coefficient suggests that larger health warning labels increases, rather than decreases, smoking prevalence. But the corresponding standard error of 1.669, which is almost double the size of the point estimate, indicates that the estimate is not statistically different from zero.

Allowing for a downward but flattening time trend (quadratic), column 2 shows that the introduction of mandated health warnings and the first time increase in the size of warning labels still have the “wrong” sign, although none of them are statistically different from zero. The point estimate of the “50% health warnings” may lead one to conclude that that larger health warning

labels reduced smoking prevalence, although statistically the estimate is highly insignificant. However, once we control for the regulation of ban of smoking in most public areas enforced in early 2007 and allow for time lag for smokers to respond to regulations, column 3 shows that the decline in smoking rates is more likely driven by the ban instead of the increase in warning labels.

**Table 1: Smoking Prevalence and Health Warning Labels in Hong Kong**

	(1)	(2)	(3)
<i>20%_Rule</i>	1.780 (1.271)	1.706 (1.814)	1.685 (1.287)
<i>30%_Rule</i>	2.647*** (1.019)	0.869 (1.688)	0.960 (1.161)
<i>50%_Rule</i>	0.740 (1.669)	-2.906 (2.380)	0.428 (2.165)
<i>Smoking_Ban</i>	-	-	-3.056 (2.742)
<i>Price</i>	-4.286 (5.272)	-4.075 (3.714)	-4.498 (6.128)
<i>Year</i>	-0.409 (0.295)	-68.516** (32.060)	-64.029* (37.150)
<i>Year</i> <sup>2</sup>	-	0.017** (0.008)	0.016* (0.009)
Trend	Linear	Quadratic	Quadratic
<i>R</i> <sup>2</sup>	0.912	0.915	0.915
Number of Observations	179	179	179

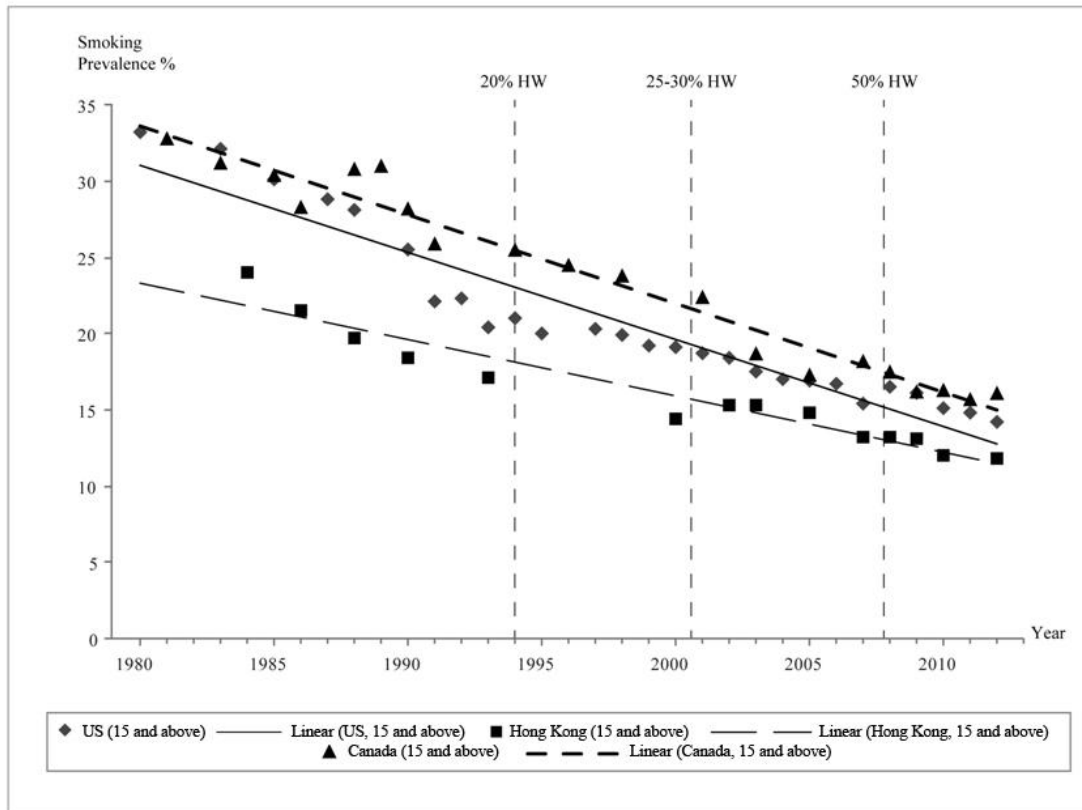
Note: Regressions are estimated using ordinary least squares method with group-specific fixed effects. A positive (resp. negative) point estimate means larger warning labels increases (resp. decreases) smoking prevalence. Robust standard errors are reported in parentheses. A point estimate with \* means it is statistically significant at the 10% level, with \*\* means it is statistically significant at the 5% level, and with \*\*\* means it is statistically significant at the 1% level.

Therefore, the conclusion from our econometric analysis is consistent with our more descriptive one in Section IV: the pre-existing trend of smoking rates did not change after health warning labels became larger.

## IX. Appendix B: Individual-Level Study for Canada and the United States

In Figure 4 we show the daily smoking rates for the 15 and above population in Hong Kong, Canada and the United States from 1980 to 2012.

**Figure 4: Smoking Prevalence in Hong Kong, the U.S. and Canada**



Sources: OECD health statistics; Hong Kong Census and Statistics Department

We note that health warnings control has always been more stringent in Canada than in the U.S. Since 2001 the coverage of graphic health warnings in Canada has increased from 25% to 50% of the package. Despite the stringent requirement, smoking prevalence in Canada did not drop below that of the U.S., where the health warnings requirement is more relaxed. We now present results using individual-level data to strengthen this conclusion.

Joint Canada/United States Survey of Health (JCUSH) provides the most reliable dataset to address the question. It was a research study conducted jointly by the Centre for Disease Control and Prevention in the United States, and National Center for Health Statistics and



Statistics Canada in Canada. Data collection began in November 2002 and ended in March 2003. Approximately 3,500 Canadians and 5,200 Americans participated in the telephone study. The most attractive feature of the study is that it used the same questionnaire and methodology in both countries, allowing us to reliably compare smoking behaviors in the two countries with significantly different regulations on health warning labels.

During the time of the survey, there was no legislation in the U.S. regarding the size of health warning labels as a percentage of the display area, and there was no requirement on using graphic images. In contrast, the size of health warning labels was raised several times in Canada. In 1989, there was a mandate that warning labels should cover 20% of the package, and the producers were required to change the messages regularly. In 1994, the coverage was raised to 25%. In 2000/2001, other than further raising the required size of the warning labels to 50%, graphic images were also introduced. In 2011, the required size of the warning labels was further increased to 75%. The effective date of enforcement of this new regulation was mid-March 2012.

There is no disagreement to the conclusion that towards the end of 2002 (the time of the survey) consumers in Canada were facing much more aggressive regulations on health warning labels that were supposed to discourage their smoking behavior.

First, we need to compare the average price of cigarettes for the two countries. According to Tax Burden on Tobacco (2013)<sup>4</sup>, in November 2002 the national average price (weighted by market share) for 20 cigarettes was USD 3.722, while according to Statistics Canada the comparable price in the same month was CAD 6.134 (or USD 3.906, at the market exchange rate of 1.5704).<sup>5</sup> Cigarettes were almost 5% more expensive in Canada than in the U.S. But exchange rate may not accurately reflect the purchasing power of money. Using the PPP-adjusted exchange rate of 1.2293 in 2002<sup>6</sup>, the price of cigarettes in Canada once converted to USD 4.990 would be over 30% more expensive than those in the U.S. Since disposable income (however defined) in Canada is lower than that in the U.S. in 2002, the cost of the same quantity of cigarettes takes up a larger proportion of income for Canadians.

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<sup>4</sup> [http://www.taxadmin.org/fta/tobacco/papers/tax\\_burden\\_2013.pdf](http://www.taxadmin.org/fta/tobacco/papers/tax_burden_2013.pdf)

<sup>5</sup> <http://www5.statcan.gc.ca/cansim/a21>

<sup>6</sup> [http://stats.oecd.org/Index.aspx?DataSetCode=SNA\\_Table4#](http://stats.oecd.org/Index.aspx?DataSetCode=SNA_Table4#) We use the PPP exchange rate for GDP, but using other definitions does not change the calculation noticeably.

In light of both the more aggressive regulations on health warning labels and the higher price of cigarettes, we should expect smoking prevalence to be significantly lower in Canada, for various demographic groups.

Taking into account the sample weight, we calculate the percentage of daily smokers, occasional smokers and former smokers, and also the age that daily smokers first started smoking. The results are summarized in Table 2. For the full sample, there is a significantly higher proportion of daily smokers in Canada (18.95%) than in the U.S. (16.80%). The same is true for occasional smokers and former smokers. The proportion of people who have never smoked is substantially higher in the U.S. The age at which daily smokers started smoking is also slightly lower for Canada.

The conclusion is that smoking prevalence is higher in Canada, despite having a higher real price of cigarettes and stricter requirements on health warning labels in the sample period. Over the sample period, Canada's requirements on health warning labels are similar to those in effect in Hong Kong today: 50% of the packages must be covered with warning messages and graphic images. The empirical evidence casts doubt on the effect of the current percentage size of health warning labels, and there is no indication that even larger health warning labels will have a more noticeable effect.

**Table 2: Smoking Prevalence in the U.S. and Canada After the 50% Graphic Labels were Introduced in Canada**

	Current Daily Smokers	Current Occasional Smokers	Former Smokers	Current Daily Smokers Age First Smoked
<b>1. Full Sample (N=8649)</b>				
Canada	18.95%	5.94%	44.22%	17.40
U.S.	16.80%	5.61%	37.47%	17.82
Canada – U.S.	2.15%	0.33%	6.75%	-0.42
Stat. significant at 5%?	Yes	No	Yes	No
<b>2. Age 18-25 (N=837)</b>				
Canada	20.48%	12.34%	28.17%	16.24
U.S.	19.01%	8.75%	24.74%	16.14
Canada – U.S.	1.47%	3.59%	3.43%	0.10
Stat. significant at 5%?	No	No	No	No
<b>3. High school or below (N=4139)</b>				
Canada	24.15%	5.84%	43.28%	16.88
U.S.	22.58%	6.30%	32.73%	17.63
Canada – U.S.	1.57%	-0.46%	10.55%	-0.75
Stat. significant at 5%?	No	No	Yes	Yes
<b>4. More than high school (N=4241)</b>				
Canada	13.60%	6.16%	45.57%	18.33
U.S.	11.30%	5.02%	41.45%	18.12
Canada – U.S.	2.30%	5.02%	4.12%	0.21
Stat. significant at 5%?	Yes	No	Yes	No

Note: Data are taken from the Joint Canada/United States Survey of Health (JCUSH). Sample weights are used to calculate all the statistics. For each panel, entries in the third row indicate the difference in smoking prevalence between Canada and the U.S. Entries in the fourth row indicate whether the difference in smoking prevalence between Canada and the U.S. is statistically significant at the conventional 5% level. When the entry is “No,” it means statistically smoking prevalence in Canada and the U.S. are the same. When the entry is “Yes,” it means statistically smoking prevalence in Canada and the U.S. are different, and in particular a positive (resp. negative) entry means smoking prevalence is higher (resp. lower) in Canada than in the U.S.

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