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The effectiveness of display bans: the case of Iceland

A Report For Philip Morris International

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01 October 2009

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Executive summary

In this brief report I summarise the findings of my empirical investigation of the expected impact of display bans on tobacco consumption.

Display bans are regulations that prohibit the visual display of tobacco products within the point of sale. They are the most restrictive of all point-of-sale regulations, which include limitations on height and visibility of displays, prohibition of self-service displays, and restrictions on logos, banners, and window posters.

Whether display bans have an impact on tobacco consumption is an empirical question. Also, the likely magnitude of that impact can only be estimated using empirical techniques. This is why this paper considers the case of Iceland, the only country in Europe to have introduced display bans before 2009.

Iceland introduced display bans in August 2001.[1] The Tobacco Control Act explicitly mandated that products had to be placed in a manner that they were not visible to the customer. Ireland and Thailand are the only two other countries to have introduced nationwide display bans – Ireland in 2009 and Thailand in 2005.[2] Most Canadian provinces and two Australian states have also implemented point of sale display bans.[3]

In Iceland, as in most western countries, smoking prevalence has been declining since at least the mid 1980s. The percentage of individuals aged 15 to 79 years who smoked declined from 33% in 1987 to 19% in 2007. Likewise, the percentage of individuals aged 15 to 24 years who smoked fell from 27% in 1989 to 18% in 2007.

Several factors may explain this negative trend. While the display ban may have been responsible for part of the observed decline, it cannot explain the evolution of the smoking rate prior to August 2001. In addition, the display ban was preceded by several other tobacco control measures, such as an advertising ban on all media and the introduction of mandatory health warnings in 1984, a ban on smoking in public areas in 1999 and brand sharing prohibition in 2000. Those interventions may also be responsible for the observed reduction in the smoking prevalence after August 2001. Finally, cigarette prices in Iceland have been continuously increasing since the mid 1980s, both

[1] The Tobacco Control Act (No. 95/2001), including advertising and display bans, took effect on 1 August 2001.
[2] In Thailand display bans remain in effect despite a 2006 court decision that overturned this measure.
[3] The first Canadian provinces to have legislated displays bans of tobacco products was Saskatchewan in 2002 but the legislation was overturned in October 2003. Two years later the Canadian Supreme Court ruled in favour of the display ban. Manitoba and Nunavut implemented their own point of sales bans in 2005 after the Supreme Court announced its decision the Saskatchewan ban. Prince Edward Island introduced point of sale display bans in 2006 and Northwest Territories and Nova Scotia in 2007. British Columbia, Ontario, Alberta and Quebec introduced display bans in 2008. New Brunswick and Yukon Territory introduced display bans in 2009. In Australia, Tasmania (2007) and Australian Capital Territory (2008) have adopted point of sale display bans yet the laws will only become effective in 2011. In both territories tobacconists will be exempted from the ban.

in absolute[4] and relative terms.[5] The increase in tobacco prices, driven primarily by tax increases, is likely to have a negative impact on smoking prevalence. A simple correlation analysis shows that the smoking rate variations are closely and inversely related to changes in cigarette prices.[6]

Simple comparisons of the smoking rate before and after the implementation of the display ban are, therefore, likely to exaggerate its impact. To estimate the impact of display bans on smoking rates accurately, one must necessarily take into account that cigarette prices and other tobacco measures may also explain the observed decline. This is what I have done using standard *multiple regression techniques*. These are standard tools used in economics and in many other scientific fields to estimate the effect of one factor of interest on a specific variable, when that variable is also influenced by many other factors.

Using these techniques I have been able to (a) estimate the impact of the Icelandic display ban on smoking prevalence taking into account that many other factors may explain the decline in smoking rates; and (b) assess whether the estimated relationship between the display ban and smoking prevalence is statistically significant or is the result of random chance.

To isolate the effect of the display ban in Iceland I used multiple regression techniques to compare the evolution of the smoking rate in Iceland *after* the implementation of the display ban with the evolution of the smoking rate in Iceland *before* this ban was implemented, and also with the evolution of the smoking rate in Norway and Sweden, two countries which have not introduced display bans to date. The use of Norway and Sweden as benchmarks for comparison is explained by common history and similar attitudes and policies towards smoking.[7]

I found that that the Icelandic display ban had *no* statistically significant effect on smoking prevalence. This is true for all age groups for which data was available: (1) individuals aged 15 to 79 years and (2) individuals aged 15 to 24 years. That is, I found *no empirical support* for the proposition that a display ban is likely to cause a reduction in smoking prevalence.

On the contrary, I found that tobacco prices have a negative and statistically significant relationship with smoking prevalence. I also found that bans on smoking in public free areas and mandatory health warning changes also have a negative and statistically significant relationship with smoking prevalence.

For example, I found that the average smoking rate in Iceland, Norway and Sweden for those aged 15 – 24 years declined by 1.4 percentage points as a result of the ban on

[4] The Consumer Price Index (CPI) for tobacco increased by 256% from 1989 to 2007.
[5] The relative price of tobacco (i.e., the CPI for tobacco divided by the overall CPI) increased by 66% over the same period.
[6] The estimated correlation between the smoking rate of individuals aged 15 to 79 years and the relative price of cigarettes is negative, close to one (-0.96) and statistically significant. An estimated relationship is said to be *statistically significant* if it cannot be explained as the product of random chance.
[7] Hakala, K. and M. Waller (2003), "Nordic Tobacco Control – towards smoke-free societies", Norden, publication number 2003:737. All five Nordic countries (Denmark, Finland, Iceland, Norway and Sweden) have a "common approach to the organisation of social and health affairs" (p. 9). "The Nordic Council of Ministers has steered inter-Nordic cooperation on social affairs and health since 1977." (p.10). The main difference between the Nordic countries lies in the use of snus which has traditionally been popular in Sweden. Smoking among men in Sweden is low (18%) in part due to the consumption of snus. We did not include Denmark and Finland as benchmark countries because data on smoking rates was not available for all age groups.

smoking in public areas. Likewise, the change of the health warnings on tobacco packages reduced the average smoking rate in these three countries by 3.0 percentage points for the same age group. Note however that this estimated coefficient is likely to be capturing the effect of the existence of a health warning in addition to the effect of the size increase of the health warning label. [8]

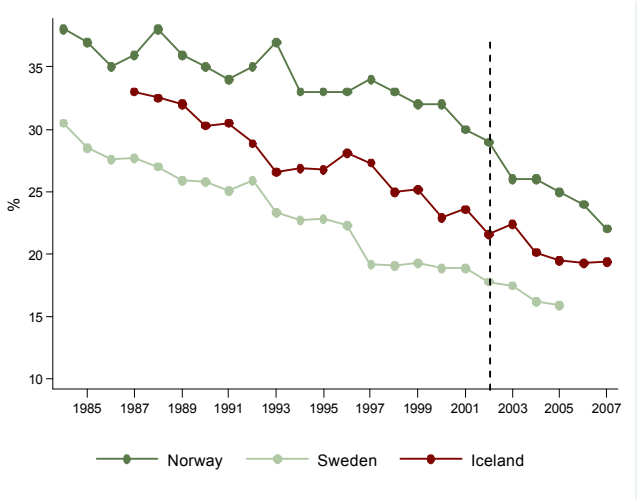
Also, I estimate that a 10 percentage point increase in the relative price of tobacco decreased average smoking rates for this age group by 0.8 percentage points. That is, given an average smoking rate of 23%, an increase of the relative price of tobacco index from 110 to 120 is estimated to reduce smoking rates to 22.2%

The estimated model performs very well according with standard statistical criteria. It explains the vast majority (86%) of the variation in smoking rates during the period 1987 to 2007.

The regression analysis therefore supports the effectiveness of certain tobacco control measures in controlling smoking and clearly establishes the impact of tobacco prices on consumption. This analysis however provides no empirical support on the effectiveness of point of sale display bans.

It is not surprising to find that display bans did not have a significant impact on smoking rates in Iceland. Figure 1 shows the evolution of smoking prevalence for individuals aged 15 to 79 years in Iceland, Norway and Sweden. The vertical, dashed line identifies the point in time (August 2001) at which the display ban was introduced in Iceland. Note that (i) the smoking prevalence trend in Iceland, where the ban was introduced, is no different from the trends in Norway and Sweden, where no such ban was introduced; and (ii) and no clear break in the Icelandic smoking prevalence trend is observed after the display ban was implemented.

Figure 1: Percentage daily smokers in Iceland, Norway and Sweden, 15-79 year group

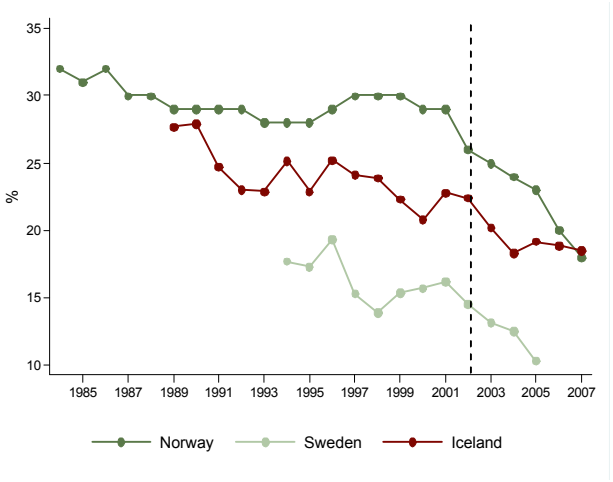


Source: OECD Health data.

[8] Using a sample of countries where the introduction of the health warning falls within the data sample period, I estimated the impact on smoking prevalence of the introduction of health warnings and the latter change in size of the label and found that only the introduction of the health warning was negative and statistically significant, i.e., its impact was different from zero (see Annex 4).

Figure 2 in turn shows the evolution of smoking prevalence for individuals aged 15 to 24 years in Iceland, Norway and Sweden. Again, the vertical, dashed line identifies the point in time (August 2001) at which the display ban was introduced in Iceland. We have that for this age group too, the smoking prevalence trend in Iceland, where the ban was introduced, is not very different from the trends in Norway and Sweden, where no such ban was introduced. If anything it would appear that the rate of decline in Sweden and Norway is faster than in Iceland. Furthermore, even though the evidence appears to show a steep decline in the Icelandic smoking prevalence trend after the display ban was introduced, this is also the case for both Norway and Sweden, where no display ban was introduced at the time.

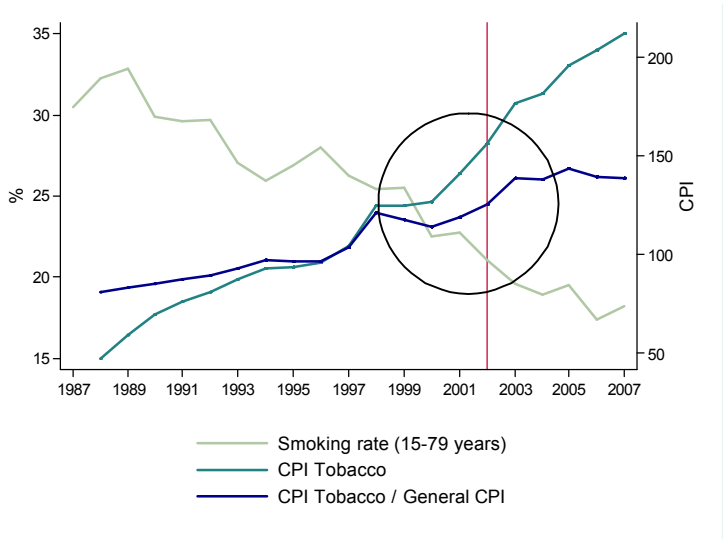
Figure 2: Percentage daily smokers in Iceland, Norway and Sweden, 15-24 year group



Source: OECD Health data

Note that the decline in the Icelandic smoking prevalence trend coincides with the increase of tobacco prices (both in absolute and relative terms) in that country. This is illustrated in Figure 3 below.

Figure 3: Evolution tobacco prices and smoking rates in Iceland



Source: Statistics Iceland

The results I have just described are *robust*. I re-estimated the regression model including additional control variables (in particular health expenditure and different measures for tobacco prices) and found that the results remained qualitatively unchanged. Similarly, I re-estimated the model using data for all European countries with publicly available smoking incidence data.[9] This implied extending the set of benchmark countries. I continued to find that point of sale regulation had no statistically significant impact on Icelandic smoking prevalence.

In summary, my analysis of the data shows that certain tobacco control measures reduce smoking prevalence and clearly establishes the impact of tobacco prices on consumption. But the data does not support the claim that a display ban is likely to cause a reduction in smoking prevalence. To the extent that there is a relationship, it is very small and the evidence shows it may be purely due to random chance. My statistical analysis therefore confirms the conclusions suggested by a simple inspection of Figure 1 and Figure 2 above: there is no evidence that the display ban in Iceland caused a reduction in smoking prevalence.

[9]Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Spain, Sweden and United Kingdom.

Section 1

Introduction and summary of conclusions

1.1 Introduction

I have been asked by Philip Morris International (PMI) to analyse the expected impact of display bans on tobacco consumption.

Display bans are regulations that prohibit the visual display of tobacco products within the point of sale. They are the most restrictive of all point-of-sale regulations, which include limitations on height and visibility of displays, prohibition of self-service displays, and restrictions on logos, banners, and window posters.

Display bans are rare. Only two countries in Europe have introduced display bans – Iceland in August 2001[10] and Ireland in 2009.[11] All Canadian provinces, except one, and two Australian states have also introduced point of sale display bans.[12]

In this report I examine the data on the impact of the Icelandic display ban on smoking prevalence amongst the Icelandic population.

In Iceland, as in most Western countries, smoking prevalence has been declining since at least the mid 1980s. The percentage of individuals aged 15 to 79 years who smoked declined from 33% in 1987 to 19% in 2007. Likewise, the percentage of individuals aged 15 to 24 years who smoked fell from 28% in 1989 to 19% in 2007.[13]

The question I examine here is to what extent this decline in smoking prevalence was caused by the display ban. This is not straightforward because smoking prevalence can

[10] The Tobacco Control Act (no. 95/2001) required that products be placed in a manner that they were not visible to the customer effective 1 August 2001.
[11] Thailand is the only other country where a nationwide display ban has been enacted. Display bans were implemented in 2005 and remain in effect despite a 2006 court decision that overturned the measure.
[12] The first Canadian provinces to have legislated displays bans of tobacco products was Saskatchewan in 2002 but the legislation was overturned in October 2003. Two years later the Canadian Supreme Court ruled in favour of the display ban. Manitoba and Nunavut implemented their own point of sales bans in 2005 after the Supreme Court announced its decision the Saskatchewan ban. Prince Edward Island introduced point of sale display bans in 2006 and Northwest Territories and Nova Scotia in 2007. British Columbia, Ontario, Alberta and Quebec introduced display bans in 2008. New Brunswick and Yukon Territory introduced display bans in 2009. In Australia, Tasmania (2007) and Australian Capital Territory (2008) have adopted point of dale display bans yet the laws will only become effective in 2011. In both territories tobacconists will be exempted from the ban.
[13] OECD Health Data 2008, December.

be affected by many different factors in addition to a display ban, such as other regulations, social trends and changes in the price of cigarettes.

It is clear that, since the decline in smoking prevalence pre-dates the introduction of a display ban, it cannot be wholly explained by it. In addition, in Iceland, the display ban was preceded by several other tobacco control measures, such as an advertising ban on all media and the introduction of mandatory health warnings in 1985, a ban on smoking in public areas in 1999 and a brand sharing prohibition in 2002.[14] Those interventions may have continued to affect smoking prevalence after August 2001. In addition, cigarette prices in Iceland have been continuously increasing since the mid 1980s, both in absolute and relative terms. The increase in tobacco prices is likely to have had a negative impact on smoking prevalence.

For these reasons a simple comparison of the smoking rate before and after the implementation of the display ban is likely to exaggerate its impact. To estimate the impact of display bans on smoking rates accurately, I need to take into account the impact of cigarette prices and other tobacco measures on smoking prevalence. This is what I have done using standard statistical techniques.

1.2 My approach

There are two main approaches that can be used to estimate the impact of a display ban on smoking prevalence.

- I can compare smoking prevalence before and after the display ban; or
- I can compare smoking prevalence in a country with a display ban (i.e. Iceland) with smoking prevalence in countries without a display ban.[15]

By combining both approaches, as I have done here, I am able to obtain a more precise and robust estimate of the impact of display bans on smoking prevalence.

In order to estimate the effect of the display ban in Iceland I have compared the evolution of the smoking rate in Iceland *after* the implementation of the display ban with the evolution of the smoking rate in Iceland *before* this ban was implemented. I have also compared it with the evolution of the smoking rate in Norway and Sweden, two countries which have not introduced display bans to date. I have used Norway and Sweden as benchmarks because they have a common history with Iceland and similar attitudes and policies towards smoking.

As explained above, it is important that I take account of factors other than a display ban that may explain changes in smoking prevalence over time or between countries. There are standard statistical techniques that allow me to take account of these factors.

The most commonly used approach, which is the one I have used here, is a *multiple regression* analysis. A "simple" regression analysis estimates the relationship between two variables. In other words, it identifies how a change in one of the variables (the

[14] World Health Organisation, Country profiles. See: http://data.euro.who.int/tobacco/Default.aspx?TabID=2404

[15] As explained in section 3.4 this comparison needs to take account of all other factors that may explain the differences in smoking prevalence rates across countries. To do so it is possible to restrict the analysis to similar countries and/or utilize regression analysis to isolate the impact of tobacco regulation on smoking prevalence.

"explanatory variable") affects the other (the "independent variable"). For example, we might identify how a change in the price of cigarettes will affect smoking prevalence. In practice, however, I would expect that smoking prevalence is affected by many different explanatory variables, not just the price of cigarettes. A *multiple regression* analysis estimates the relationships between the independent variable and many explanatory variables. In this case, it allows me to identify the impact on smoking prevalence of a change in price, the introduction of different regulations, including a display ban, factors specific to different countries and many other relevant factors. By combining data across countries and over time (commonly known as cross country analysis) and holding all of these other variables constant, I can identify the impact of a display ban on smoking prevalence.

A multiple regression analysis allows me to draw two conclusions. First, I can estimate the impact of each potential explanatory variable on smoking prevalence. Second, I can test whether this relationship is *statistically significant*, in other words whether there is a low probability that this estimate reflects a random occurrence.

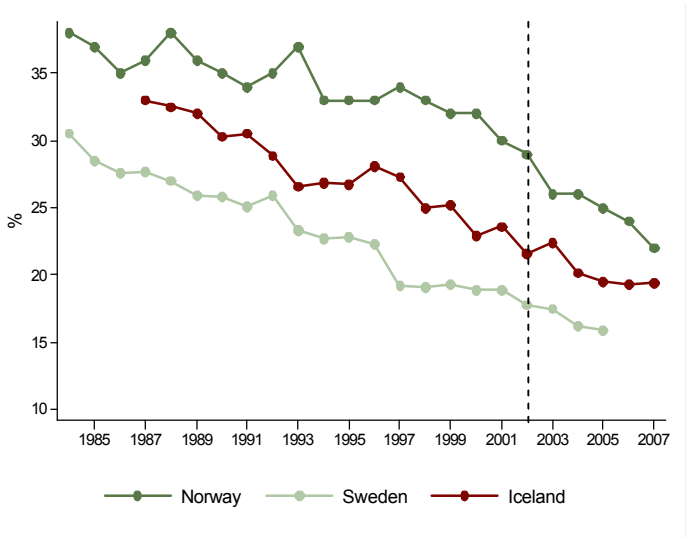
I have obtained publically available data on smoking prevalence, tobacco prices and dates of introduction of the regulatory tobacco control measures for Iceland, Norway and Sweden. In addition, to account for the potential effect of socio-demographic and economic factors, I have also obtained data on income per capita, health and education expenditure per capita, and unemployment for each of the three countries.

I have used these data and standard multiple regression statistical techniques to estimate how smoking prevalence in each of the three countries for each of the years in the sample period is affected by several socio-demographic and economic factors (e.g., gender, health expenditure, gross domestic product), tobacco control measures (e.g., ban on smoking in public areas, introduction of health warnings on tobacco packages, etc.), and tobacco prices. I estimated the impact of these factors on smoking prevalence for two age groups: (1) the group of individuals aged 15 to 79 years and (2) the group of individuals aged 15 to 24 years. In addition, I performed numerous robustness exercises to assess the reliability of the estimation results.

1.3 Results

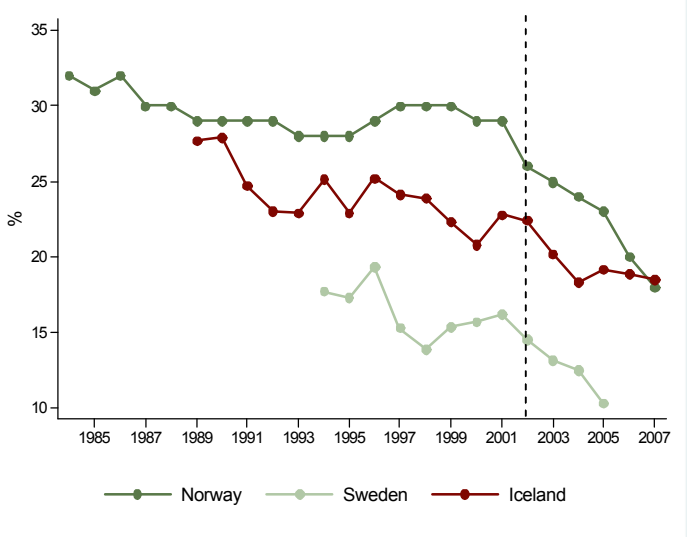
Before reporting the results of my statistical analysis it is useful to examine the high-level trends in smoking prevalence in Iceland, Norway and Sweden. These are shown in Figure 4 and Figure 5 below, which show data for different age groups. In both graphs the dotted line represents the introduction of the display ban in Iceland in 2001.

Figure 4: Percentage daily smokers in Iceland, Norway and Sweden, 15-79 year olds



Source: OECD Health data.

Figure 5: Percentage daily smokers in Iceland, Norway and Sweden, 15-24 year olds



Source: OECD Health data

The graphs show that for both age groups smoking prevalence is in long-term decline in all three countries. If the display ban had an effect on smoking prevalence I would expect this rate of decline to speed up in Iceland relative to Norway and Sweden, where there are no display bans, after 2001. However, the graphs show no such trend – if anything they show the reverse with a faster rate of decline in Norway and Sweden after 2001. In other words, a simple inspection of these graphs does *not* suggest that the display ban in Iceland caused a decline in smoking prevalence.

As I have explained above, smoking prevalence is affected by many factors. It is therefore possible that the display ban *did* have an effect on smoking prevalence in Iceland but that this effect is "hidden" in these graphs because it is counteracted by the opposing effect of other factors. I have therefore conducted a statistical analysis to isolate the impact of the display ban in Iceland.

Using the multiple regression techniques described above I have been able to (a) estimate the size of the impact of the Icelandic display ban on smoking prevalence taking into account the many other factors that may affect smoking rates; and (b) assess whether this estimated relationship between the display ban and smoking prevalence truly exists or is the result of random chance.[16]

I found that tobacco prices have a negative and statistically significant relationship with smoking prevalence. I also found that bans on smoking in public areas and mandatory health warnings in tobacco packages have negative and statistically significant impacts on smoking prevalence.

However, I found that that the Icelandic display ban had *no* statistically significant effect on smoking prevalence. This is true for both age groups for which data was available: (1) individuals aged 15 to 79 years and (2) individuals aged 15 to 24 years. That is, I found *no empirical support* for the proposition that a display ban is likely to cause a reduction in smoking prevalence.

The results I have just described are *robust*. I carried out numerous additional analyses to determine the reliability of the estimation results. In particular, I re-estimated the regression model using different and additional explanatory variables (in particular health expenditure and different measures for tobacco prices) and found that the results remained qualitatively unchanged. In addition, I gathered information on other European countries to use as benchmarks. By comparing smoking prevalence rates in countries with and without display bans, while econometrically accounting for other economic factors that might have differed between these markets, I was able to estimate the impact of point of sale regulation on smoking prevalence.[17] I continued to find that point of sale regulation had no statistically significant impact on Icelandic smoking prevalence.

In summary, my analysis of the data shows that certain tobacco control measures reduce smoking prevalence and clearly establishes the impact of tobacco prices on consumption. But the data does not support the claim that a display ban is likely to cause a reduction in smoking prevalence. To the extent that there is a relationship, it is very small and the evidence shows it may be purely due to random chance.

My statistical analysis therefore confirms the conclusions suggested by a simple inspection of Figure 4 and Figure 5 above: there is no evidence that the display ban in Iceland caused a reduction in smoking prevalence.

[16] That is, the use of regression techniques allows me to determine whether the estimated impact of the display ban on smoking prevalence is statistically significant.
[17] Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Spain, Sweden and United Kingdom.

1.4 Structure of the report

This report is structured as follows. In Section 2 I describe the data I have used. In Section 3 I explain why a simple comparison of smoking prevalence in a given country before and after the introduction of a display ban may produce erroneous conclusions. I also explain why a simple comparison of smoking prevalence in countries with and without display bans is not sufficient to correctly assess the impact of regulatory measures. I then describe how multiple regression analysis techniques can be used to rigorously analyse the impact of display bans on tobacco consumption. In Section 4, I summarise the results of the regression analysis and discuss my findings. Lastly, I offer some concluding remarks in Section 5.

1.5 Academic credentials and professional experience

I have significant experience in empirical analysis and the economics of the tobacco industry. I earned M. Phil and D. Phil degrees in economics from the University of Oxford. I am Research Fellow of the Centre for Economic Policy Research (CEPR, London) and the *Centro de Estudios Monetarios y Financieros* (CEMFI, Madrid). I am or have been a member of the editorial boards of *Competition Policy International*, the *Review of Economic Studies*, the *Spanish Economic Review* and *Investigaciones Económicas*. I received the 1990 Young Essay's Award of the European Association for Research in Industrial Economics.

I have written several papers on competition policy and industrial organisation in, among other journals, the *Antitrust Bulletin*, the *Antitrust Law Journal,* the *European Competition Journal*, the *European Competition Law Review*, the *European Economic Review*, the *Fordham International Law Journal*, the *International Journal of Industrial Organization*, the *Journal of Competition Law and Economics*, the *Journal of Economics and Management Strategy*, the *Journal of Economic Theory*, the *RAND Journal of Economics*, the *University of Chicago Law Review*, and *World Competition*. I am also co-author of the book, *The Law and Economics of Article 82 EC,* published by Hart Publishing, 2006.

I have provided written and/or oral testimony in competition policy matters before the Cypriot, Dutch, French, German, Irish, Israeli, Italian, Portuguese, Spanish, Turkish, UK and US competition authorities and courts, as well as in cases before the European Commission, the European Court of First Instance and the UK Competition Appeals Tribunal. I have provided consultancy advice to both the OFT and the European Commission and authored reports published by both the OFT and the European Commission.

Section 2

Data

In this section I describe the data I have used for the econometric analysis. I have used publically available data on smoking prevalence, tobacco prices and the dates of introduction of the regulatory tobacco control measures in Iceland, Norway and Sweden.[18] In addition, I have obtained data on income per capita, health and education expenditure per capita and unemployment for each of the three countries.

2.1 Smoking prevalence

I used annual data obtained from the Public Health Institute of Iceland (PHII) and the Organisation for Economic Cooperation and Development (OECD) on smoking rates for men and women in two age categories:

- For Iceland, I obtained PHII data on daily smoking rates of the entire population (individuals aged 15 to 79 years) by gender from 1987 to 2007 and OECD Health data on smoking rates of the younger population (individuals aged 15 to 24 years) for the period 1989-2007.[19]
- For Sweden and Norway, I used OECD Health data on daily smoking rates of individuals aged 15 to 79 yeas and individuals aged 15 to 24 years.

The OECD Health data is a comprehensive source of comparable statistics on health and health systems across OECD countries. Both the PHII data and the OECD Health data are obtained through standard health interview surveys.

The smoking prevalence data for Iceland from the PHII and the OECD Health data coincide. They are based on yearly surveys performed for the Committee for Tobacco

[18] See Annex 1 for a detailed description of the data.

[19] An alternative source for data on smoking prevalence for the younger population is the European Survey Project on Alcohol and other Drugs (ESPAD). I chose to use the PHII data because it was more appropriate for the proposed econometric analysis for three reasons. First, ESPAD only surveys 16 year olds whereas PHII surveys a range of ages which allows assessing the impact of the regulatory measures on the smoking prevalence of various age groups. Second, ESPAD only reports smoking prevalence rates at 4-year intervals (1995, 1999, 2003 and 2007) while the PHII survey is conducted annually. As the 2003 ESPAD report highlights "four years is a relatively long period during which many changes might have occurred. In other words, the straight lines may mask considerable annual fluctuation" (see European School Survey Project on Alcohol and Other Drugs (ESPAD) Report, p. 32). Third, ESPAD surveys have been conducted in schools and this could significantly bias the responses. Even though the anonymous character of the study was emphasized and the survey leader was instructed to refrain from walking around in the classroom, the school surrounding may have enhanced the social nature of the survey procedure and this has been shown to play a big role in shaping answers to subjective questioning. (See Bertrand, M. and S. Mullainathan (2001), "Do People Mean What They Say? Implications for Subjective Survey Data", *American Economic Review*, 91(2), pp. 3-4.)

Use Prevention. From 1989 onward, information was gathered on daily smoking rates of males and females aged 15 to 79 years and 15 to 24 years.[20]

The data for Norway and Sweden is based on yearly surveys. In Sweden information is gathered on females and males aged 16 to 84 years. In Norway the information is gathered on females and males aged 16 to 74 years. In both countries smoking rates for the individuals aged 16 to 24 years are reported separately.[21]

2.2 Tobacco prices

I constructed various measures of the relative price of tobacco by dividing the consumer price index for tobacco by several general consumer price measures. For each country I used data from the corresponding national statistics office.

2.3 Date of tobacco control measures

I obtained the dates of implementation of the regulatory control measures in each country from the World Health Organization. This information was reviewed by PMI.

2.4 Summary

The table below provides a summary of all the data and data sources used.

[20] The question asked is: Do you smoke or have you smoked? The possible answers are:
(i) no, I have never smoked.
(ii) no, I used to smoke but stopped more than a year ago
(iii) no, I used to smoke but stopped less than a year ago
(iv) yes, I smoke occasionally (more seldom than daily)
(v) yes, I smoke daily.
Smoking rates are based on the number of affirmative responses to (iv) and (v).

[21] The following are the two questions and possible answers in Norway and Sweden:
1. Do you smoke?
(i) yes, daily
(ii) yes, occasionally
(iii) No
2. How many cigarettes do you usually smoke on average each day?
(i)does not smoke cigarettes
(ii) fewer than 20
(iii) 20 or more (heavy smokers)
Smoking rates are based on the number of affirmative responses to 1 (i) and 2 (ii) and (iii).

Table 1: Summary of data used in econometric analysis, Iceland, Norway and Sweden

Variable	Iceland	Norway	Sweden
Smoking rate 15-24	1987-2007 OECD Health database 2008	1984-2007 OECD Health database 2008	1994-2005 OECD Health database 2008
Smoking rate 15-79	1989-2007 PHII	1984-2007 OECD Health database 2008	1984-2005 OECD Health database 2008
Tobacco price index	1988 – 2008 Statistics Iceland	1979-2008 Statistics Norway	1980-2008 Statistics Sweden
GDP per capita	1987-2007 OECD	1984-2007 OECD	1984-2007 OECD
Total expenditure on health / GDP	1985-2007 OECD	1985-2006 OECD	1985-2006 OECD
Net migration per 1000 inhabitants	1987-2007 OECD	1984-2007 OECD	1984-2007 OECD

Section 3

Methodology

3.1 Introduction

In this section I explain why the analysis of the expected impact of display bans on tobacco consumption in Iceland requires the use of multiple regression techniques. More precisely, (i) I explain why a simple comparison of smoking prevalence before and after the introduction of the display ban in Iceland may produce erroneous conclusions; and (ii) I also explain why a simple comparison of smoking prevalence in Iceland (where a display ban was introduced in 2001) and Sweden and Norway (with no display bans to date) is also not sufficient to correctly assess the impact of regulatory measures.

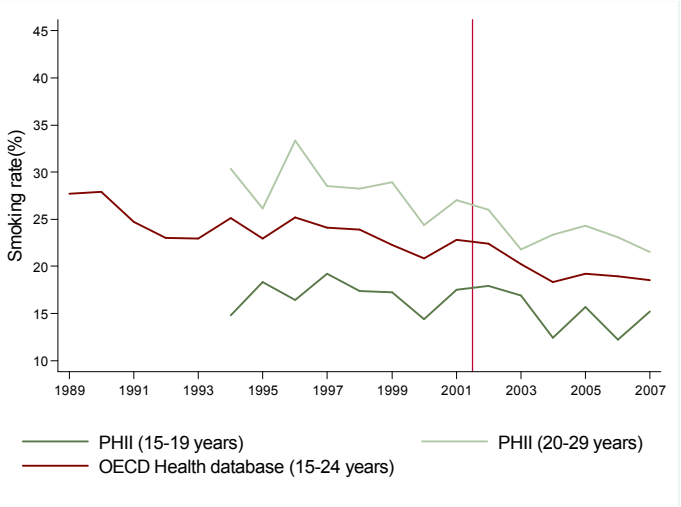
3.2 Smoking prevalence in Iceland before and after the ban

One possible approach to assess the impact of the introduction of the display ban in Iceland in August 2001 is to compare the evolution of smoking prevalence in that country before and after the introduction of the display ban.

Smoking prevalence has been declining in Iceland since the mid 1980s, as in most Western countries. For example, the percentage of individuals aged 15 to 79 years who smoke declined from 33% in 1987 to 19% in 2007.[22] This declining trend is also observed for other age groups, as shown in Figure 6. Smoking rates of individuals aged 15 to 24 years fell from 28% in 1989 to 19% in 2007, and also followed a negative trend for individuals aged 15 to 19 years and 20 to 29 years.

[22] OECD Health data 2008.

Figure 6: Percentage daily smokers in Iceland, by age group



Note: The vertical line indicates the year display bans were implemented in Iceland.
Source: OECD health data 2008 and PHII.

The decline in smoking prevalence is driven by many factors, some that can be clearly identified and quantified, such as price increases, and others that are difficult to measure such as changes in the level of press coverage of smoking related health issues. So while the display ban may have been responsible for part of the observed decline, it is clearly not the only explanation for this negative trend. This is for several reasons.

First, the display ban cannot explain the decline in smoking prevalence prior to its introduction, in August 2001.

Second, the display ban regulation was preceded by various other regulatory measures including advertising bans on all media and mandatory health warnings in 1984, bans on smoking in public areas in 1999 and brand sharing prohibition in 2001. (Table 2 reports a complete summary of these tobacco control measures and the date of their implementation in Iceland.) These regulations are likely to be responsible for part of the observed reduction in smoking prevalence in Iceland before and after August 2001.

Table 2: Timing of tobacco control measures in Iceland.

Tobacco control measure	Iceland
Ban on TV advertising	1972
Ban on direct advertising in magazines & newspapers	1972
Ban on indirect advertising	1984
Ban on smoking in public transport	1984
18 year minimum age requirement	1984
Introduction health warning label	1985
Minimum pack size	1996
Tar/nicotine ceilings first implemented	1998
Ban on smoking in workplaces	1999
Ban on smoking in public areas	1999
Ban on brand sharing	2001
Display ban	2002
Introduction of 30/40 health warning label	2004
Tar/nicotine ceilings lowered	2004
Ban on smoking in pubs and bars	2007

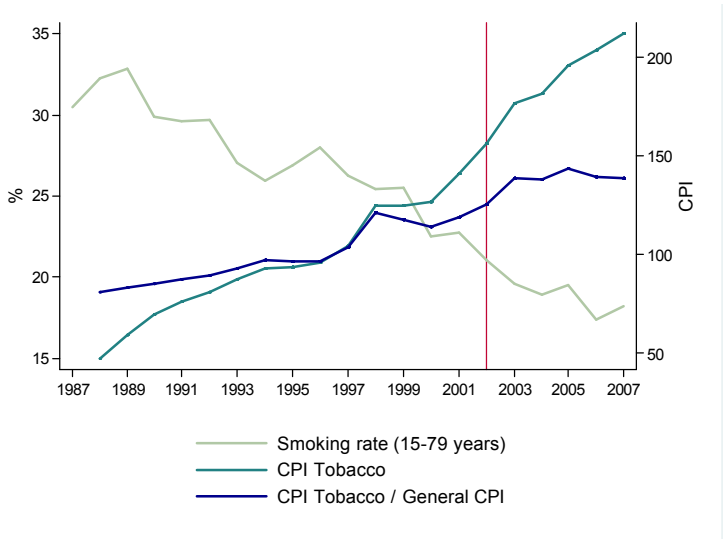
Note: I am using annual data, therefore, I assigned measures implemented in the second half of the year to the following year (e.g. the display ban in Iceland was implemented in August 2001 but in the table above it appears as implemented in 2002).
Source: World Health Organization reviewed by PMI

Third, cigarette prices in Iceland have been increasing since the mid 1980s, both in absolute and relative terms, driven primarily by tax increases. The Consumer Price Index (CPI) for the whole economy increased by 115% from 1989 to 2007. During the same period the CPI for tobacco increased by 256%. In other words, the relative price of tobacco (i.e., the tobacco CPI divided by the overall CPI) increased by 66% over this period.

One would expect that this increase in tobacco prices would have had a negative impact on smoking prevalence. The data suggests that this is indeed the case. Figure 7 shows a clear negative relationship between smoking prevalence and cigarette prices: cigarette prices increased by 66% from 1989 to 2007, while smoking prevalence declined by 41%. A simple correlation analysis confirms the strength of this relationship. The estimated correlation between smoking rates and the relative price of cigarettes is negative, very near one (-0.96) and statistically significant.[23] This means that variations of smoking rates are closely related to changes in cigarette prices.[24]

[23] The estimated correlation between the smoking rate of individuals aged 15 to 79 years and the relative price of cigarettes is statistically significant at a 1% level. An estimated relationship is said to be *statistically significant* if it cannot be explained as the product of random chance. In this case, the likelihood of mistakenly asserting that the observed correlation exists and is close to one is less than 1%. See Federal Judicial Center (2000), *Reference Manual for Scientific Evidence*, p. 149.
[24] The correlation coefficient measures the extent to which two variables move in the same/opposite direction and whether these movements are closely related.

Figure 7: Evolution tobacco prices and smoking rates in Iceland



Source: Statistics Iceland and PHII.

For all these reasons, a simple comparison of the smoking rate before and after the implementation of the display ban would not be able to establish whether, or to what extent, the smoking rate reductions where caused by the prohibition of point-of-sale promotions. The comparisons would be misleading, because other observable or unobservable factors differed systematically before and after the implementation of the display ban.

A better way of assessing the effect of the display ban on smoking prevalence using Icelandic data only is to compare the rate of decline of the smoking rate in the period before the display ban and the corresponding figure for the period following the introduction of the display ban. Had the ban been effective, I would expect to see the rate of decline of the smoking prevalence to speed up after the ban. However, as shown in Figure 6, there is no clear break in the declining trend in Iceland after the display ban was implemented. However, as explained above, smoking prevalence is affected by many factors. It is therefore possible that the display ban had an affect on smoking prevalence in Iceland but that this effect is offset by other factors and, consequently, it is not identified by a simple, two-dimensional graphical analysis.

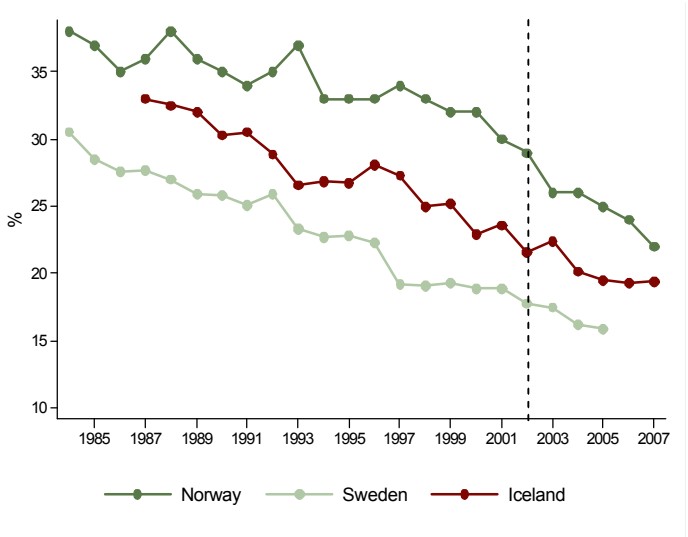
3.3 Cross-country comparisons: Norway and Sweden

A second approach to estimate the impact of the display ban on smoking prevalence in Iceland is to compare the smoking prevalence in Iceland with the smoking prevalence in countries without a display ban. Or, more correctly, to compare the rate of decline in the smoking prevalence of Iceland after the introduction of the display ban with the rate of decline of the smoking prevalence for the same time period in countries where the display ban was not introduced. As explained above, in this report I have used Norway

and Sweden as benchmarks because they have a common history with Iceland and similar attitudes and policies towards smoking.[25]

Figure 8 shows the evolution of adult smoking prevalence in Iceland, Norway and Sweden for individuals aged 15 to 79 years. The vertical dashed line identifies the point in time (August 2001) when the display ban was implemented in Iceland. Smoking prevalence in Iceland has been declining since at least the mid 1980s. The same trend is found in Norway and Sweden. If the display ban had an effect on smoking prevalence I would expect this rate of decline to speed up in Iceland relative to Norway and Sweden after 2001. However, the graph shows no such trend – if anything it shows the reverse with a faster rate of decline in Norway and Sweden after 2001. In other words, a simple inspection of these graphs does not suggest that the display ban in Iceland caused a decline in smoking prevalence.

Figure 8: Percentage daily smokers in Iceland, Norway and Sweden, 15-79 year olds

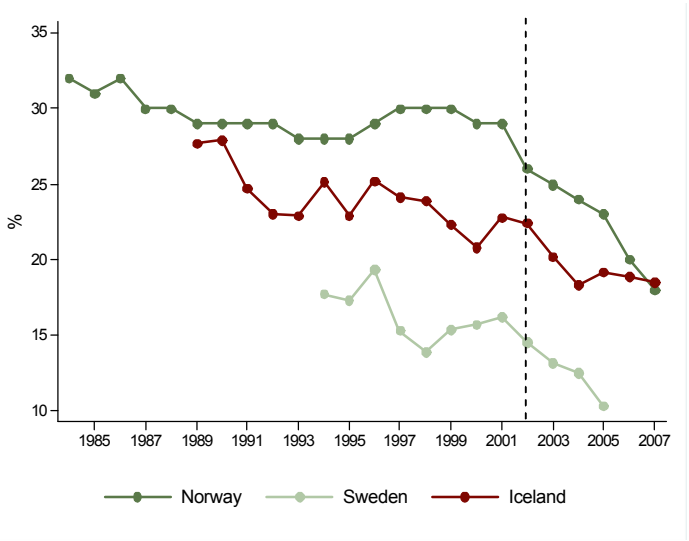


Source: OECD Health data.

The same trend occurs in the smoking prevalence rates of 15 to 24 year olds in these three countries (see Figure 9), where the vertical dashed line again identifies the point in time when the display ban was introduced in Iceland). Smoking rates have been declining since the late 1980s for this age group as well, although the decline of smoking prevalence has been slightly less pronounced than for the total population.

[25] Hakala, K. and M. Waller (2003), "Nordic Tobacco Control – towards smoke-free societies", Norden, publication number 2003:737. All five Nordic countries (Denmark, Finland, Iceland, Norway and Sweden) have a "common approach to the organisation of social and health affairs" (p. 9). "The Nordic Council of Ministers has steered inter-Nordic cooperation on social affairs and health since 1977." (p.10). The main difference between the Nordic countries lies in the use of snus which has traditionally been popular in Sweden. Smoking among men in Sweden is low (18%) in part due to the consumption of snus. We did not include Denmark and Finland as benchmark countries because data on smoking rates was not available for all age groups.

Figure 9: Percentage daily smokers in Iceland, Norway and Sweden, 15-24 year olds



Source: OECD Health data

Again, if the display ban had an effect on smoking prevalence I would expect this rate of decline to speed up in Iceland relative to Norway and Sweden after 2001. However, the graph shows no such trend. If anything, it would appear that the decline after 2001 is faster in Norway and Sweden than in Iceland. In Norway and Sweden, smoking rates fell from 2001 to 2008 by 38% and 36%, respectively. In Iceland smoking rates declined by 23% over the same period.

However, as I have explained above, smoking prevalence is affected by many factors. It is therefore possible that the display ban *did* have an effect on smoking prevalence in Iceland but that this effect is "hidden" in these graphs because it is counteracted by the opposing effect of other factors. In other words, the simple cross-country comparison faces the same problems as the simple comparison of Icelandic smoking rates over time in section 3.2: it is not possible to disentangle the effect of the display ban from the effects of other regulations, the evolution of cigarette prices, etc.

3.4 Multiple regression analysis

It should now be clear that, in order to properly assess the impact of the display ban on smoking prevalence, I need to take account of all factors that may explain changes in smoking prevalence over time and between countries, and not just the implementation of the display ban. This requires using *multiple regression* techniques.[26] These techniques make it possible to estimate the relationship between two variables (e.g., smoking prevalence and a display ban), when the variable under investigation (smoking prevalence in our case) is influenced by many other factors (e.g., cigarette prices).

[26] See Stock, J. H., and M. W. Watson (2003), *Introduction to Econometrics,* Boston, MA: Addison Wesley, Chapter 11. See also D. Rubinfeld (2000), "Reference Guide on Multiple Regression" in *Reference Manual on Scientific Evidence*, Second Edition, Federal Judicial Center.

Using a multiple regression analysis, I can therefore quantify the impact on smoking prevalence of a display ban. More precisely, I can estimate by how much smoking prevalence would change if a display ban is introduced while all other factors influencing the smoking rate are kept constant. And, furthermore, I can test whether this relationship is *statistically significant*.

Statistical significance is important because the relationships I identify are *estimates* of the true relationship. There is likely to be some difference between my estimate and the underlying true relationship. This is the case with any statistical analysis. There are various reasons for this:

- The data I use, although it comes from the most reliable sources, such as national statistical offices, is mainly based on surveys. Although these surveys are conducted rigorously there will inevitably be some small difference between the result of a survey and the underlying facts.
- Smoking prevalence is affected by many factors, not all of which can be measured. For example, smoking rates might be affected by the level of press coverage of health issues, which would be very difficult to measure. This means that my analysis does not capture every conceivable explanatory effect (although as explained below the relationships I identify can explain more than 80% of the variation of smoking rates in the data I examine).

For these reasons it is possible to find a small relationship between two variables when in practice no such relationship exists. To guard against this possibility, statisticians and social scientists have developed tests to assess how likely it is that a relationship really exists between two variables. The commonly accepted practice is that a relationship is said to be "statistically significant" only if these tests show that there is a high probability that a relationship really exists. If this threshold is not met then we cannot be confident that any observed relationship between the two variables really exists.

In summary, the use of multiple regression allows me to (a) estimate the size of the impact of the Icelandic display ban on smoking prevalence taking into account that many other factors may explain the decline in smoking rates; and (b) assess whether the estimated relationship between the display ban and smoking prevalence truly exists or is driven by chance.

Multiple regression techniques can be used to compare smoking prevalence in Iceland before and after the display bans or smoking prevalence across countries with and without display bans or to combine both approaches. I chose to combine both approaches because by using both the time and the cross-sectional dimension of the data, and controlling for the other factors that have been affecting smoking prevalence, I can more precisely estimate the impact of interest.[27]

[27] I have also performed the before and after approach using Icelandic data only. However, for the reasons explained in Section 3.2 and the small sample size I obtained weak results. I found that none of the regulations had a statistically significant impact on smoking rates and the R-squared of the model indicated a poor fit.

Section 4

Multiple regression results

In this section I describe the results of my multiple regression analysis and discuss my findings.

I estimated a multiple regression model where the smoking prevalence in each of the three countries for each of the years in the sample period is explained by several socio-economic factors (e.g. GDP, health expenditure, gender), tobacco control measures (e.g., ban on smoking in public free areas, introduction of health warnings in tobacco packages, etc.), tobacco prices and country specific effects that do not vary over time.[28] This model was estimated for two age groups: (1) the group of individuals aged 15 to 24 years and (2) the group of individuals aged 15 to 79 years.

4.1 Individuals aged 15 to 24 years

Table 3 below shows the results of the multiple regression analysis of the impact of tobacco control measures on smoking prevalence in Iceland, Norway and Sweden among the individuals aged 15 to 24 years. The first column of the table identifies the explanatory variables included in the analysis. The second column contains the estimated coefficients. These show the direction and the magnitude of the effect on smoking incidence of a change in the explanatory variables. The third column contains the significance level of the estimated coefficients. Values of 0.05 or below indicate that the estimated coefficient is statistically different from zero, that is, the estimated coefficient is not the product of random chance with a level of confidence or 95% or more.

[28] This approach, usually referred to as difference-in-difference (DID) estimator, has become widespread in empirical economics. "The DID approach is often associated with so-called 'natural experiments', where policy changes can be used to effectively define control and treatment groups." (See Imbens, G. and J. Wooldridge (2009), "Recent Developments in the Econometrics of Program Evaluation", *Journal of Economic Literature*, Vol. 47, No. 1, p. 67.) The main advantage of using this approach is that it allows disentangling the effect of the policy change from other factors that may have changed over time and are unrelated to the policy change. Furthermore, by taking into account characteristics of the different countries included in the sample and including country fixed effects, the estimated impact is not affected by any systematic differences in smoking rates between countries. (See Wooldridge, J. (2002), *Econometric Analysis of Cross Section and Panel Data,* Cambridge: MIT Press, p. 130.) In the empirical tobacco control literature this approach has been applied in the past to estimate the impact of specific measures, such as advertising bans, using data for several OECD countries. (See for example, Hamilton, J. (1975), "Effects of tobacco advertising restrictions", *Proceedings of the Third World Conference on Smoking and Health*, DHEW, Washington, DC, pp. 829-840; Stewart, M. (1993), "The effect on tobacco consumption of advertising bans in OECD countries", *International Journal of Advertising*, Vol. 12, pp. 25-32; and Nelson, J. (2003), "Cigarette demand, structural change and advertising bans: international evidence", *Contributions to Economic Analysis and Policy,* Vol. 2, Issue 10, Article 10.)

The estimated model performs very well according to standard statistical criteria. It explains the vast majority, more than 80% of the variation in smoking rates between 1987 and 2007. This is shown by the fact that the R-squared statistic, at the bottom of the table, is close to one (0.86).[29]

My results confirm that higher tobacco prices, driven to a great extent by higher government taxes, reduce smoking prevalence. According to my estimates, an increase of the relative price has a negative and statistically significant effect on smoking prevalence. The estimated coefficient of the relative price of cigarettes indicates that a 10 percentage point price increase decreased average smoking rates by 0.8 percentage points (see row 7 Table 3). [30] That is, given an average smoking rate of 23%, an increase of the relative price of tobacco index from 110 to 120 is estimated to reduce smoking rates to 22.2%.[31]

The results also support the effectiveness of certain tobacco control measures. I found that bans on smoking in public areas, in restaurants and pubs had a negative and statistically significant relationship with smoking prevalence. For example, I found that the average smoking rate in Iceland, Norway and Sweden for those aged 15 to 24 years declined by one percentage point as a result of the ban on smoking in public areas (see row 2, Table 3). Likewise, the ban on smoking in restaurants and pubs led to a decrease of two percentage points in the average smoking rates of 15-24 year olds in Norway, Sweden and Iceland (see row 5, Table 3). Furthermore, I estimated that the introduction of 30/40 health warning labels reduced average smoking rates by three percentage points in these three countries (see row 3, Table 3).[32] It is important to note, however, that this estimated effect may be capturing both the impact on smoking incidence of the existence of health warnings, introduced prior to the beginning of my sample, and the size increase of the label implemented at a later date. When I estimated the same model on the set of countries for which smoking prevalence data is available prior to the implementation of the health warnings, I found that the introduction of health warnings had a negative and statistically significant effect on smoking prevalence and that the change in label size did not have an impact on smoking prevalence (see Annex 4).

In contrast, I find that display bans did *not* have a significant impact on smoking rates in Iceland. The estimated coefficient shown in the first row of the table is negative but very small (less than half a percentage point) and *not* statistically significant. This means that it is not possible to assert that the impact is different from zero. In plain words, the results

[29] The R-squared is a statistic that measures the percentage of variation in the dependent variable that is accounted for by all the explanatory variables. Thus, it provides a measure of the overall goodness-of-fit of the multiple regression equation. Its value ranges from 0 to 1, with an R-squared of zero meaning that none of the explanatory variables contribute to explaining the variation of the dependent variable around its mean. An R-squared of one, on the other hand, means that the explanatory variables explain the variation in the dependent variable perfectly. See Rubinfeld, L. and P. Steiner (1984), "Quantitative Methods in Antitrust Litigation", *Law and Contemporary Problems*, Vol. 46, No. 4, p. 100.

[30] The estimated impact of a relative price increase on smoking incidence is not an elasticity measure that quantifies the response of tobacco consumption to an increase in tobacco prices. It quantifies the impact of price increases on the number of smokers.

[31] I have used the ratio of the tobacco consumer price index and the general consumer price index (2005 = 100, graphs in annex 1 show the evolution of the index in each country). This allows me to have a homogeneous measure of the evolution of tobacco prices relative to the price of the average basket of goods purchased by consumers in each country. An increase in the relative tobacco price index from 110 to 120 represents an 8.3% increase in relative tobacco prices, which is equivalent a 8.3% increase in tobacco prices assuming constant general consumer prices.

[32] See the EC Directive 2001/37 concerning the manufacture, presentation and sale of tobacco products available at: http://eur-lex.europa.eu/pri/en/oj/dat/2001/l_194/l_19420010718en00260034.pdf."

offer no support for the claim that a display ban is likely to cause a reduction in smoking prevalence among youth. To the extent that there is an observed relationship between the introduction of the display ban and smoking rates, it is very small and may be due to random chance.

Table 3: Estimated impact of tobacco control measures on smoking prevalence, 15-24 year olds. Dependent variable: Smoking rate (x100)

Row No.	Explanatory variables	Estimated coefficient	p-value
1	**Display ban**	**-0.2671**	**0.8061**
2	Ban on smoking in public areas	-1.3902**	0.0320
3	Introduction of 30/40 health warning label	-3.0116***	0.0021
4	Ban on brand sharing	1.2548	0.1390
5	Ban on smoking in pubs, bars and restaurants	-2.0115*	0.0757
6	Sex [=Males]	-1.0291**	0.0232
7	Relative CPI tobacco	-0.0808***	0.0033
	Constant	25.3998***	0.0000
	Country fixed effects	YES	
	Observations	110	
	R-squared	0.8647	

*Notes: [1] *, **, and *** indicates that the estimated coefficient is significant at the 90%, 95% and 99% confidence level; [2] the sample period covers 1989- 2007; [3] relative CPI Tobacco is defined as the ratio of the tobacco consumer price index and the general consumer price index; [4] the constant is sample average smoking rate in the country of reference country (i.e. the country not included in the fixed effects which in this case is Sweden); [5] the country fixed effects capture the difference between the country's average smoking rate and the average smoking rate in the country of reference (measured by the constant). The estimated fixed effect coefficients indicate that smoking prevalence in Norway is 9.7 percentage points higher than in Sweden and that smoking rates in Iceland are 5.2 percentage points higher than in Sweden; [6] the coefficient for males is negative and statistically significant due to the consumption of snus tobacco in Sweden. In Sweden the proportion of men that use snus is higher than the proportion of men that smoke and the opposite is true for women. When I introduce in this model a snus variable I construct based on the limited available data, the estimated coefficient for males becomes positive and ceases to be statistically significant; [7] see Annex 5 for a description of the regulatory measures included.*

Source: Authors' calculations using data provided obtained from PHII, OECD Health Data and Statistics Iceland, Statistics Norway and Statistics Sweden.

4.2 Individuals between 15 and 79 years

I found very similar results when I used the same econometric model to estimate the impact of display bans on smoking prevalence of 15 to 79 year olds.

Table 4 below shows the average estimated impact of tobacco control measures on smoking prevalence for this wider age group. This model also performs very well explaining more than 90% of the variation in smoking rates between 1987 and 2007.

I again found that display bans were *not* an effective tobacco control measure in Iceland. The estimated impact is negative but very small (less than one percentage point) and not statistically significant (see row 1, Table 4). In contrast, these results support the

effectiveness of the introduction of 30/40 health warning labels (see row 3, Table 4). As mentioned previously, the estimated coefficient of the 30/40 health warning is likely to be also capturing the impact on smoking prevalence of the introduction of health warning in the mid 1970's and early 1980's in Norway and Iceland and in 1993 in Sweden.[33]

According to my estimates, tobacco price increases have a negative and statistically significant relationship with smoking prevalence (see row 7, Table 4). In particular, I find that increases in the relative price of tobacco had a negative and significant impact on smoking rates. I estimate that a 10 percentage point increase in the relative price of tobacco decreased average smoking rates by 1.7 percentage points. That is, assuming a smoking rate of 20%, an increase in the relative tobacco price index from 110 to 120 is estimated to reduce smoking rates to 18.3%.[34]

Table 4: Estimated impact of tobacco control measures on smoking prevalence, 15-79 year olds. Dependent variable: Smoking rate (x100)

Row No.	Explanatory variables	Estimated coefficient	p-value
1	**Display Ban**	**-0.8794**	**0.4209**
2	Ban on smoking in public areas	-0.8456	0.3713
3	Introduction of 30/40 health warning label	-2.6155***	0.0003
4	Ban on brand sharing	0.9032	0.2158
5	Ban on smoking in pubs, bars and restaurants	-0.2446	0.7633
6	Sex [=Males]	0.9836**	0.0121
7	Relative CPI Tobacco	-0.1702***	0.0000
	Constant	36.1159***	0.0000
	Country FE	YES	
	Observations	110	
	R-squared	0.9159	

*Notes: [1] *, **, and *** indicates that the estimated coefficient is significant at the 90%, 95% and 99% confidence level; [2] the sample period covers 1989- 2007; [3] relative CPI Tobacco is defined as the ratio of consumer price index for tobacco and the general consumer price index; [4] the constant is sample average smoking rate in the country of reference country (i.e. the country not included in the fixed effects which in this case is Sweden); [5] the country fixed effects capture the difference between the country's average smoking rate and the average smoking rate in the country of reference (measured by the constant). The estimated fixed effect coefficients indicate that smoking prevalence in Norway is 7.3 percentage points higher than in Sweden and that smoking rates in Iceland are 2.7 percentage points higher than in Sweden; [6] I estimate that smoking incidence on males is around 1% higher than smoking incidence on females. Taking into account snus consumption (see explanatory note in Table 3), the estimated smoking rate for males is 2.2 percentage points higher than for females; [7] see Annex 5 for a description of the regulatory measures included.*

Source: Authors' calculations using data provided obtained from PHII, OECD Health Data and Statistics Iceland, Statistics Norway and Statistics Sweden.

[33] I am unable to estimate the impact of the introduction of health warning labels in Sweden in this model because the indicator variable of the health warning is perfectly collinear with the country fixed effect. This means it would be impossible to determine whether the estimated coefficient is capturing the impact of the health warning or of other country specific factors that affect smoking rates (e.g. the use of snus). I estimate the impact of the introduction of health warnings in Sweden and other countries in Annex 4.

[34] The estimated impact of the effect of prices on smoking rates is higher for 15-79 year olds than for 15-24 year olds. This finding is consistent with greater discretionary expenses faced by the older population which explains in part the observed pattern of downtrading of adults in their late 20's and early 30's.

In summary, the empirical evidence indicates that display bans did not reduce smoking prevalence of 15-24 year olds in Iceland. The same is true for 15-79 year olds.

4.3 Robustness

It is important to establish that these results do not depend on the way that my analysis was conducted. The results I report above are based on a specific set of data and a specific choice of explanatory variables. If these results are correct, I should obtain qualitatively the same results if I add more countries to the data or if I add more explanatory variables to the model. In order to ensure that this is the case I have carried out these "robustness" checks.[35]

The results I described above are robust. I re-estimated the regression model including additional control variables (in particular, health expenditure, GDP and migration) and found the results remained qualitatively unchanged. Similarly, I extended the set of benchmark countries using data on all European countries with publicly available smoking incidence data.[36] I continued to find that point of sale regulation had no impact on Icelandic smoking prevalence.[37]

In summary, I found that the impact of display bans was statistically insignificant irrespective of the choice of data and econometric model specification used.

[35] It is standard good practice in statistical analysis to carry out such sensitivity or robustness tests. The two standard approaches to conduct robustness tests are to check that results are not sensitive to changes in (i) the data sample and (ii) the choice of estimation model. See Kennedy, P. (2003), *A Guide to Econometrics,* Fifth Edition, Cambridge, MA: The MIT Press, Chapter 20.
[36] Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Spain, Sweden and United Kingdom.
[37] See Annex 3 for detailed results.

Section 5

Conclusions

My empirical investigation of the impact of display bans on tobacco consumption in Iceland shows that the introduction of this regulatory measure had *no* statistically significant effect on smoking prevalence in that country. This is true for all age groups for which data was available. Therefore, I found no support for the claim that a display ban is likely to cause a reduction in smoking prevalence.

In contrast, tobacco price increases, driven mainly by increases in taxes, had a negative and statistically significant impact on smoking prevalence. Furthermore, other tobacco control measures, like bans on smoking in public areas and health warnings on cigarette packages were effective tobacco control measures, as they had a negative and statistically significant effect on smoking prevalence.

In other words, the experience in Iceland does *not* suggest that a display ban would reduce smoking prevalence, and instead shows that other measures may be more effective in controlling tobacco consumption.

Annex 1
Descriptive analysis

This appendix briefly describes the data I have used for the econometric analysis.

I used public information on smoking rates, tobacco prices and dates of regulatory measures implemented in each country.

I obtained the dates of implementation of the regulatory control measures in each country from the World Health Organisation. This information was reviewed by PMI. Table 2 in the main text and Table 5 below summarize this information for Iceland and Norway and Sweden, respectively.

Table 5: Timing of tobacco control measures in Norway and Sweden

Tobacco control measure	Iceland	Norway	Sweden
Ban on TV advertising	1972	1996	1994
Ban on direct advertising in magazines and newspapers	1972	1996	1994
Ban on indirect advertising	1984	1996	1994
Ban on smoking in public transport	1984	1998	1994
18 year minimum age requirement	1984	1975	1993
Introduction health warning labels	1985	1975	1993
Minimum pack size	1996	none	none
Tar/nicotine ceilings first implemented	1998	1996	1994[2]
Ban on smoking in the workplace	1999	1988	2005
Ban on smoking in public areas	1999	1988	1994
Ban on brand sharing	2001	1996	2003
Display ban	2002	none	none
Introduction 30/40 health warning label	2004	2003	2002
Tar/Nicotine ceilings lowered	2004	2003	2004
Ban on smoking in pubs and bars	2007	2004	2005

Note: [1] I am using annual data, therefore, measures implemented in the second half of the year were assigned to the following year; [2] Only applicable to tar content
Source: World Health Organisation, reviewed by PMI.

I obtained smoking rates from the Public Health Institute of Iceland, the Great Britain General Household Survey and the OECD Health Database. Table 6 below shows the available data for EU-15 countries.

Table 6: Smoking rates, data available for EU-15 countries, Norway and Iceland

	15-24 years	15-79 years
Belgium	1997-2004 [1]	1984-2006
Denmark		1984-2004
Finland		1984-2006
France		1987-2006 [4]
Germany [2]	1989-2005	1989-2005
Greece		1987-2004 [5]
Iceland	1989-2007	1987-2007
Ireland		1985-2002 [6]
Italy	1993-2007 [3]	1986-2007 [7]
Luxembourg		1987-2007 [8]
Netherlands		1984-2006
Norway	1984-2007	1984-2007
Spain	2006	1985-2006 [9]
Sweden	1994-2005	1984-2005
United Kingdom [10]	1972-2007	1972-2007

Notes: [1] Smoking rates for 1997, 2001 and 2004 are not available by sex; [2] smoking rates for 1989, 1992, 1995, 1999, 2003 and 2005; [3] smoking rate for 2004 not available; [4] smoking rates for 1996, 2003 and 2005 not available, [5] annual data from 1988 to 1992, 1994, 1998, 2000 and 2004; [6] smoking rates from 1985 to 1994, 1998 and 2002; [7] smoking rates from 1993 to 2007 (excluding 2004); [8] smoking rates for 1987, 1990, 1992, 1998 and for 2001-2007; [9] smoking rates for 1985, 1987, 1989,1993,1995,1997, 2001, 2003 and 2006; [10] biannual data from the Great Britain General Household Survey from 1984 to 1998 and annual data between 1972 and 1984 and between 2001 and 2006; [11] Austria and Portugal are not included since the available information covers 4 years or less

Source: OECD Health database 2008.

I obtained data on tobacco prices from the national statistics office each country and from Eurostat.

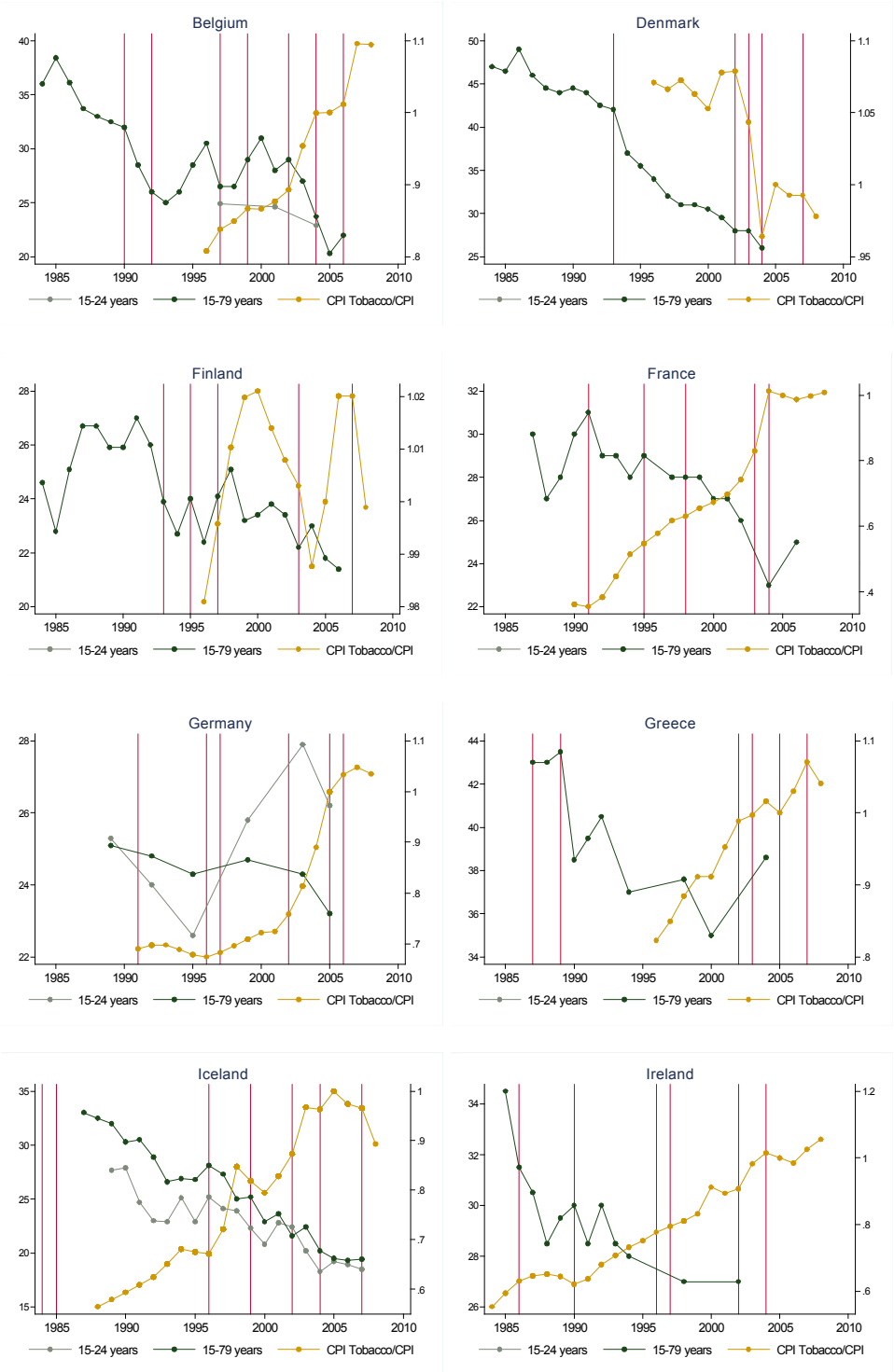
Table 7: Tobacco consumer price index

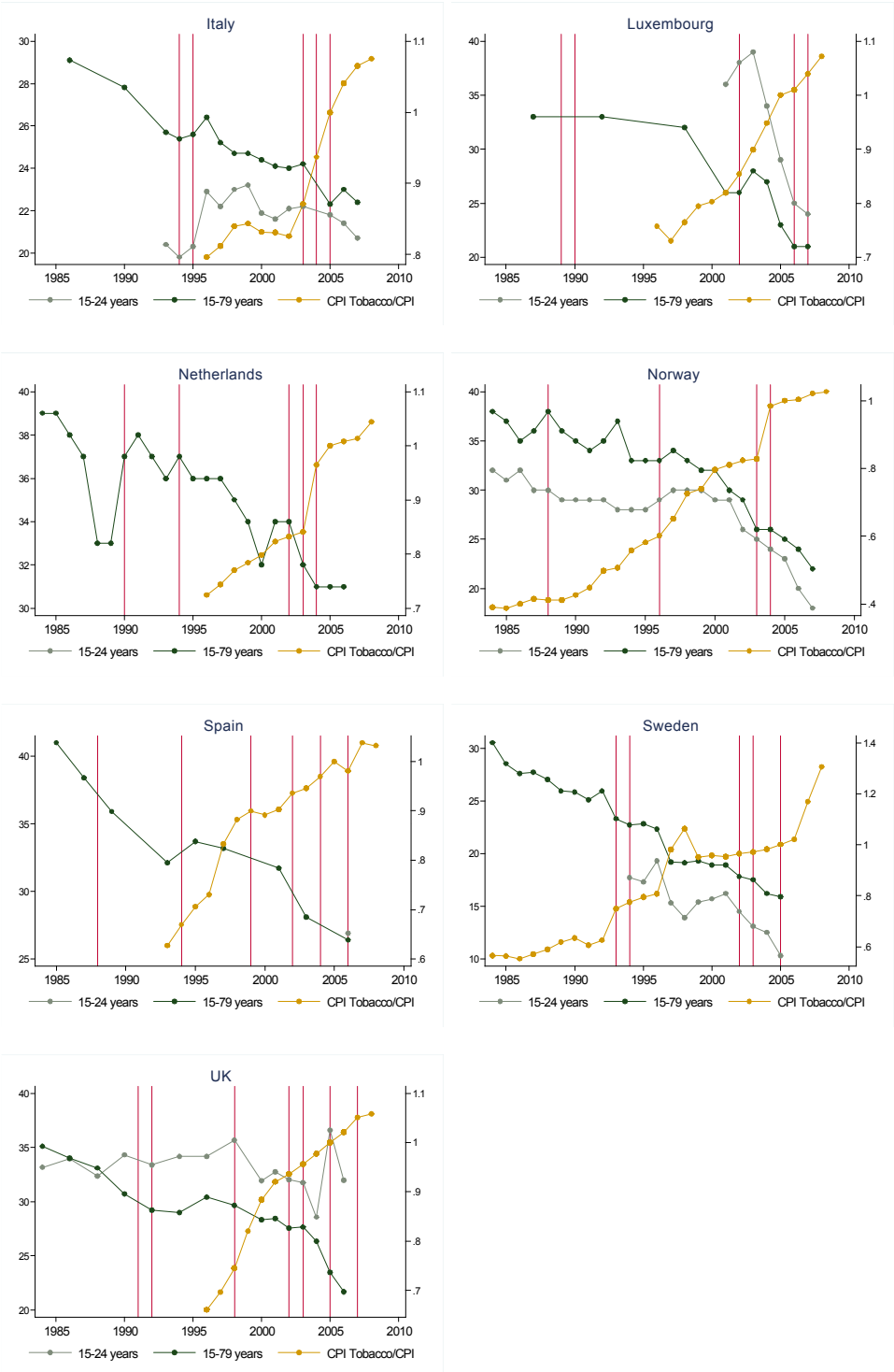
Country	Source	Available data
Belgium	Statistics Belgium	1998-2008
Denmark	Statistics Denmark	2000-2008
Finland	Eurostat[1]	2001-2008
France	National Institute of statistics and economic studies	1991-2008
Germany	Statistisches Bundesamt Deutschland	1991-2008
Greece	General Secretariat of national statistical service of Greece	1996-2008
Iceland	Statistics Iceland	1988-2008
Ireland	Central Statistics Office	1976-2008
Italy	L'Istituto nazionale di statistica	1996-2008
Luxembourg	Statec Luxembourg	1996-2008
Netherlands	Statistics Netherlands	1996-2008
Norway	statistics Norway	1979-2008
Spain	Instituto Nacional de Estadística	1985-2008
Sweden	Statistics Sweden	1980-2008
UK	UK National Statistics	1996-2008
EU-15 [1]	EUROSTAT	1996-2008

Notes: [1] For Finland I used the tobacco harmonized index of consumer prices from Eurostat because the index provided by the national statistic office included the price of alcohol.

The graphs below show the evolution of tobacco prices and smoking rates in all EU-15 countries.

Figure 10: Evolution of tobacco prices and smoking rates





Notes: Vertical lines representing regulatory measures
Source: LECG analysis using data from OECD Health database 2008, Great Britain General Household Survey, and National Statistics services.

Table 8 shows the average value of all the additional explanatory variables I used in the econometric analysis. The table includes some variables that are not reported in the final results because they were not statistically significant and/or were highly correlated with tobacco prices. For example, the unemployment rate was not statistically significant because it remained relatively stable over the period 1994-2005 in Iceland, Norway and Sweden.[38] In the case of the GDP per capita, we found that it was not statistically significant because in each country it followed a trend similar to that of the relative price of cigarettes and thus both variables were highly correlated in sample.

Table 8: Explanatory variables, average values between 1990 and 2007

	GDP Per Capita, Annual, Current Prices and Current PPPs (in USD)	GDP Per Capita, Annual, Current Prices and Current Exchange rate (in USD)	Total expend. on health, % GDP	Current and capital expend. on Education (all levels)	Unemployment rate	Net migration rate per 1000 inhabitants
Belgium	26153.9	27029.4	8.8	13970.8	8.3	3.2
Denmark	26259.7	33889.8	8.6	82794	5.7	2.2
Finland	23647.0	27123.6	7.8	7366.7	10.6	1.2
France	23667.2	25688.5	10	82063.6	9.8	1.2
Germany	25728.8	28856.6	10.3	110227.7	8.5	3.6
Greece	17979.8	13997.3	8	4864.9	10.6	6
Iceland	29268.3	36265.8	9.1	51050.1	0	3.6
Ireland	23763.5	25030.2	6.8	4009	8.3	4.1
Italy	24714.6	23289.4	8.1	55724	9.7	3.8
Luxembourg	59120.7	66040.3	6.7	667.5	3.4	9.9
Netherlands	27019.2	28180.8	8.4	18689.3	4.5	2.9
Norway	33003.6	43171.8	8.2	87072.9	4.2	3
Spain	21687.8	18956.1	7.6	29420.8	13.5	7.9
Sweden	25982.2	30662.8	8.6	137643.2	7	2.6
UK	26529.4	28168.6	7.5	55429.3	6.3	1.5

Source: OECD and Eurostat

[38] The average smoking rate in Iceland, Norway and Sweden declined by 2.7% between 1994 and 2005 while the average unemployment rate declined by 0.3% over the same period.

Annex 2
Empirical methodology

To estimate the impact of the display ban on smoking prevalence in Iceland, after accounting other factors that might have also influenced smoking rates, I used multiple regression techniques.

In particular, to estimate the impact of the display ban on smoking prevalence, I estimated the following econometric model:

$$Y_{it} = \alpha + \gamma \cdot R_{it} + \beta \cdot X_{it} + \delta \cdot FE + \varepsilon_{it} \qquad [1]$$

where:

- i refers to country and t refers to year;
- Y_{it} is the dependent variable, which measures the percentage of daily smokers in country i at year t;
- R_{it} is a vector of indicator variables that indicate when the different tobacco control measures in each country were implemented;[39]
- X_{it} is a variable that measures the relative price of tobacco in country i at year t;
- FE is a vector of sex and country fixed effects intended to capture the differences in the average smoking rates of males and females and between countries; and
- ε_{it} is the standard error term, which is assumed to be zero, on average, and normally distributed.

The estimated coefficient β measures the change in smoking rate in response to the change in the relative price of tobacco. The coefficients γ measure the effect on smoking rates of the different regulatory measures.

When comparing the evolution of smoking rates over time I exploited the fact that not all the countries in the sample had implemented display bans. The evolution of smoking rates in those countries without display bans provide a good benchmark to assess the effect of tobacco display restrictions on smoking prevalence. Finding that the display bans did not have an impact on the evolution of smoking prevalence in Iceland in comparison to smoking rates in Norway and Sweden, after controlling for other factors that influence smoking rates, is therefore a good indication that the display bans are not an effective tobacco control measure.

[39] The variables in this vector (e.g. last health warning change, smoke free public areas) take the value of one starting the year the regulatory measure was implemented and zero before. Thus, the last heath warning change variable in Iceland for example takes the value of 1 from 2004 onwards and zero from the beginning of the sample until 2003.

Annex 3
Robustness analysis

The standard practice in econometric analysis is to evaluate the reliability of empirical results by conducting sensitivity analysis. Results are robust when they do not differ significantly with small modifications of the data or the estimation model.

In this section I present the detailed econometric results obtained from the various robustness analyses I performed:

- I re-estimated the regression model including additional control variables (in particular GDP, health expenditure and demographic variables); and
- I re-estimated the model adding data on all EU-15 countries with publically available smoking incidence data.[40]

In all cases I found that the impact of POS regulation remained statistically and economically insignificant.

Inclusion of additional control variables

First, I present the results obtained when I re-estimate the econometric model above including additional control variables. [41]

Table 9 below compares the results of the baseline model in Table 3 (column [1]) with the different estimations including additional economic and demographic variables.

I found that:

- The impact of the display ban is negative, as expected, but small and not statistically significant; and
- GDP and health expenditures had a negative impact on smoking rates. However, the estimated coefficients of these two variables are not statistically significant because in each country both follow a trend similar to that of the relative price of cigarettes. This implies that neither the GDP nor the health expenditure coefficients can be reliably estimated when included in the estimation model together with the relative price of cigarettes due to multicollinearity problems.
- Migration is estimated to have had a positive impact on smoking prevalence.[42]

[40] The model for 15-24 year olds is estimated using data for Germany Iceland, Italy, Norway, Sweden and UK. The model for 15-79 year olds is estimated using data from Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Spain, Sweden and UK.

[41] I have performed one additional robustness test including the lag of the smoking rate as explanatory variable. To fit the model I have used the Arellano-Bond consistent generalized method-of-moments (GMM) estimator. I continue to find that the display ban does not have a statistically insignificant impact on smoking prevalence.

Table 9: Estimated impact of tobacco control measures on smoking prevalence, 15-24 year olds

	[1]	[2]	[3]	[4]
Display Ban	**-0.2671**	**-0.2457**	**-0.7635**	**-0.5158**
	[0.8061]	**[0.8207]**	**[0.5728]**	**[0.6620]**
Ban on smoking in public areas	-1.3902**	-1.4785**	-1.2803*	-1.3045*
	[0.0320]	[0.0299]	[0.0531]	[0.0931]
Introduction 30/40 health warning labels	-3.0116***	-3.1171***	-2.8173***	-2.9292***
	[0.0021]	[0.0017]	[0.0069]	[0.0029]
Ban on brand sharing	1.2548	1.1657	1.4293*	1.1331
	[0.1390]	[0.2032]	[0.0990]	[0.2019]
Ban on smoking in pubs, bars and restaurants	-2.0115*	-2.1437*	-1.7751	-1.6599
	[0.0757]	[0.0671]	[0.1377]	[0.1459]
Sex [=Males]	-1.0291**	-1.0291**	-1.0291**	-1.0302**
	[0.0232]	[0.0238]	[0.0236]	[0.0257]
Relative CPI Tobacco	-0.0808***	-0.0839***	-0.051	-0.0665**
	[0.0033]	[0.0061]	[0.4093]	[0.0332]
Accumulated migration / Total population		13.1905		
		[0.7579]		
GDP Per Capita, Annual, Current Prices and Current PPPs (in USD)			-0.0001	
			[0.5524]	
Total expenditure on health, % GDP				-0.1468
				[0.8030]
Constant	25.3998***	35.1072***	35.0875***	35.4513***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Country FE	YES	YES	YES	YES
Observations	110	110	110	106
R-squared	0.8647	0.8648	0.8653	0.8645

*Notes: [1] *, **, and *** indicates that the estimated coefficient is significant at the 90%, 95% and 99% confidence level; [2] p-values are reported in brackets; [3] the sample period covers 1989- 2007; [4] relative CPI Tobacco is defined as the ratio of consumer price index for tobacco and the general consumer price index; [5] see Annex 5 for a description of the regulatory measures included.*

Source: Authors' calculations using data provided obtained from PHII, OECD and Statistics Iceland, Statistics Norway and Statistics Sweden.

Extension of benchmark country sample

To test the sensitivity of the results to a modification of the data sample, I gathered additional data on smoking prevalence of 15-79 year olds and 15-24 year olds for the following countries in Europe: Belgium, Denmark, Finland, France Greece, Ireland, Luxembourg, Netherlands and Spain in the case of 15-79 year olds and Germany, Iceland, Italy, Norway, Sweden and UK in the case of 15-24 year olds.[43]

Table 10 and Table 11 summarize the implementation dates of tobacco control measures across the countries for which I have smoking prevalence data. In Europe, the Directive

[42] The share of migrants in the total population (accumulated migration / total population) is included to capture the possible effect to a change in the population composition on smoking prevalence.

[43] I obtained this data from the OECD. Smoking prevalence data was not available or very limited (i.e., only one or two years of data was available) for Austria and Portugal. Smoking rates for UK were obtained from the Great Britain General Household Survey.

on *the approximation of the laws, regulations and administrative provisions of the Member States concerning the manufacture, presentation and sale of tobacco products*[44] regulates the implementation of tobacco control measures across all countries.

Table 10: Timing of tobacco control measures in Germany, Italy, UK, Luxembourg, Netherlands and Spain

	Germany	Italy	UK	Luxembourg	Netherlands	Spain
Ban on TV advertising	1974	1962	1965	1989	1990	1994
Ban on advertising in magazine and newspapers	2006	1962	2003	2006	2003	2006
Ban on indirect advertising	[1]	1962	2003	2006	2002	2006
Ban on smoking in public areas	[2]	1995 [3]	2007	1989	1990	2006
Ban on smoking in public transport	2007	1975 [4]	2007	1989 [5]	2004 [6]	1999
Ban on smoking in pubs and bars	[2]	2005	2007	2006 [10]	[7]	2006
Introduction health warning labels	1997	1994	1991 [11]	1989	1990	1999
Introduction 30/40 health warning labels	2005	2003	2002	2007	2002	2002
Introduction of T/N ceilings	1991	1993	1992	1990	1994	2004
T/N ceilings lowered (interim change)	1996	1998	1998	1998	1997/2002	none
T/N ceiling lowered (last update)	2004	2004	2003	2002	2004	2004
18 year minimum age requirement	2007	1934	2007 [8]	2006	1990	1988
Ban on brand sharing	none	1962	2005	1989	2002	2006
Display ban	none	none	[9]	None	none	none
Minimum pack size	2009	2005	1991	1990	1990	2006

Notes: [1]Restriction on promotional events was introduced in 2006 and ban on promotional discounts was introduced in 1992; [2] smoking restriction in public areas and in pubs and restaurants in 2008; [3] in 1995 smoking was banned in health care facilities and theatres and cinemas, education facilities and government facilities and restricted in indoor workplaces and offices; in 1975 Smoking restricted in government facilities and workplaces; in 1980 smoking restricted in Health care and education facilities; and in 2005 smoking banned in indoor workplaces and offices and in government facilities; [4] buses only. Smoking restriction in other public transport in 1980 and banned in 2005; [5] smoking restriction in trains and air transport; [6] air transport in 2002; [7] restriction in 2008; [8] from 2007 onwards 18 years old, previously 16 year old age limit; [9] display restrictions in 2004; [10] smoking is banned in HORECA (hotel, restaurant and other catering services) if food is served since 5 September 2006; [11] voluntary agreement to include health warnings on cigarette packs in 1971.

Source: World Health Organization and reviewed by PMI.

[44] Directive 2001/37/EC of the European Parliament and of the Council of 5 June 2001. See http://eur-lex.europa.eu/pri/en/oj/dat/2001/l_194/l_19420010718en00260034.pdf

Table 11: Timing of tobacco control measures in Belgium, Denmark, Finland, France, Greece and Ireland

	Belgium	Denmark	Finland	France	Greece	Ireland
Ban on TV advertising	1999	1993	1971	1976	1987	1986
Ban on advertising in magazine and newspapers	1999	2002	1977	1976	2005	2004
Ban on indirect advertising	1999	2002	1997	1976	1987	2002
Ban on smoking in public areas	2006	2007	1977/1995	1991	1980 [5]	1990 [7]
Ban on smoking in public transport	1982	2007	1995 [2]	1991	2002	1996 [8]
Ban on smoking in pubs and bars	2006 [1]	2007	2007	2008	[6]	2004
Introduction health warning labels	1992	2003	1978	1991	1989	1986
Introduction 30/40 health warning labels	2002	2003	2003 [3]	2004	2003	2004
Introduction of T/N ceilings	2002	2004	2004	2004	2007	2003
T/N ceilings lowered (interim change)	1997	none	1998	1998	none	1997
T/N ceiling lowered (last update)	1992	2004	1977	1993	2007	1992
18 year minimum age requirement	2004	2004[9]	1995 [4]	2003	2009	2002
Ban on brand sharing	1999	2002	1977	1991	none	none
Display ban	none	none	none	none	none	2009
Minimum pack size	1990	none	2009	2003	2009	2002

Notes: [1] Smoke banned in pubs and bars only; [2] smoke banned in trains and air transport in 2004; [3] health warning amendments in 1980, 1986, 1991, 1993, 2000, 2002, 2003; [4] 16 minimum age in 1977; [5] 1980 and 2002; [6] restriction in 2002; [7] smoke banned in health care facilities in 2004; [8] smoke banned in air and water transport in 2000; [9] in 2004 the minimum age was set at 18, in 2008 it was increased to 18.

Source: World Health Organization and reviewed by PMI.

The results of the robustness analysis are displayed in Table 12 and Table 13 below.

For the 15-24 year olds (Table 12) I estimated the impact of the display ban in Iceland using a sample of countries that include Iceland, Italy, Germany, Norway, Sweden and UK (column 1). I also re-estimated the econometric model excluding Italy from the estimation (column 2) to make sure that including Italy where smoking prevalence is measured on daily and occasional smokers did not bias the results.[45]

[45] The Italian smoking prevalence figures are measured on occasional and daily smokers. The smoking prevalence figures of all the other countries are measured only on daily smokers.

I find that:

- the Icelandic display ban did not have a statistically significant impact on smoking rates;
- the ban on smoking in public areas, pubs and restaurants had a negative and statistically significant impact on smoking rates;
- the introduction of 30/40 health warning labels also had a negative and statistically significant impact on smoking rates, however, as the results in Annex 4 suggest, this estimated effect may be capturing both the impact on smoking incidence of the existence of health warnings, introduced prior to the beginning of my sample, and the change in size implemented at a later date; and
- a 10 p.p increase in the relative price of tobacco decreased smoking rates by 0.4 to 0.7 p.p.

Table 12: Estimated impact of tobacco control measures on smoking prevalence, 15-24 year olds

	GE+IC+IT NO+SE+UK [1]	GE+IC+NO +SE+UK [2]
Display Ban	-0.7733	-0.8702
	[0.3881]	[0.3539]
Ban on smoking in public areas	-1.8044***	-1.8126***
	[0.0022]	[0.0023]
Introduction 30/40 health warning label	-1.3554**	-1.8587***
	[0.0115]	[0.0023]
Ban on brand sharing	0.4891	1.1447*
	[0.4796]	[0.0950]
Ban on smoking in pubs, bars and restaurants	-2.0051**	-3.4236***
	[0.0138]	[0.0003]
Relative CPI Tobacco	-0.0619***	-0.0612***
	[0.0038]	[0.0035]
Constant	38.7243***	38.7900***
	[0.0000]	[0.0000]
Country/Sex FE	YES	YES
Observations	160	138
R-squared	0.9004	0.9044

*Notes: [1] *, **, and *** indicates that the estimated coefficient is significant at the 90%, 95% and 99% confidence level; [2] p-values are reported in brackets; [3] relative CPI Tobacco is defined as the ratio of consumer price index for tobacco and the general consumer price index; [4] see Annex 5 for a description of the regulatory measures included.*

Source: Authors' calculations using data provided obtained from PHII, OECD Health Data and National Statistics services.

I also tested the robustness of the results for the 15-79 years age group (see Table 13). For this age group smoking prevalence data is available for a larger set of countries.[46]

[46] Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Spain, Sweden and United Kingdom.

I find that:

- the Icelandic display ban did not have a statistically significant impact on smoking rates;
- the ban on smoking in public areas, pubs and restaurants had a negative and statistically significant impact on smoking rates;
- the introduction of 30/40 health warning labels also had a negative and statistically significant impact on smoking rates although, as mentioned above, this estimated effect may be capturing both the impact on smoking incidence of the existence of health warnings, introduced prior to the beginning of my sample in most countries, and the change in size implemented at a later date; and.
- a 10 p.p increase in the relative price of tobacco decreased smoking rates by 1.2 p.p.

Results remained unchanged when I excluded those countries for which daily and occasional smoking rates are reported.

Table 13: Estimated impact of tobacco control measures on smoking prevalence, 15-79 year olds

	All countries	Only daily smoking rate countries
Display Ban	-0.9749	-0.8768
	[0.1831]	[0.2510]
Ban on smoking in public areas	-1.6630***	-1.6963***
	[0.0005]	[0.0004]
Introduction 30/40 health warning label	-1.2576***	-1.7255***
	[0.0008]	[0.0000]
Ban on brand sharing	-0.5847	-0.4973
	[0.1962]	[0.3140]
Ban on smoking in pubs, bars and restaurants	-0.824	-1.4655**
	[0.1772]	[0.0408]
Relative CPI Tobacco	-0.1247***	-0.1150***
	[0.0000]	[0.0000]
Constant	35.0428***	34.3745***
	[0.0000]	[0.0000]
Country/Sex FE	YES	YES
Observations	352	286
R-squared	0.9073	0.8953

*Notes: [1] *, **, and *** indicates that the estimated coefficient is significant at the 90%, 95% and 99% confidence level; [2] p-values are reported in brackets; [3] relative CPI Tobacco is defined as the ratio of consumer price index for tobacco and the general consumer price index; [4] fixed effects for country and sex are included; [5] The daily smoking rate countries excludes Denmark (1984-1994); Italy; Luxembourg (1987-1994); Netherlands and Spain (1985-1989). These countries report daily and occasional smoking rates; [6] see Annex 5 for a description of the regulatory measures included.*

Source: Authors' calculations using data provided obtained from PHII, OECD Health Data and National Statistics services.

Annex 4
Estimated impact of mandatory health warnings

In most of the countries for which smoking prevalence data is available, the introduction of the health warnings predates my sample period. This implies that the estimated coefficient of the introduction of 30/40 health warning labels is likely to capture the effect of both the existence of the health warning and the latter modifications. To test this hypothesis I estimated the model using data only for those countries in which the health warnings became mandatory within the sample period (France, Germany, Ireland, Spain and Sweden). The results shown in Table 14 confirm my hypothesis. I find that the introduction of health warnings had a negative and significant impact on smoking prevalence and that the introduction of larger sized health warning labels was not statistically different from zero.

Table 14: Estimated impact of tobacco control measures on smoking prevalence, 15-79 year olds in countries where health warnings became mandatory within the sample period

	[1]
Ban on smoking in public areas	-1.7856***
	[0.0065]
Introduction health warning labels	-1.4872**
	[0.0259]
Introduction 30/40 health warning labels	-1.4223
	[0.1309]
Brand sharing	0.2603
	[0.8731]
Ban on smoking in pubs, bars and restaurants	-1.6293
	[0.3907]
Relative CPI Tobacco	-0.0827***
	[0.000]
Constant	29.3129
	[0.000]
Country/Sex FE	YES
Observations	118
R-squared	0.9126

*Notes: [1] *, **, and *** indicates that the estimated coefficient is significant at the 90%, 95% and 99% confidence level; [2] p-values are reported in brackets; [3] relative CPI Tobacco is defined as the ratio of consumer price index for tobacco and the general consumer price index; [4] fixed effects for country and sex are included; [5] the countries included in the estimation are France, Germany, Ireland, Spain and Sweden; [6] see Annex 5 for a description of the regulatory measures included.*

Source: Authors' calculations using data provided obtained from OECD Health Data and National Statistics services.

Annex 5
Glossary

Data on regulatory measures has been obtained from the World Health Organization and reviewed by PMI.

The regulatory measures included in the estimated models are the following:

- Ban on brand sharing: no sale of non-tobacco products with tobacco brand name; no sales of tobacco products with brand name of non tobacco products.
- Display ban: display ban at the point of sale.
- Introduction health warning: introduction of mandatory health warning labels on tobacco products and tobacco advertising: including placing of the message, area and content.
- Introduction 30/40 health warning label: adaptation of health warnings according to the EC 2001/37 directive concerning the manufacture, presentation and sale of tobacco products.
- Ban on smoking in public areas: ban on smoking in health care facilities, education facilities; government facilities, theatres and cinemas.
- Ban on smoking in pubs, bars and restaurants: smoking banned in pubs, bars and restaurants.