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September 2018

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WWZ Working Paper 2018/24

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A publication of the Center of Business and Economics (WWZ), University of Basel.

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# Tobacco Control Policies and Smoking Behavior in Europe: More Than Trends?

Reto Odermatt\* and Alois Stutzer†

September 12, 2018

## Abstract

In many European countries, there is an unmissable trend towards stricter tobacco control policies and a parallel reduction in the prevalence of smoking. The extent to which policies promote this latter trend, however, is less clear. We therefore analyze the staggered introductions of smoking bans and the variation in cigarette taxes over more than twenty years. After taking into account unobserved country- and time-specific effects as well as country-specific trends, we find no clear evidence that smoking bans are associated with lower levels of smoking. In contrast, higher cigarette prices tend to be negatively related to smoking, in particular for men and people under the age of 30. However, price elasticities are small. Overall, the results suggest that only about one sixth of the decline in the prevalence of smoking in Europe can be explained by our policy variables.

*Keywords:* Smoking bans, cigarette taxes, smoking behavior, tobacco control policies

*JEL classification:* D12, H31, I18, K32

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# 1 Introduction

Smoking is a major and persistent public health issue in many countries around the world (e.g., Jha and Peto 2014 or World Health Organization 2015). We focus on Europe, where the situation is characterized by a series of trends. There is a general downward trend in smoking prevalence. In the 12 member countries of the European Union back in 1992, 35.2 percent of the adult population smoked cigarettes on a regular basis. By 2012, the fraction is decreased to 26.1 percent in the same countries.<sup>1</sup> During the same time period, there is a clear upward trend in cigarette taxes and, consequently, in cigarette prices (see, e.g., Bogdanovica et al. 2012; Blecher et al. 2013). A more recent trend – and a fundamental extension of tobacco control policies in many European countries – is the introduction of smoking bans in the hospitality sector as well as at many workplaces (see, e.g., Studlar et al. 2011 or Toshkov 2013). With regard to the trends in cigarette tax increases and the introduction of smoking bans, there is a controversial debate as to whether these interventions are successful preventive health policies and whether and to what extent they promoted the observed decline in smoking prevalence in Europe. In fact, there might be an underlying fourth trend towards generally less favorable attitudes regarding the consumption of cigarettes affecting smoking prevalence as well as electoral support for tougher policy interventions (see, e.g., Chapman and Freeman 2008, Martínez-Sánchez et al. 2010, or Rennan et al. 2014).

In this paper, we try to better understand these trends and evaluate how cigarette prices and smoking bans are related to smoking prevalence (extensive margin) as well as to the number of cigarettes smoked (intensive margin). We present an empirical analysis based on a newly compiled large-scale country panel data set on individual smoking behavior in 21 European countries spanning over a period of 23 years. Data is from 9 survey-waves of the Eurobarometer involving more than 138,000 adult respondents and 162 country-year observations. To our knowledge, this is one of the largest data sets so far compiled for the purpose of studying the effects of tobacco control policies on individual smoking behavior for European countries.

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<sup>1</sup>We draw these estimates from data of the Eurobarometer survey series (no comparable data for Greece is available).

There is a substantial body of literature that is concerned with the understanding of the regulation of individual smoking behavior.<sup>2</sup> However, many of the advanced empirical analyses deal with the experience of the United States, and much less is known about the drivers of differential smoking behavior in Europe. Differentiating between the two settings is crucial though, since the prevalence of smoking is on average about 10 percentage points higher in European countries compared to the United States (Cutler and Glaeser 2009).

Studies for Europe often rely on cross-country comparisons or are conducted based on time series for single countries (see, e.g., Gallus et al. 2006 or Fernández et al. 2004 for cigarette prices, and Anger et al. 2011, Jones et al. 2015 or Del Bono and Vuri 2017 for smoking bans). The few studies that use repeated cross-sectional data often have a different focus (e.g., Chaloupka et al. 2010 concentrate on the impact of tobacco tax structures on prices or Palali and van Ours 2017 analyze smoking initiation) or rely on either fewer countries (e.g., the study by Hu et al. 2016 based on nine countries) or fewer years of data (e.g., the analysis in Bosdriesz et al. 2016 based on a sample over seven years). The respective designs are thus less well-suited to approach an analysis of the general trends in smoking behavior throughout Europe.

Our analysis builds on the existing literature and tries to advance it in several directions. First, the empirical evaluation relies on a comprehensive and comparable data set from one source for the measurement of individual smoking behavior. The comparability of (aggregated) data on smoking behavior from different sources is often limited and is prone to suffer from structural breaks in the time series due to changing survey methods.<sup>3</sup> Second, we simultaneously take into account trends in cigarette prices as well as spatial consumption restrictions. To identify the effect of smoking bans, we exploit the staggered introduction of smoking bans across 24 European countries and regions (the introduction dates vary across the entities of the United Kingdom). We build an index for the presence of smoking bans that reflects the introduction date as well as the comprehensiveness and enforcement of the bans. The effect of cigarette prices

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<sup>2</sup>For general accounts of tobacco policies within the economics of smoking, see, e.g., Viscusi (1992), Chaloupka and Warner (2000), Gruber (2001), and Cnossen (2006).

<sup>3</sup>Bogdanovica et al. (2011), for example, provide a comparison of survey methods applied to measure country-specific smoking prevalence in European countries in 2006. For some countries there are sizable differences of up to 13 percentage points between the national measures and the values generated based on the Eurobarometer.

is identified based on their variation within countries over time. Third, the econometric analysis takes into account the potential endogeneity of cigarette prices by applying an instrumental variable strategy which uses taxes as instruments. Fourth, in our statistical evaluation, we take into account general country-specific time trends that might drive observed simple correlations. Our data reveals a downward trend in smoking behavior in our sample of European countries over the time period of more than twenty years. On average, the smoking prevalence diminishes by 0.42 percentage points per year, and the number of cigarettes daily smoked by smokers decreases slightly by 0.04 cigarettes a year. Simultaneously, real cigarette prices increased by more than 60 percent between 1990 and 2012, combined with nationwide introductions of smoking bans. The descriptive analysis shows a negative correlation between cigarette prices and the prevalence of smoking. The introduction of smoking bans is negatively correlated with smoking prevalence and with smokers' cigarette consumption.

However, we do not find robust negative effects of the tobacco control policies on smoking behavior once we take time fixed effects and country-specific time trends into account. For the full sample, regression results for smoking prevalence do not indicate clear and precise estimates for price sensitivity or any systematic reaction to the introduction of smoking bans. In the specification where we instrument for cigarette prices using excise taxes, we find a price elasticity for smoking prevalence of -0.11 that is not statistically significant. In the conditional demand analysis, capturing the effect of the policies on the amount of cigarettes consumed by daily smokers, we find a smaller negative price elasticity of -0.08 that is not statistically significant either. With a 50 percent price increase, the elasticities compare to an average decrease in the smoking propensity of 1.22 percentage points and in the smoking intensity (i.e., the number of cigarettes consumed by smokers) of 0.52 cigarettes, respectively. The analysis for subgroups shows heterogeneity in the effects of higher cigarette prices. For the propensity to smoke, the negative effect is driven by males and people under the age of 30. For the intensity of smoking, we find the biggest effect for young people. Based on these findings, it is difficult to reject the thesis that social trends account for the largest part of the decline in smoking prevalence, rather than the adoption of tougher tobacco control policies.

The remainder of the paper is organized as follows: In Section 2, the tobacco control policies applied in the European Union as well as our index for smoking bans are introduced. Section 3 describes the country panel data on smoking behavior as well as some first descriptive analyses. The results of the econometric analysis are presented in Section 4. Section 5 offers some concluding remarks.

## 2 Tobacco Control Policies in the Member Countries of the European Union

In Europe, tobacco control measures are primarily enacted and implemented by the federal and sub-federal governments of individual countries (see, e.g., the review in Studlar et al. 2011). This holds in particular for the two major policies, i.e., cigarette taxes and smoking bans. The European Union complements the policies and measures of its member states by adopting specific legislations (for example, on tobacco products), releasing recommendations, and running information campaigns. We concentrate on taxes and smoking bans and use quantitative measures that allow us to make both of these policies comparable across countries as well as over time. As taxes only affect behavior via their effect on prices, we also compile a comparable data set on prices.<sup>4</sup>

### 2.1 Cigarette Prices and Taxes

Information on cigarette prices and the tax structures of tobacco products in the EU member countries is provided in the *Excise Duty Tables on manufactured tobacco* from the European Commission European Commission (1990-2012b). From this data, we use the price information provided for the most popular price category (MPPC). The MPPC represents the price per 1,000 cigarettes of the most popular brand in a country. It served as the benchmark price category for the minimum taxation requirements in the European Union and provides a measure for

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<sup>4</sup>In a companion paper, we use the same data sources to study the effect of tobacco control policies on individual life satisfaction (Odermatt and Stutzer 2015).

comparing cigarette prices across countries and years. The primary channel through which policymakers can influence the cigarette price is through changes in tax levels. The excise tax structure comprises a specific tax, i.e., a fixed amount per 1,000 cigarettes, and an *ad valorem* excise tax, i.e., a percentage of the retail selling price. According to the European council directive (2011/64/EU), the overall tax yield from these two sources must not be less than EUR 64 per 1,000 cigarettes (or at least 57 percent of the retail price). Despite these minimum taxation requirements, there is remarkable variability in the imposed taxes and the cigarette prices across EU member countries with upward trends over time in most of them.

Figure A.1 provides an overview of the variation in the price and excise tax levels across countries and over time. To make these values comparable across the countries, we adjust the prices and the specific tax for the country-specific price levels and report them in constant prices, i.e., the currency value for the euro in 2005. The dark gray and light gray solid lines show the development of the real MPPC cigarette price and the real specific tax, respectively. The dashed line indicates the *ad valorem* tax rates (between 0 and 1). The average real cigarette price in the sample is 163.40 euros per 1,000 cigarettes (or 3.26 euros per package of 20 cigarettes) with a standard deviation of 60.90 euros. From 1990 to 2012 the average price in our sample increased by more than 60 percent, and the average increase in the tax level was about 50 percent. A similar but less pronounced positive trend can be observed for the specific tax rate, with an average level of 43.90 euros with a standard deviation of 38.46 euros. The average *ad valorem* tax rate is 0.35 (or 35 percent).

## 2.2 Smoking Bans

Today, smoking bans have become a common tool for preventive health care policy around the world. Many countries ratified the WHO Framework Convention on Tobacco Control. The treaty obliges the member states to reinforce their effort to reduce the dissemination of smoking. In response, many countries introduced smoking bans in indoor workplaces, indoor public places, public transport and in bars and restaurants; i.e., the hospitality sector. In Europe, the first

country that banned smoking comprehensively was Ireland in March 2004. In the meantime, almost all European countries have introduced some type of spatial smoking restriction.

Table A.1 gives an overview of the introduction dates of workplace and hospitality sector bans in the 24 countries and regions in our sample.<sup>5</sup>

Some countries first introduced bans only in workplaces. In a second step, the bans were then extended to the hospitality sector. This occurred in Austria, Belgium, Estonia, France, the Netherlands and Slovakia. In Latvia and Spain, the ban in the hospitality sector was tightened four years after its implementation. We take account of the fact that the comprehensiveness of the bans differs across the countries and regions. For these particularities, we use the scores of the *Tobacco Control Scale* (TCS) (Joossens and Raw 2006, 2007, 2011) to qualify the bans.<sup>6</sup>

### 3 Data on Smoking Behaviour and Descriptive Analysis

To study the effects of smoking bans and cigarette price increases on smoking behavior, we make use of the individual-level data from the Eurobarometer surveys (EB) (European Commission 2012a). The EB is a repeated cross-section survey in the member states of the European Union regarding people’s attitudes and public opinion in general. Intermittently, the EB addresses special topics, such as health-related issues that include smoking behavior. We make use of two measures. First, we identify whether an individual smokes or not. People are considered smokers when they indicate that they smoke manufactured or roll-your-own cigarettes, cigars or a pipe. Former smokers are classified as non-smokers. Second, current smokers are asked how many cigarettes per day they smoke. Respondents report their daily consumption in nine categories, ranging from “less than 5 cigarettes” up to “40 or more cigarettes”. We take the median value

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<sup>5</sup>For the United Kingdom, the entities England, Scotland, Wales and Northern Ireland are considered as separate geographical units in the analysis of smoking bans, since in these places the bans were introduced on different dates.

<sup>6</sup>The assigned scores from the TCS are indicated in the columns next to the implementation dates in Table A.1. The TCS reflects the results of expert surveys regarding tobacco control activities in the European countries. We use the sum of the sub-scale scores for smoke-free policies in workplaces (max. ten points) and for the bans in the hospitality sector (max. eight points) and divide it by the maximum achievable scores in order to build an index  $[0,1]$  that reflects the comprehensiveness of the bans. In turn, our variable *smoking ban<sub>jt</sub>* takes the value of the index for country/region  $j$  at time  $t$  when a ban is in place.



of each category to approximate the actual number of cigarettes smoked and impute the number of 43 cigarettes for the top category.

In our analysis, we consider 21 European countries; i.e., Austria, Belgium, Cyprus (Republic of), Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, Spain, Sweden and the United Kingdom. We use data from 9 survey waves covering the years 1990, 1992, 1994, 1995, 2002, 2005, 2006, 2009 and 2012. For Austria, Finland and Sweden, data are only available from the beginning of 1995. The newest members to the EU (i.e., Cyprus, Estonia, Latvia, Lithuania, Malta, Slovenia and Slovakia) are part of our analysis from the year 2005 onwards.<sup>7</sup>

Figure 1 shows the development of the smoking prevalence, i.e., the share of smokers among the adult respondents, and the average daily cigarette consumption of daily smokers per country. The trends are separately shown for women and men. One can see that, on average, a larger fraction of men smokes compared to women and that male smokers smoke more cigarettes than female smokers. The smoking prevalence declines over the last two decades in most of the European countries. For smokers, no clear trend is observable for the number of cigarettes smoked. The average smoking prevalence in the sample is 0.31, with a standard deviation of 0.46. The average number of cigarettes consumed by smokers per day amounts to 15.95, with a standard deviation of 9.11.

When considering the phenomenon of tobacco smoking in Europe overall, we observe a downward trend in the prevalence of smoking over twenty years and, simultaneously, increasing taxes and prices for cigarettes and the introduction of smoking bans. Table 1 reports the corresponding correlations between the presence of a ban, cigarette prices and smoking behavior in our sample when calculated using simple linear regressions.

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<sup>7</sup>We exclude those countries for which we do not have information on the comprehensiveness of the smoking bans from the TCS, i.e., those who implemented a smoking ban after January, 2011. This applies to Bulgaria, the Czech Republic, Hungary, and Poland. We further exclude Greece, where the ban was disobeyed due to the lack of enforcement (no change in the sub-scales of the TCS), and Romania for which we only have observations for two survey waves.

Figure 1: Smoking prevalence and average daily cigarette consumption among smokers, 1990-2012



Data source: Eurobarometer survey series.

Table 1: Correlation of smoking bans and cigarette prices with smoking behavior, 1990-2012

	Smoking yes(=1) no(=0)			Number of cigarettes (smokers)		
	I	II	III	IV	V	VI
Smoking ban	-0.087*** (-20.40)		-0.083*** (-18.09)	-0.660*** (-4.07)		-0.742*** (-4.36)
ln(cigarette price)		-0.032*** (-9.30)	-0.008** (-2.20)		-0.005 (-0.04)	0.178 (1.41)
No. of observations	138,334	138,334	138,334	38,861	38,861	38,861

Notes: OLS estimations. t-values in parentheses. Coefficients for the constant are not shown.

Significance levels: \* .05 < p < .1, \*\* .01 < p < .05, \*\*\* < .01.

Data source: Eurobarometer survey series.

Specifications I to III show the correlation with the prevalence of smoking and specifications IV to VI with the number of cigarettes consumed by smokers. On average, 8.65 percentage points fewer people smoke in the years after an extensive smoking ban was introduced (specification I). With regard to the price of cigarettes, we observe a negative correlation in specification II that reflects a decrease in the prevalence of smoking of 1.30 percentage points for a 50 percent price increase. This effect is much smaller than the decline in smoking prevalence of approximately 9 percentage points in the raw data. The heterogeneity across countries seems to prevent picking up the full negative trend in prevalence by the positive trend in prices. This also holds for specification III when simultaneously including bans and prices. A negative relationship also shows up when we look at the correlation between smoking bans and the number of cigarettes smoked by smokers (specifications IV and VI). No significant relationship between cigarette prices and smokers' cigarette consumption is observed in the pooled simple regression neither in specification V, nor in specification VI when controlling for the ban. In a next step, we look at the relationships in a multiple regression framework controlling for other sources of variation that might drive the correlations between tobacco control policies and smoking behavior.

## 4 Empirical Analysis

### 4.1 Methodology

The individual-level data allows us to examine the impact of smoking bans and cigarette prices separately on the prevalence of smoking and the daily consumption of cigarettes. We apply a two-part model of cigarette demand (Cragg 1971), a widely used approach in which the probability of smoking is estimated in a first step (participation equation or extensive margin). In a separate second step, the number of cigarettes smoked per day is estimated only for those who smoke at least one cigarette per day (conditional demand equation or intensive margin).<sup>8</sup> Moreover,

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<sup>8</sup>The structure of such a two-part model is similar to Heckman's two-stage sample selection model. However, we aim at modeling actual smoking, as opposed to potential smoking (if a person does not smoke, he or she is unlikely to display a latent positive expected consumption). For this case, the two-part model is more appropriate

we propose an instrumental variable strategy to overcome the potential simultaneity problem between cigarette demand and cigarette prices.

In the first step, the outcome is a dichotomous variable equal to 1 if an individual reports being a smoker, and 0 if not. In order to quantify the association between the variables capturing the tobacco control policies and the propensity to smoke, we estimate a probit specification of the following form:

$$\begin{aligned}
 P(\text{smoke} = 1)_{ijt} = & \Phi (\beta_0 + \beta_1 \text{ban}_{jt} + \beta_2 \ln(\text{price})_{jt} + \beta_3 X_{ijt} \\
 & + \beta_4 Z_{jt} + \beta_5 S_j + \beta_6 D_t + \beta_7 (S_j * \text{trend})).
 \end{aligned}
 \tag{1}$$

The probit model accounts for the limited nature of the dependent variable.  $\Phi$  is the cumulative distribution function of the standard normal distribution. The probability of smoking  $P(\text{smoke}=1)_{ijt}$  of individual  $i$  in country/region  $j$  at time  $t$  is regressed on an index variable  $\text{ban}_{jt}$  [0,1] that captures the implementation of any smoking ban in the specific country/region at the time of the survey. This approach exploits the staggered introduction of smoking bans across European countries and regions to identify the effects on consumption behavior. The second policy variable is  $\ln(\text{price})_{jt}$  for the country-specific level of cigarette prices. In the baseline specifications, the effect for cigarette prices is identified based on their variation within countries over time (but see the instrumental variable strategy introduced below). As control variables, we include individual socio-demographic characteristics  $X_i$ ; i.e., age, sex, level of education, marital status, number of children in the same household, and the occupation of the respondent. Further controls are a vector of country-level variables  $Z_{jt}$  that consists of the real GDP per capita in logarithmic form and the rates of unemployment and inflation. We include a vector  $S_j$  of country-specific effects that will account for time-invariant regional heterogeneity potentially correlated with smoking policies, such as, for instance, unobserved country-level sentiments towards smoking. In addition, we include a vector  $D_t$  to control for survey year-specific

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(see, e.g., Dow and Norton 2003 or Madden 2008 for a discussion).

time effects and country-specific linear time trends  $S_j * trend$ .<sup>9</sup> The time dummies and the interactions of each country dummy variable with a time trend pick up generally decreasing trends in smoking that are likely to be correlated with the the adoption of policies. This might, for example, be due to a general trend in less favorable attitudes towards cigarette consumption, thereby affecting smoking prevalence, as well as an increase in electoral support for tougher policy interventions. For the calculation of standard errors, we apply a conservative estimation strategy by clustering the standard errors at the country/region level. We apply sample weights provided in the EB data files throughout to reproduce representative samples for each country. Table A.2 in the Appendix offers descriptive statistics for the included variables, and Table A.3 lists the used surveys and data sources. The final sample consists of 138,334 observations.<sup>10</sup>

In the second part of our model, an OLS specification is applied to estimate the following conditional demand equation:

$$E[C_{ijt}|C_{ijt} > 0] = \beta_0 + \beta_1 ban_{jt} + \beta_2 \ln(price)_{jt} + \beta_3 X_{ijt} + \beta_4 Z_{jt} + \beta_5 S_j + \beta_6 D_t + \beta_7 (S_j * trend) + \varepsilon_{ijt}, \quad (2)$$

where the dependent variable  $C_{ijt}$  denotes the number of cigarettes consumed. The other variables are defined as in equation 1. The sample to estimate this equation consists of those 38,681 respondents who indicate that they smoke one or more cigarettes a day. As the distribution of the number of cigarettes consumed tends to be skewed to the right, some studies recommend a logarithmic transformation of the dependent variable. We apply a Box-Cox test (Box and Cox 1964), an iterative transformation procedure that compares maximum likelihood estimations of log versus linear specifications. It allows testing which functional form of the dependent variable provides the best fit for a given set of data. The results indicate that this is the case for the

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<sup>9</sup>For the newest EU countries for which we only have few years of observation (i.e., three waves for Latvia and Lithuania, and four waves for Cyprus, Estonia, Malta, Slovenia and Slovakia), we include one common time trend.

<sup>10</sup>We include all the observations except for people who refused to indicate their marital status or who no longer knew how old they were when they finished their education. Individuals who do not report the number of children in their household are identified by a separate indicator.

untransformed linear specification.<sup>11</sup>

Another challenge for the identification of the behavioral response to price changes is simultaneity, i.e., that cigarette prices are an endogenous function of supply and demand, potentially biasing our estimates of the price elasticity. In addition, from a public health point of view, prices can primarily be steered through taxes. Consequently, in our preferred specifications, we use the excise tax measures to instrument cigarette prices. This provides identification solely from tax-induced price movements.

## 4.2 Effects of Smoking Bans and Cigarette Prices on Smoking Prevalence

Using reported smoking status as the binary dependent variable, we assess the consequences of smoking bans and cigarette prices for the prevalence of smoking (see equation 1). Table 2 presents the corresponding average marginal effects from probit estimates. Price elasticities are reported in square brackets with z-values in parentheses. The full regression outputs are reported in Table A.4.<sup>12</sup>

The negative correlation between implemented smoking bans and people reporting their status as smokers presented in the descriptive analysis in Section 3 remains economically and statistically significant when additionally controlling for socio-demographic characteristics and country-level variables, as well as country-specific fixed effects in specification I. However, the negative partial correlation of the smoking ban is not robust to the inclusion of time effects and becomes statistically non-significant and small when additionally taking time fixed effects and country-specific time trends into account in the regressions (specifications II and III).

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<sup>11</sup>In two robustness analyses, we estimate the daily cigarette consumption using, first, a generalized linear model (GLM) with a log-link and a gamma family distribution. Manning and Mullahy (2001) suggest this alternative estimation procedure in order to take into account the logarithmic transformation of the dependent variable. Second, we apply a tobit model that considers the right-censoring of our dependent variable at the threshold value of 43 cigarettes per day. The resulting elasticities from both robustness exercises are very similar compared to the estimates derived from equation 2.

<sup>12</sup>The estimated correlations between socio-economic characteristics and smoking behavior are in line with empirically established relationships: high levels of education, being married, and not being unemployed are related to a lower probability of being a smoker. GDP per capita is not significantly correlated to smoking prevalence, while the rate of unemployment tends to be positively and the rate of inflation negatively related with the status of being a smoker.

Table 2: Tobacco control policies and the prevalence of smoking in 24 European countries and regions, 1990-2012

Dependent variable: smoking yes(=1) no(=0)								
	I	II	III	IV	V	VI	VII	VIII
	Probit	Probit	Probit	Probit	IV-probit	IV-probit	IV-probit	IV-probit
	Full sample	Full sample	Full sample	Full sample	Full sample	Females	Males	<30years
Smoking ban	-0.028**	0.003	0.007	0.008	0.004	0.001	0.010	0.014
	(-1.97)	(0.27)	(0.76)	(0.87)	(0.43)	(0.10)	(0.55)	(0.55)
ln(cigarette price)	-0.001	0.019	0.003		-0.030	0.022	-0.091*	-0.120*
	[-0.005]	[0.068]	[0.012]		[-0.108]	[0.102]	[-0.274]*	[-0.363]*
	(-0.05)	(0.80)	(0.26)		(-1.15)	(0.84)	(-1.87)	(-1.67)
ln(specific taxes)				-0.004				
				[-0.015]				
				(-0.68)				
Ad valorem tax				-0.046				
				[-0.059]				
				(-1.44)				
Individual characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-level variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country/region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-spec. time trends	No	No	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	138,334	138,334	138,334	138,334	138,334	75,030	63,304	31,152
Pseudo-R <sup>2</sup>	0.071	0.072	0.073	0.073				

Notes: Marginal effects from probit and IV-probit estimations. T-values in parentheses. Price elasticities in square brackets. Standard errors are clustered at the level of 24 countries/regions.

Significance levels: \*  $.05 < p < .1$ , \*\*  $.01 < p < .05$ , \*\*\*  $< .01$ .

Data source: Eurobarometer survey series.

For the same control strategies, specifications I to III show the statistical relationship between cigarette prices and smoking prevalence in 21 European countries. We do not find systematic partial correlations, *ceteris paribus*, with estimated elasticities between -0.01 and 0.07. However, specifications I to III do not take the potential endogeneity of prices into account. Our preferred estimations therefore either include taxes instead of prices or apply an instrumental variable strategy. Specification IV looks at the direct effect of the excise tax measures on smoking prevalence. For both measures, there is a negative partial correlation that is imprecisely measured, however. The negative effect of the *ad valorem* tax amounts to a decrease in the propensity to smoke of 4.6 percentage points with an increase in the tax from 0 to 100 percent. This implies a tax elasticity of -0.07. The point estimate for the corresponding elasticity for the specific cigarette taxes is much smaller with -0.02. In specifications V to VIII, we apply an instrumental variable approach based on maximum likelihood estimation (IV-probit), whereby we take the tax measures as instruments for cigarette prices.<sup>13</sup> When exploiting the price variation that is driven by tax changes, we find a negative partial correlation between cigarette prices and the propensity to smoke with a price elasticity of around -0.11. However, the statistical relationship is imprecisely measured.

Moreover, the overall price effect masks heterogeneity with regard to the socio-demographic characteristics of people: For males and for people under the age of 30, we find larger and statistically significant price elasticities of -0.27 and -0.36, respectively. For males, an increase in cigarette prices by 50 percent thus implies a reduction in their smoking propensity of 13.7 percent or an average marginal effect of about -3.7 percentage points. For people under the age of 30, the average marginal decrease in the prevalence of smoking amounts to -4.9 percentage points with the same price increase. For female smokers in contrast, a not very precisely estimated

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<sup>13</sup>The positive partial correlation of the tax measures with the endogenous variable  $\ln(\text{cigarette price})$  in the first-stage regression is highly statistically significant at the 0.1%-level with a partial  $R^2$  of 0.265 and an F-statistic of 6.19 (p-value=0.007). The effects of  $\ln(\text{specific taxes})$  and *ad valorem taxes* on  $\ln(\text{cigarette price})$  are 0.253 (t-value=3.39) and 1.223 (t-value=3.52), respectively. For the specific tax, the coefficient represents an elasticity. Evaluated at the average value of the cigarette price of 163.40 euros and the average value of the specific tax of 43.90 euros per 1,000 cigarettes, this implies a nearly one-to-one relationship between taxes and prices (a 10 percent increase in the tax of 4.39 euros is estimated to result in a price increase of 4.13 euros). An increase in the *ad valorem* tax of 10 percentage points is estimated to lead to a cigarette price increase of 13.0 percent ( $e^{0.122}-1=0.130$ ).



price elasticity of +0.10 is observed. This strong differential reaction to cigarette prices between women and men is consistent with previous evidence for the United States (see, e.g., Cawley and Ruhm 2012).

### 4.3 Effects of Smoking Bans and Cigarette Prices on Conditional Demand

In contrast to the previous subsection where we analyzed the impact of the tobacco control policies on the decision whether to smoke or not (extensive margin), we now consider whether there is a systematic statistical relationship between the policies and the decision regarding how much to smoke, conditional on smoking (intensive margin). This subsection thus presents the results based on specifications of equation 2. We apply OLS estimations with the number of cigarettes as the dependent variable. The results are summarized in Table 3.<sup>14</sup>

Specifications I to III indicate that the estimation results are sensitive to the inclusion of time fixed effects and country-specific time trends. Once we control in a flexible way for time trends in specification III, the policies do not relate to smoking intensity in a statistically significant way. However, the number of cigarettes consumed per day is estimated to be slightly smaller if smoking bans are in place and cigarette prices are higher. A negative but statistically insignificant price elasticity of -0.04 is estimated, and a reduction of 0.11 cigarettes consumed per day after the implementation of a comprehensive smoking ban. A negative effect of a larger magnitude holds when considering the ad valorem tax, instead of prices, in specification IV. The coefficient of -2.76 expresses that the number of cigarettes consumed per day is smaller by that amount if the ad valorem tax increases by 100 percentage points. This implies an average ad valorem tax elasticity of -0.06. For specific taxes, the imprecisely estimated elasticity is close to zero.

Specifications V to VIII present the results when cigarette prices are instrumented by cigarette taxes. For the full sample as well as the different subgroups, the estimates show negative price elasticities. They are not statistically significantly different from zero, however. For the full sample, a slightly more elastic conditional demand compared to the impact of taxes of -0.08 is

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<sup>14</sup>The full regression outputs are reported in Table A.5 in the Appendix.

Table 3: Tobacco control policies and the smoking behavior of smokers (conditional demand) in 24 European countries and regions, 1990-2012

Dependent variable: number of cigarettes per day								
	I	II	III	IV	V	VI	VII	VIII
	OLS	OLS	OLS	OLS	2SLS	2SLS	2SLS	2SLS
	Full sample	Full sample	Full sample	Full sample	Full sample	Females	Males	<30years
Smoking ban	0.819*** (2.99)	0.021 (0.05)	-0.114 (-0.20)	0.053 (0.09)	-0.170 (-0.33)	-0.490 (-0.90)	-0.033 (-0.05)	0.137 (0.17)
ln(cigarette price)	-2.298*** [-0.149]*** (-4.84)	-2.006*** [-0.131]*** (-4.54)	-0.592 [-0.039] (-0.86)		-1.286 [-0.084] (-1.21)	-1.241 [-0.091] (-1.04)	-1.139 [-0.068] (-0.87)	-2.931 [-0.220] (-1.49)
ln(specific taxes)				0.021 [0.001] (0.06)				
Ad valorem tax				-2.844** [-0.064]** (-2.23)				
Individual characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-level variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country/region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-spec. time trends	No	No	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	38,861	38,861	38,861	38,861	38,861	18,092	20,769	11,000
$R^2$	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10

Notes: OLS and 2SLS estimations. T-values in parentheses. Price elasticities in square brackets. Standard errors are clustered at the level of 24 countries/regions.

Significance levels: \*  $.05 < p < .1$ , \*\*  $.01 < p < .05$ , \*\*\*  $< .01$ .

Data source: Eurobarometer survey series.

estimated. With a 50 percent price increase, this implies a small reduction in the number of cigarettes smoked of -0.52. This average price effect is of similar magnitude for male and female smokers. The biggest negative effect is estimated for young smokers under the age of 30. The point estimates suggest that they smoke, on average, 1.19 cigarettes less a day when cigarettes are 50 percent more expensive. The corresponding price elasticity is -0.22.

## 5 Conclusion

There is a trend towards stricter policies to control tobacco consumption in many Western countries. In Europe, this trend is accompanied by fewer people smoking today compared to two decades ago. It is, however, difficult to assess whether tobacco control policies contributed to this latter trend.

In our empirical analysis, we identify the behavioral consequences of two major restrictions to smoking in Europe. For primarily fiscal reasons, cigarettes are rather heavily taxed in many countries. The level and change in taxation are therefore major driving forces in the variation in observed prices. Moreover, since 2004, starting in Ireland, more and more countries have introduced spatial restrictions to smoking, primarily focusing on the workplace and the hospitality sector but also reaching out to public transportation and to public places. Our empirical strategy exploits the staggered introduction of smoking bans across 24 European countries and regions and applies an instrumental variable strategy based on cigarette taxes to identify the effect of price changes on the prevalence of smoking as well as the number of cigarettes consumed by daily smokers. For both outcome variables, we analyze variation around country-specific time trends.

We find, on average, no evidence that smoking bans systematically reduce smoking when taking time trends into account.<sup>15</sup> However, higher cigarette prices are weakly related to overall lower reported levels of smoking, *ceteris paribus*. Our results reveal price elasticities for the propensity

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<sup>15</sup>Please note that we are not assessing whether fewer people are exposed to passive smoke after the introduction of smoking bans (for corresponding evidence see, e.g., Shetty et al. 2011).

to smoke and conditional demand for cigarettes of around -0.11 and -0.08, respectively. Thereby, the negative price effects are driven by the behavioral reactions of males (with a price elasticity of -0.27) and of people under the age 30 (with a price elasticity of -0.36). When considering the impact on daily cigarette consumption, conditional on being a daily smoker, people under the age 30 show the strongest reaction to cigarette price increases amounting to a price elasticity of -0.22. The literature discusses various reasons why the responsiveness to prices might be higher for some socio-demographic groups. One argument is that young smokers have to spend a larger fraction of their disposable income on a pack of cigarettes than adult smokers. Furthermore, if the level of addiction increases with consumption over time, young smokers, who have been smoking for a relatively shorter length of time, are better able to adjust their consumption to changes in prices (see, e.g., Chaloupka and Warner 2000 or DeCicca et al. 2002 for a detailed discussion). For the differential price sensitivity between women and men, the results of Cawley et al. (2016) show that cigarette taxation will result in less behavior change among those for whom the demand for cigarettes is derived from the demand for weight control, which applies especially to young women.

Our results for Europe complement the findings for the United States, where smaller price elasticities are estimated with individual-level data compared to studies based on data at the level of states or provinces (e.g., Gallet and List 2003 or DeCicca and McLeod 2008). Furthermore, our findings are in line with recent studies which apply refined estimation techniques and also tend to find only small or even no effects of cigarette price or tax increases (e.g., Tauras 2006, Adda and Cornaglia 2010, Callison and Kaestner 2014, or Hawkins et al. 2016).

When we apply the estimates of the marginal price effects to the average increase in cigarette prices over the observation period, i.e., a price increase of about 60 percent, a decline in the prevalence of smoking of roughly 1.41 percentage points is predicted. This is only about one sixth of the total decline of about nine percentage points in the fraction of smokers over the same time period. The introduction of smoking bans has no clear explanatory power in this phenomenon. In other words, about five sixths of the decline in the prevalence of smoking cannot be explained by our policy variables. This decline might, on the one hand, be due to

other policy interventions ranging from limitations and restrictions on advertising, packaging and labeling to anti-smoking campaigns. On the other hand, much of the unexplained decline might just reflect changes in health and lifestyle attitudes. There is thus ample scope for further studies to investigate people's tobacco consumption.

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Table A.1: Introduction dates of public smoking bans in 24 European countries and regions

Country	Workplace ban		Hospitality sector ban	
	Introduction date	Scope [1-10]	Introduction date	Scope [1-8]
Austria	01.01.09	2	01.07.10	2
Belgium	01.01.06	6	01.01.07	4
Cyprus (Republic of)	01.01.10	2	01.01.10	6
Denmark	15.08.07	4	15.08.07	4
Estonia	04.06.05	4	05.06.07	6
Finland	01.06.07	8	01.06.07	6
France	01.02.07	8	01.01.08	6
Germany <sup>a</sup>	01.08.07– 01.07.08	4	01.08.07– 01.07.08	4
Ireland	29.03.04	10	29.03.04	8
Italy	10.01.05	8	10.01.05	6
Latvia	01.07.06	4	01.07.06 01.10.10	4 8 <sup>b</sup>
Lithuania	01.01.07	4	01.01.07	6
Luxembourg	05.09.06	4	05.09.06	4
Malta	01.04.05	8	01.04.05	6
Netherlands	01.01.04	6	01.07.08	4
Portugal	01.01.08	4	01.01.08	4
Slovakia	01.04.09	4	01.09.09	4
Slovenia	01.08.07	6	01.08.07	6
Spain	01.01.06	10	01.01.06 01.10.10	2 8 <sup>b</sup>
Sweden	01.06.05	6	01.06.05	6
United Kingdom:				
Wales	02.04.07	10	02.04.07	8
Scotland	01.03.06	10	01.03.06	8
England	01.07.07	10	01.07.07	8
Northern Ireland	30.04.07	10	30.04.07	8

*Notes:* <sup>a)</sup> In the federal states in Germany, smoking bans were implemented on different dates within the indicated implementation period. However, we are not able to exploit the resulting variation in the introduction dates, as none of the survey waves used in our analysis lies within this period. According to Joossens and Raw (2007, 2011), tobacco control in workplaces in Germany became more restrictive between 2007 and 2010; i.e., the index of the Tobacco Control Scale (TCS) increased from 2 to 4. As there is no change in the federal law, we assume that the change occurred parallel to the implementation of bans in the hospitality sector. <sup>b)</sup> In Latvia, the ban in the hospitality sector was tightened on May 1<sup>st</sup>, 2010 and in Spain on January 1<sup>st</sup>, 2011.

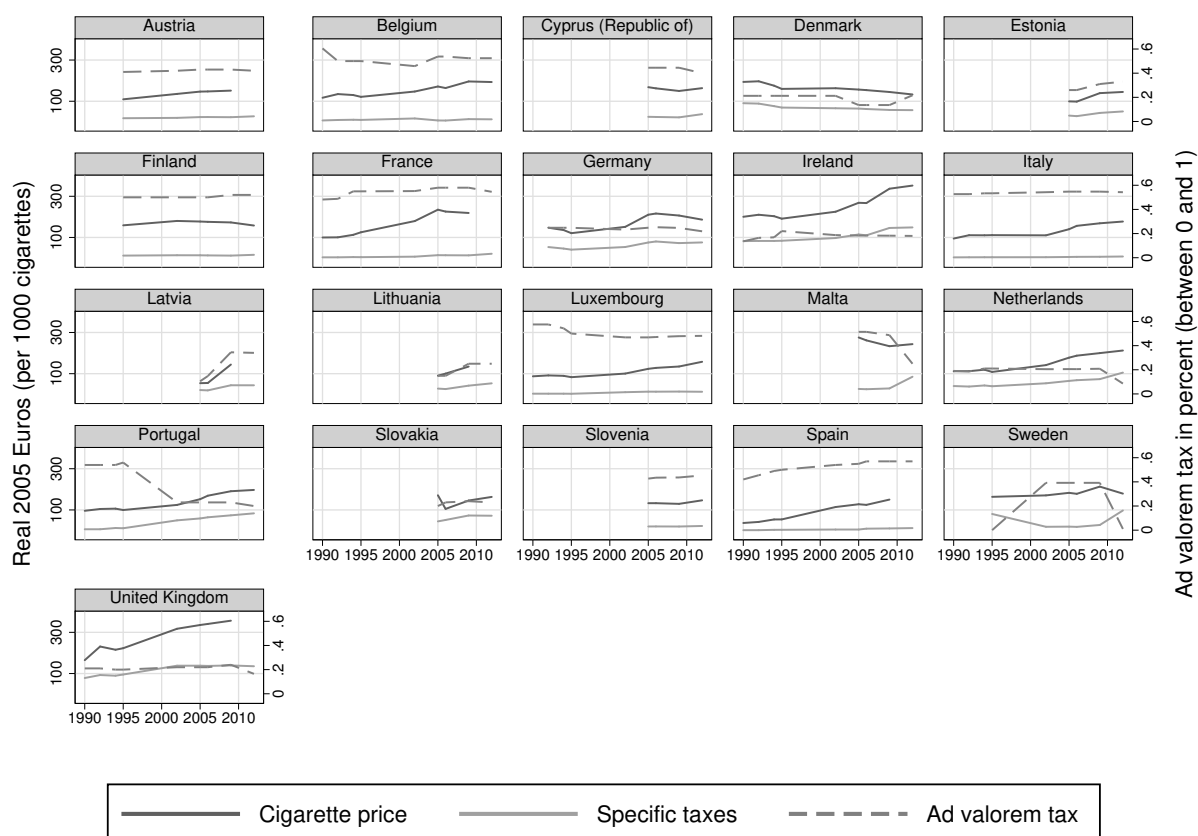
*Data source:* European countries and regions in the United Kingdom: European Commission (2010), European Network for Smoking Prevention (2010); German Laender: Aufmuth (2010), Kvasnicka (2010); TCS: Joossens and Raw (2006, 2007, 2011).

Table A.2: Descriptive statistics for the full sample and the sample of smokers

	Full sample		Smokers	
	Mean	SD	Mean	SD
<i>Individual level</i>				
Smoking yes(=1) no(=0)	0.31	0.46	1.00	0.00
Number of cigarettes per day	4.57	8.71	15.95	9.11
Age	46.15	18.35	40.78	15.50
Female	0.54	0.50	0.47	0.50
Education up to age 15 or less	0.25	0.43	0.22	0.42
Education up to age 16-19	0.39	0.49	0.47	0.50
Education up to age 20 or more	0.26	0.44	0.22	0.42
Education, still studying	0.09	0.29	0.08	0.27
Married	0.55	0.50	0.49	0.50
Single with partner	0.12	0.33	0.15	0.36
Single	0.18	0.39	0.22	0.42
Divorced	0.06	0.24	0.09	0.29
Widowed	0.07	0.26	0.04	0.20
Other marital status	0.01	0.11	0.01	0.10
No child in HH under age 15	0.57	0.50	0.51	0.50
One child in HH under age 15	0.13	0.34	0.15	0.36
Two children in HH under age 15	0.10	0.30	0.11	0.31
Three children in HH under age 15	0.03	0.17	0.03	0.17
Four or more children in HH under age 15	0.06	0.24	0.07	0.26
No information about children in HH	0.11	0.31	0.13	0.34
Unemployed	0.06	0.24	0.10	0.30
Without occupation	0.21	0.41	0.18	0.38
Retired	0.24	0.43	0.15	0.35
Manual worker	0.13	0.34	0.19	0.40
Farmer/fisherman	0.01	0.11	0.01	0.09
Professional	0.01	0.12	0.01	0.12
Self-employed	0.03	0.18	0.04	0.20
Business proprietor	0.02	0.13	0.02	0.13
Employed professional	0.02	0.14	0.02	0.12
General management	0.01	0.11	0.01	0.11
Middle management	0.07	0.25	0.06	0.23
Employed position (desk)	0.08	0.27	0.08	0.27
Employed position (travel)	0.03	0.16	0.04	0.18
Service sector	0.07	0.26	0.09	0.28
Supervisor	0.01	0.10	0.01	0.11
<i>Country level</i>				
Smoking ban	0.21	0.31	0.18	0.30
Real cigarette price per 1000	163.40	60.90	161.84	62.32
ln(cigarette price)	5.03	0.39	5.01	0.40
Real specific taxes	43.90	38.46	44.01	38.98
ln(specific taxes)	3.26	1.14	3.24	1.18
Ad valorem taxes	0.35	0.16	0.35	0.16
Real GDP per capita	23,737.42	7,006.17	23,790.14	6,750.01
ln(GDP per capita)	10.04	0.28	10.04	0.27
Unemployment rate	8.35	3.41	8.39	3.47
Inflation rate	2.70	1.85	2.74	1.83
No. of observations	138,334		38,861	

*Data Sources:* Individual-level data is from Eurobarometer survey series. HH stands for household. For country level data see Tables A.1 and A.3

Figure A.1: Real cigarette prices and specific taxes per 1,000 cigarettes (in 2005 euros) and ad valorem tax rates, 1990-2012



*Data source:* Own calculations based on the *Excise Duty Tables* provided by the European Commission (1990-2012b) and on country-specific price level information (see Table A.3 for detailed data sources).

Table A.3: Data sources

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*Individual-level data from Eurobarometer*

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Smoking behaviour

- Surveys: 34.1; 38.0; 41.0; 43.0; 58.2; 64.1; 66.2; 72.3; 77.1.
- Question and answers for smoking participation: Which of the following applies to yourself? 1. You smoke manufactured cigarettes; 2. You smoke roll-your-own cigarettes; 3. You smoke cigars or a pipe; 4. You used to smoke but you have stopped; 5. You have never smoked.
- Question and answers for number of cigarettes: How many cigarettes a day do you smoke? 1. less than 5 cigarettes a day; 2. 5 to 9 cigarettes a day; 3. 10 to 14 cigarettes a day; 4. 15 to 19 cigarettes a day; 5. 20 to 24 cigarettes a day; 6. 25 to 29 cigarettes a day; 7. 30 to 34 cigarettes a day; 8. 35 to 39 cigarettes a day; 9. 40 or more cigarettes a day; 10. Do not smoke every day

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*Country level data*

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Cigarette prices and taxes

- European Commission: [ec.europa.eu](http://ec.europa.eu) (Excise Duty Tables 1990-2012)

Gross domestic product

- Eurostat: [epp.eurostat.ec.europa.eu](http://epp.eurostat.ec.europa.eu) (data file `nama_aux_gph`)
- World Bank: [data.worldbank.org](http://data.worldbank.org) (for Ireland and Portugal)

Unemployment rate

- Eurostat: [epp.eurostat.ec.europa.eu](http://epp.eurostat.ec.europa.eu) (data file `une_rt.a`)

Inflation rate

- Eurostat: [epp.eurostat.ec.europa.eu](http://epp.eurostat.ec.europa.eu) (data file `prc_hicp_aind`)
- OECD: [stats.oecd.org](http://stats.oecd.org) (for 1990)

Price level index

- Eurostat: [epp.eurostat.ec.europa.eu](http://epp.eurostat.ec.europa.eu) (data file `prc_ppp_ind`)
  - OECD: [stats.oecd.org](http://stats.oecd.org) (for 1990-1994)
-

Table A.4: Full regression output of Table 2

Dependent variable: smoking yes(=1) no(=0)								
	I	II	III	IV	V	VI	VII	VIII
	Probit	Probit	Probit	Probit	IV-probit	IV-probit	IV-probit	IV-probit
	Full sample	Full sample	Full sample	Full sample	Full sample	Females	Males	<30years
Smoking ban	-0.028**	0.003	0.007	0.008	0.004	0.001	0.010	0.014
	(-1.97)	(0.27)	(0.76)	(0.87)	(0.43)	(0.10)	(0.55)	(0.55)
ln(cigarette price)	-0.001	0.019	0.003		-0.030	0.022	-0.091*	-0.120*
	(-0.05)	(0.80)	(0.26)		(-1.15)	(0.84)	(-1.87)	(-1.67)
ln(specific taxes)				-0.004				
				(-0.68)				
Ad valorem tax				-0.046				
				(-1.44)				
ln(GDP per capita)	-0.043	-0.007	-0.030	-0.015	-0.013	0.033	-0.066	-0.050
	(-1.20)	(-0.31)	(-0.57)	(-0.29)	(-0.27)	(0.64)	(-0.81)	(-0.45)
Unemployment rate	0.000	0.000	-0.000	0.001	0.001	0.001	0.000	0.009***
	(0.45)	(0.22)	(-0.03)	(0.52)	(0.86)	(0.84)	(0.17)	(3.07)
Inflation rate	0.001	-0.005***	-0.004***	-0.004***	-0.004***	-0.005**	-0.003	-0.001
	(0.86)	(-4.08)	(-2.69)	(-2.80)	(-2.83)	(-2.47)	(-1.00)	(-0.24)
Age	0.009***	0.009***	0.009***	0.009***	0.009***	0.007***	0.011***	0.106***
	(6.93)	(6.97)	(6.95)	(6.95)	(6.95)	(4.28)	(9.65)	(8.84)
Age <sup>2</sup> /100	-0.015***	-0.015***	-0.015***	-0.015***	-0.015***	-0.014***	-0.017***	-0.220***
	(-12.89)	(-12.84)	(-12.82)	(-12.82)	(-12.81)	(-9.13)	(-13.92)	(-8.63)
Female	-0.098***	-0.098***	-0.098***	-0.098***	-0.098***	-0.098***		-0.044***
	(-6.69)	(-6.69)	(-6.72)	(-6.72)	(-6.72)	(-6.72)		(-3.17)
Education until less than age 15	Reference							
Education up to age 16-19	0.007	0.008	0.008	0.008	0.008	0.024	-0.014	-0.034
	(0.43)	(0.52)	(0.50)	(0.50)	(0.49)	(1.33)	(-1.03)	(-1.08)
Education up to age 20 or more	-0.067***	-0.065***	-0.064***	-0.064***	-0.064***	-0.048**	-0.084***	-0.150***
	(-3.58)	(-3.41)	(-3.39)	(-3.38)	(-3.39)	(-2.03)	(-5.22)	(-4.13)
Education, still studying	-0.137***	-0.133***	-0.133***	-0.133***	-0.133***	-0.126***	-0.177***	-0.163***
	(-4.63)	(-4.48)	(-4.49)	(-4.48)	(-4.49)	(-4.69)	(-4.70)	(-3.32)
Married	Reference							
Single with partner	0.054***	0.057***	0.056***	0.056***	0.056***	0.058***	0.057***	0.080***
	(7.01)	(7.11)	(7.03)	(7.06)	(7.03)	(7.04)	(5.01)	(5.64)
Single	0.048***	0.048***	0.049***	0.048***	0.048***	0.072***	0.036***	0.055***
	(7.99)	(7.90)	(8.01)	(8.01)	(7.97)	(9.90)	(5.38)	(4.10)
Divorced	0.147***	0.149***	0.149***	0.149***	0.149***	0.148***	0.157***	0.187***
	(20.05)	(20.00)	(20.25)	(20.22)	(20.25)	(20.88)	(14.81)	(7.08)
Widowed	0.042***	0.042***	0.043***	0.043***	0.043***	0.059***	0.101***	0.043
	(4.80)	(4.78)	(4.89)	(4.89)	(4.89)	(6.99)	(8.78)	(0.59)
Other marital status	0.022**	0.025**	0.028**	0.029**	0.029***	0.043***	0.042**	0.031
	(1.99)	(2.22)	(2.53)	(2.56)	(2.61)	(3.03)	(2.12)	(1.08)
No children in HH under age 15	Reference							
One child in HH under age 15	-0.008*	-0.007	-0.007	-0.007	-0.007	-0.006	-0.014*	0.008
	(-1.70)	(-1.51)	(-1.40)	(-1.40)	(-1.40)	(-1.13)	(-1.74)	(0.80)
Two children in HH under age 15	-0.027***	-0.026***	-0.025***	-0.025***	-0.025***	-0.030***	-0.027***	0.025*

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Table A.4: (continued)

Three children in HH under age 15	(-3.23) -0.028***	(-3.16) -0.027***	(-3.09) -0.026***	(-3.09) -0.026***	(-3.09) -0.026***	(-3.30) -0.028***	(-2.78) -0.033**	(1.84) 0.042**
Four or more children in HH under age 15	(-3.03) 0.004	(-2.80) 0.011	(-2.68) 0.012	(-2.68) 0.012	(-2.68) 0.012	(-2.80) 0.006	(-2.45) 0.014	(2.02) 0.058**
No information about children in HH	(0.60) 0.033***	(1.02) -0.061	(1.08) -0.070	(1.08) -0.071	(1.08) -0.071	(0.46) -0.041	(0.98) -0.088	(2.40) -0.176**
Manual worker	(5.10) Reference	(-1.06)	(-1.25)	(-1.26)	(-1.27)	(-0.67)	(-1.12)	(-1.98)
Unemployed	0.055*** (7.47)	0.054*** (7.32)	0.054*** (7.28)	0.054*** (7.27)	0.054*** (7.27)	0.026*** (3.07)	0.087*** (8.27)	0.027 (1.63)
Without occupation	-0.060*** (-4.21)	-0.060*** (-4.25)	-0.061*** (-4.35)	-0.061*** (-4.36)	-0.061*** (-4.35)	-0.034*** (-4.46)	-0.054 (-1.63)	-0.071*** (-3.03)
Retired	-0.018 (-1.63)	-0.018 (-1.54)	-0.018 (-1.55)	-0.018 (-1.55)	-0.018 (-1.55)	-0.009 (-0.58)	-0.038*** (-3.68)	0.010 (0.29)
Farmer/fisherman	-0.142*** (-8.73)	-0.140*** (-8.80)	-0.139*** (-8.90)	-0.139*** (-8.88)	-0.139*** (-8.89)	-0.195*** (-7.03)	-0.146*** (-8.32)	-0.215*** (-4.82)
Professional	-0.060*** (-4.17)	-0.061*** (-4.20)	-0.061*** (-4.23)	-0.061*** (-4.22)	-0.060*** (-4.21)	-0.037 (-1.49)	-0.074*** (-4.84)	-0.135*** (-4.21)
Self-employed	-0.020* (-1.88)	-0.020* (-1.89)	-0.021* (-1.95)	-0.021* (-1.95)	-0.021* (-1.95)	-0.004 (-0.32)	-0.036** (-2.42)	-0.022 (-1.20)
Business proprietor	-0.042*** (-3.74)	-0.041*** (-3.59)	-0.041*** (-3.56)	-0.041*** (-3.55)	-0.041*** (-3.53)	-0.004 (-0.21)	-0.067*** (-4.57)	-0.082** (-2.57)
Employed professional	-0.111*** (-8.14)	-0.111*** (-8.26)	-0.111*** (-8.13)	-0.111*** (-8.13)	-0.111*** (-8.14)	-0.089*** (-7.38)	-0.121*** (-6.92)	-0.109*** (-4.64)
General management	-0.089*** (-6.24)	-0.091*** (-6.36)	-0.092*** (-6.48)	-0.092*** (-6.48)	-0.092*** (-6.47)	-0.053*** (-3.16)	-0.114*** (-6.46)	-0.007 (-0.16)
Middle management	-0.098*** (-9.83)	-0.098*** (-9.99)	-0.098*** (-10.14)	-0.098*** (-10.14)	-0.098*** (-10.11)	-0.080*** (-6.73)	-0.111*** (-9.70)	-0.117*** (-6.37)
Employed position (desk)	-0.083*** (-9.18)	-0.083*** (-9.22)	-0.083*** (-9.24)	-0.083*** (-9.23)	-0.083*** (-9.23)	-0.061*** (-5.46)	-0.117*** (-8.53)	-0.093*** (-8.17)
Employed position (travel)	-0.021** (-2.37)	-0.019** (-2.25)	-0.019** (-2.29)	-0.020** (-2.30)	-0.020** (-2.31)	-0.007 (-0.55)	-0.031** (-2.13)	-0.041** (-2.26)
Service sector	-0.036*** (-5.36)	-0.036*** (-5.09)	-0.035*** (-5.11)	-0.035*** (-5.13)	-0.035*** (-5.11)	-0.027*** (-2.81)	-0.052*** (-4.52)	-0.049*** (-3.89)
Supervisor	-0.039** (-2.49)	-0.039** (-2.49)	-0.039** (-2.48)	-0.039** (-2.49)	-0.039** (-2.49)	-0.042 (-1.47)	-0.049*** (-2.66)	-0.046 (-1.49)
Country/region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-spec. time trends	No	No	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	138,334	138,334	138,334	138,334	138,334	75,030	63,304	31,152
Pseudo-R <sup>2</sup>	0.071	0.072	0.073	0.073				

Notes: Marginal effects from probit and IV-probit estimations. Z-values in parentheses. Price elasticities in square brackets. Standard errors are clustered at the level of 24 countries/regions. Significance levels: \* .05 < p < .1, \*\* .01 < p < .05, \*\*\* < .01.

Data source: Eurobarometer survey series.

Table A.5: Full regression output of Table 3

Dependent variable: number of cigarettes								
	I	II	III	IV	V	VI	VII	VIII
	OLS	OLS	OLS	OLS	2SLS	2SLS	2SLS	2SLS
	Full sample	Full sample	Full sample	Full sample	Full sample	Females	Males	<30years
Smoking ban	0.819*** (2.99)	0.021 (0.05)	-0.114 (-0.20)	0.053 (0.09)	-0.170 (-0.33)	-0.490 (-0.90)	-0.033 (-0.05)	0.137 (0.17)
ln(cigarette price)	-2.298*** (-4.84)	-2.006*** (-4.54)	-0.592 (-0.86)		-1.286 (-1.21)	-1.241 (-1.04)	-1.139 (-0.87)	-2.931 (-1.49)
ln(specific taxes)				0.021 (0.06)				
Ad valorem tax				-2.844** (-2.23)				
ln(GDP per capita)	-0.805 (-0.68)	1.881 (1.57)	1.714 (0.75)	1.915 (0.86)	2.097 (0.88)	1.906 (0.69)	2.434 (0.75)	1.396 (0.26)
Unemployment rate	0.021 (0.46)	-0.035 (-1.19)	-0.052 (-1.11)	-0.048 (-1.13)	-0.031 (-0.57)	0.024 (0.35)	-0.086 (-1.31)	0.008 (0.06)
Inflation rate	-0.077 (-1.50)	-0.110 (-1.44)	-0.102 (-1.66)	-0.086 (-1.43)	-0.110* (-1.67)	-0.210** (-1.97)	-0.030 (-0.35)	-0.231** (-2.28)
Age	0.515*** (18.20)	0.519*** (18.33)	0.520*** (17.82)	0.520*** (17.84)	0.520*** (18.21)	0.425*** (8.97)	0.583*** (20.88)	0.982*** (5.62)
Age <sup>2</sup> /100	-0.554*** (-18.43)	-0.557*** (-18.44)	-0.558*** (-18.03)	-0.558*** (-18.06)	-0.558*** (-18.43)	-0.488*** (-10.00)	-0.616*** (-19.21)	-1.642*** (-4.06)
Education until less than age 15	Reference							
Education up to age 16-19	-0.751*** (-4.26)	-0.751*** (-4.32)	-0.727*** (-4.20)	-0.726*** (-4.18)	-0.729*** (-4.30)	-0.913*** (-3.81)	-0.476** (-2.30)	-1.471*** (-5.39)
Education up to age 20 or more	-1.990*** (-8.51)	-1.983*** (-8.30)	-1.969*** (-8.45)	-1.966*** (-8.43)	-1.969*** (-8.63)	-2.181*** (-6.47)	-1.672*** (-7.34)	-3.440*** (-10.85)
Education, still studying	-1.807*** (-4.14)	-1.799*** (-4.20)	-1.797*** (-4.20)	-1.800*** (-4.22)	-1.796*** (-4.30)	-3.210*** (-8.63)	-2.666*** (-3.25)	-3.228*** (-6.58)
Married	Reference							
Single with partner	0.258 (1.29)	0.391* (1.99)	0.398* (2.00)	0.399* (2.01)	0.397** (2.04)	0.460* (1.94)	0.409 (1.48)	0.342 (1.34)
Single	0.248 (1.52)	0.346** (2.22)	0.368** (2.31)	0.366** (2.31)	0.366** (2.34)	0.632*** (4.80)	0.298 (1.54)	0.274 (1.46)
Divorced	1.197*** (4.48)	1.344*** (4.97)	1.342*** (5.03)	1.348*** (5.07)	1.340*** (5.12)	2.020*** (8.06)	1.791*** (5.44)	1.826*** (3.18)
Widowed	0.269 (0.87)	0.401 (1.25)	0.414 (1.28)	0.421 (1.30)	0.412 (1.31)	1.377*** (4.77)	1.485*** (2.64)	0.905 (0.38)
Other marital status	-0.061 (-0.12)	0.022 (0.05)	0.036 (0.08)	0.047 (0.10)	0.067 (0.15)	-0.147 (-0.21)	0.647 (1.08)	0.474 (1.13)
No children in HH under age 15	Reference							
One child in HH under age 15	-0.511*** (-2.88)	-0.463** (-2.71)	-0.454** (-2.64)	-0.451** (-2.63)	-0.454*** (-2.70)	-0.497*** (-2.72)	-0.086 (-0.41)	-0.309 (-1.17)
Two children in HH under age 15	-0.788*** (-4.12)	-0.727*** (-3.86)	-0.711*** (-3.67)	-0.712*** (-3.68)	-0.710*** (-3.77)	-0.765*** (-4.04)	-0.438* (-1.78)	-0.194 (-0.72)
Three children in HH under age 15	0.153	0.228	0.213	0.214	0.212	-0.145	0.667	1.496***

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Table A.5: (continued)

	(0.44)	(0.65)	(0.61)	(0.61)	(0.62)	(-0.47)	(1.29)	(2.74)
Four or more children in HH under age 15	0.081	0.374*	0.408*	0.408*	0.409**	0.573	0.526	0.564
	(0.42)	(1.86)	(1.95)	(1.96)	(2.01)	(1.37)	(1.45)	(1.44)
No info about children in HH	0.375	-1.163	-1.257	-1.268	-1.269	-3.335*	1.751	-4.650*
	(1.16)	(-0.50)	(-0.54)	(-0.54)	(-0.55)	(-1.94)	(0.78)	(-1.93)
Manual worker	Reference							
Unemployed	-0.096	-0.107	-0.095	-0.098	-0.096	0.791**	0.100	-0.367
	(-0.57)	(-0.62)	(-0.55)	(-0.57)	(-0.57)	(2.39)	(0.43)	(-1.36)
Without occupation	-2.158***	-2.137***	-2.158***	-2.155***	-2.158***	0.418*	-1.018	-1.597***
	(-6.15)	(-6.17)	(-6.29)	(-6.28)	(-6.43)	(1.89)	(-1.27)	(-4.10)
Retired	-0.384	-0.386	-0.384	-0.381	-0.385	0.781***	-0.319	-0.625
	(-1.22)	(-1.23)	(-1.23)	(-1.21)	(-1.25)	(3.02)	(-0.83)	(-0.48)
Farmer/fisherman	-0.179	-0.165	-0.119	-0.113	-0.122	-3.198	-0.347	0.074
	(-0.24)	(-0.22)	(-0.16)	(-0.15)	(-0.16)	(-1.54)	(-0.59)	(0.07)
Professional	-0.630	-0.649	-0.677	-0.677	-0.673	0.646	-0.952	-1.398
	(-0.96)	(-0.95)	(-1.02)	(-1.03)	(-1.04)	(0.85)	(-1.20)	(-1.09)
Self-employed	0.754***	0.757***	0.708**	0.708**	0.708***	1.442***	0.630**	1.304**
	(2.99)	(3.01)	(2.79)	(2.79)	(2.86)	(3.10)	(2.48)	(2.50)
Business proprietor	0.826**	0.823**	0.802**	0.802**	0.806**	0.253	0.945**	0.364
	(2.31)	(2.30)	(2.29)	(2.29)	(2.34)	(0.38)	(2.19)	(0.30)
Employed professional	-2.395***	-2.402***	-2.391***	-2.393***	-2.393***	-1.147	-2.307***	-1.588**
	(-4.95)	(-4.97)	(-5.02)	(-5.03)	(-5.13)	(-1.58)	(-4.59)	(-2.57)
General management	-0.225	-0.228	-0.256	-0.259	-0.252	-0.030	-0.437	0.115
	(-0.51)	(-0.52)	(-0.57)	(-0.58)	(-0.57)	(-0.05)	(-0.71)	(0.08)
Middle management	-1.225***	-1.224***	-1.225***	-1.223***	-1.225***	-0.476	-1.046***	-1.240*
	(-4.86)	(-4.82)	(-4.90)	(-4.88)	(-5.01)	(-1.12)	(-5.67)	(-1.88)
Employed position (desk)	-2.539***	-2.524***	-2.532***	-2.530***	-2.535***	-1.176***	-1.635***	-2.215***
	(-9.18)	(-9.12)	(-9.33)	(-9.29)	(-9.48)	(-3.85)	(-4.20)	(-7.37)
Employed position (travel)	0.225	0.208	0.212	0.209	0.210	-0.266	0.274	-0.272
	(0.85)	(0.78)	(0.80)	(0.78)	(0.81)	(-0.62)	(1.22)	(-0.62)
Service sector	-1.620***	-1.601***	-1.624***	-1.621***	-1.623***	-0.442*	-0.649**	-1.362***
	(-7.59)	(-7.61)	(-7.80)	(-7.76)	(-7.98)	(-1.70)	(-2.29)	(-4.92)
Supervisor	0.112	0.106	0.114	0.115	0.111	-0.448	-0.380	-0.235
	(0.20)	(0.20)	(0.21)	(0.21)	(0.21)	(-0.74)	(-0.71)	(-0.19)
No. of observations	38,861	38,861	38,861	38,861	38,861	18,092	20,769	11,000
R <sup>2</sup>	0.112	0.114	0.116	0.116	0.116	0.097	0.101	0.118
Country/region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-spec. time trends	No	No	Yes	Yes	Yes	Yes	Yes	Yes

Notes: OLS and 2SLS estimations. T-values in parentheses. Price elasticities in square brackets. Standard errors are clustered at the level of 24 countries/regions.

Significance levels: \*  $.05 < p < .1$ , \*\*  $.01 < p < .05$ , \*\*\*  $< .01$ .

Data source: Eurobarometer survey series.