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6 November 2012

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Abstract

The short-term effects of public smoking bans on individual smoking and drinking habits were investigated in this paper. In 2005, a smoking ban was introduced in Italy, and we exploited this exogenous variation to measure the effect on both smoking participation and intensity and the indirect effect on alcohol consumption. Using data from the Everyday Life Aspects survey, for the period 2001-2007, we show that the introduction of smoke-free legislation in Italy significantly affected smoking behavior. We also document significant indirect effects on alcohol consumption for the main alcoholic beverage categories. A robustness analysis is also performed, to test the extent to which unobservable variables may bias our estimated parameters. Our results are then used to perform a cost-effectiveness analysis of the anti-smoking legislation in Italy.

Keywords: Anti-smoking legislation, regression discontinuity, Difference-in-Differences, cost-effectiveness analysis

JEL classification: I10, I12, I18

1 Introduction

The most important expected implication of clean indoor air laws ($CIALs$) is their beneficial effect in reducing cigarette consumption. Since smoking is an ongoing and substantial problem for national health service authorities, it is of interest to assess its possible indirect effects on health, such as passive smoking (Eriksen & Chaloupka 2007), the relationship with weight gains (Liu et al. 2010) and the positive spillover effects on drinking

Yörük & Yörük (2011). In this paper, we present evidence of the effectiveness of the $CIAL$, implemented in Italy as from 10 January 2005, in reducing smoking and on its possible indirect effects on alcohol consumption.

The introduction of smoking bans allows us to observe individuals' smoking choices, with similar observable and unobservable characteristics, subjected to different restrictions. Typically, individuals observed in the pre-ban period were exposed to lower restrictions and were freer to choose when and where to smoke. Conversely, in the post-ban period, smoking became more costly - for example, because smokers have to spend more time in reaching appropriate smoking areas at the workplace (Jones et al. 2011). In addition smokers also have to spend more time reaching smoking areas at restaurants or pubs, or finding those where smoking rooms are available.

As noted above, one possibility arising from the introduction of smoking bans is measuring the interactions between smoking and drinking habits in causal terms, as smokers usually record higher alcohol consumption levels than non-smokers. Dee (1999) highlighted complementarities in the consumption of such adult goods, exploiting the minimum legal drinking age ($MLDA$) to assess causal variations in terms of smoking. The same approach was also adopted by Yörük & Yörük (2011) and Crost & Guerreo (2012) to evaluate the effects of alcohol on marjuana use. Our work is related to these studies, because we share with them the idea of using an exogenous reform to evaluate the effects of smoking on alcohol consumption in Italy.

Our analysis is supported by related studies on the effects of smoking bans on smoking habits in other European countries. For instance, Nagelhout et al. (2012) showed that (comprehensive) smoking ban in Ireland and England had positive effects on quitting, whereas (partial) ban had no effect in the Netherlands. Jones et al. (2011) did not find significant effects of the smoking ban in England or Scotland, nor were non-significant effects found in Germany by Anger et al. (2011). Kennedy et al. (2012) provide an analysis of the French smoking ban in hospitality venues; they showed that the indoor smoking ban moved smoking to outdoor spaces and reduced smoking habits. In addition, using data from a survey conducted after the 2004 $CIAL$ in Ireland, Anonymous (2005) found that, among Irish smokers who quit after the law came into force, 80% not only reported that the law had helped them to quit but, of these, 88% stated that it had helped them to remain non-smokers[1]. Gallus et al. (2006), evaluating the 2005 Italian law for smoke-free public places, estimated that smoking prevalence decreased by 1.9% between 2004 and 2005. Significant effects of the smoke-free policy in Italy were also highlighted recently by Federico et al. (2012), with a special focus on the role of education. These results are also in line with findings from studies analysing countries outside Europe (e.g., the US, Australia and Canada; Fichtenberg & Glantz (2004)).

Our study makes three main contributions to the existing literature. First, it provides new estimates of the short-term effects of smoking bans on smoking habits. We find that smoking restrictions led to a significant reduction in cigarette consumption. In particular, we estimate that the probability of quitting smoking increased by 2.05 percentage points and that the average daily number of cigarettes smoked decreased by almost half a cigarette (i.e., -0.36).

Second, focusing on ever-smokers (defined as current and former smokers), we investigate the indirect effects of the anti-smoking law on alcohol consumption, for the main categories of alcoholic beverages. Although we do not deny evidence of complementarity relations between cigarette and alcohol consumption, we document larger reductions associated with alcoholic beverages prevalently consumed in public houses and restaurants, which are responsible for a re-allocation effect on wine consumed at home.

Third, we use our estimates to provide a cost-effectiveness analysis, showing that the costs associated with the implementation of the smoking ban do not exceed the health benefits to quitters.

The rest of the paper is organized as follows. Section 2 describes the dataset used and the basic facts for empirical analysis. Section 3 specifies our empirical strategy, which uses a regression discontinuity (RD) design to estimate the effect on smoking habits, whereas a *Difference-in-Differences* (DID) approach is used to evaluate interactions with alcohol consumption. Section 4 presents the main results from our analysis. To evaluate the effect of unobserved confounders, several robustness checks are described in Section 5 . Section 6 provides the results of the cost-effectiveness analysis of the Italian CIAL, and Section 7 concludes.

[1] This result is in line with that of Fong et al. (2006).

2 Data and basic facts

The dataset used in this paper is the ELA survey, conducted in Italy by the Italian Institute of Statistics (ISTAT). The ELA survey is a representative cross-section sample of the Italian population and provides detailed information on the demographics, social characteristics and health of 20,000 households each year, corresponding to approximately 50,000 individual records yearly.

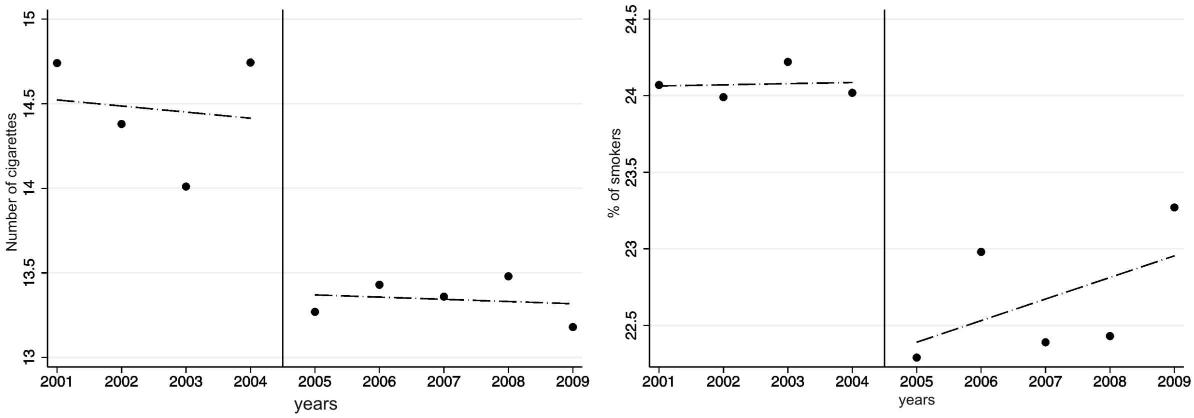
For the aims of the present study, the importance of this survey lies in the detailed section devoted to the analysis of smoking and drinking habits of individuals aged 18 and over. In particular, we use information about smoking rates and cigarette consumption as well as about the percentage of habitual drinkers for the following categories: beer, wine, alcoholic apéritifs, alcohol consumption outside meals, bitters[2] and spirits. The information from the ELA survey allows us to define various types of alcohol consumers, according to their consumption levels. For the selected alcoholic beverages, we define as ''habitual consumers" those who drink at least 1 or 2 glasses of beer or wine, or alcoholic apéritifs, alcohol outside meals, bitters or liquors at least once a week. The reference category is composed of individuals who very rarely or never consume alcohol.

Smoking and drinking outcomes are evaluated by six rounds of the ELA survey, from 2001-2007, collected around the discontinuity generated by the smoking ban. Since data for 2004 were not available, we selected a sample of individuals aged from 20 to 60 in the pre-ban period (2001-2003) and compared it with individuals of the same age in the post-ban period (2005-2007). The pre-ban sample constitutes a proper counterfactual, for individuals affected by the ban, with the most similar observable and unobservable characteristics.

Figure 1 shows the trends of smoking rates and cigarette consumption around the date of introduction of the ban. We observe how the anti-smoking law was effective in reducing smoking, creating a clear discontinuity in 2005. The smoking indicators are significantly higher before the smoking ban than after it. We can descriptively estimate a reduction of almost one cigarette and 1.6 percentage points in the percentage of smokers between these two periods.

Figure 2 shows the age profiles for the same variables. The solid line represents the

[2]the biiters category is intended in this work as alcohol flavoured with bitter plant extracts, used as an additive in cocktails or as a medicinal substance to promote appetite or digestion and not as bitter afpéritifs



Note: 2004 values for number of cigarettes and percentage of smokers were not available from Italian official statistics; for illustrative purposes, these values are approximated by linear interpolation.

Figure 1: Discontinuity smoking outcomes

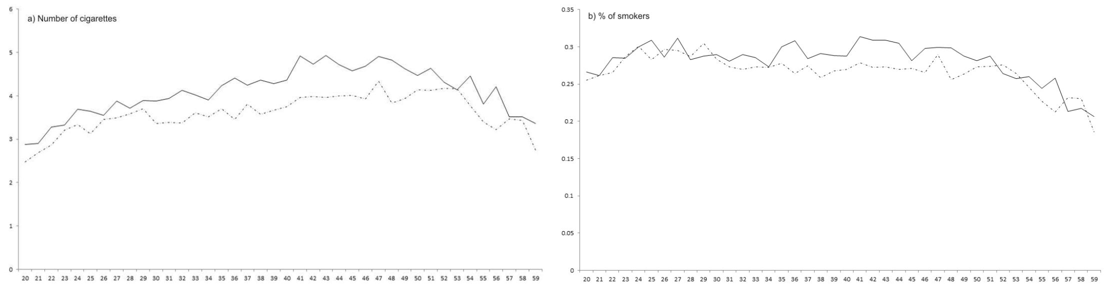


Figure 2: Age profiles of smoking habits pre- and post-CIAL

average of smoking rates and cigarette consumption for individuals recorded before the introduction of the ban; the dashed line represents the same indicators for individuals of the same age but observed in the post-ban period. For each age value, smoking habits are found to be significantly lower after the introduction of the ban. The descriptive analysis shows that the variation of smoking indicators is not null around the discontinuity introduced in 2005 from the anti-smoking legislation, and justify the use of a RD design that will be presented in the next section.

3 Empirical strategy

The 2005 Italian CIAL, restricting smoking in public places, causes an exogenous impulse on smoking indicators and, interestingly, allows us to evaluate possible interaction effects between smoking and alcohol consumption. We employ a regression discontinuity (RD) design to evaluate the direct effect on smoking habits, but a DID approach to estimate the indirect effects on the main categories of alcoholic beverages.

The basic RD model used to estimate smoking variations is as follows:

$$\begin{aligned} Smoking_{it} = & \alpha_0 + \alpha_1 SB_{it} + \alpha_2 age_i + \alpha_3 age_i^2 + \alpha_4 R_j + \\ & + \alpha_5 trend_t + \alpha_6 trend_t^2 + \sum_{j=1}^{J} \psi_j X_{itj} + \epsilon_{it}. \end{aligned} \tag{1}$$

Equation 1 describes changes in smoking habits for individual i at time t, proxied either by cigarette consumption or by the percentage of smokers as a function of the smoking ban (SB_{it}), which is a dummy variable with value 1 if the smoking ban was implemented in t ($t \geq 2005$) and 0 otherwise. In addition, we add a quadratic polynomial in age and regional dummies, and a quadratic time trend, plus a set of covariates X_{itj} (described in Appendix A).

Under this specification, we define a ''treatment group", formed of observations recorded after the smoking ban came into force (2005-2007), and a ''control group", composed of observations recorded in the pre-ban period (2001-2003). The parameter of interest, α_1, is the treatment effect of the smoking ban. If we assume that the observable control variables vary smoothly around the discontinuity and that α_1 is significant, we can conclude that the OLS estimator is adequate to capture the causal effect of the smoking ban on smoking patterns. A potential problem, related to the identification of α_1, is that we must rely on the assumption that no other unobserved factors influenced smoking decisions except the smoking ban. To account for this point, we include in our specification a quadratic time trend, which is assumed to capture the effect of unobservable variables.

We also present the DID model adopted to estimate the extent to which the anti-smoking law affected alcohol consumption. We use this strategy because it allows us to compare the changes in alcohol consumption of individuals whose smoking habits were affected by the smoking ban with those of unaffected individuals. The DID model is described in the following equation:

$$
\begin{aligned}
Alcohol_{it} =& \gamma_0 + \gamma_1 SB_{it} + \gamma_2 Treatment_{it} + \gamma_3 (Treatment \times SB)_{it} + \\
&+ \gamma_4 age_i + \gamma_5 age_i^2 + \gamma_6 R_j + \gamma_7 trend_t + \gamma_8 trend_t^2 + \sum_{j=1}^{J} \psi_j X_{itj} + \epsilon_{it}.
\end{aligned}
\tag{2}
$$

The dependent variable is dichotomous and records whether individual i at time t consumed alcoholic beverages. The other variables of the model are the same as those used in equation 1, already discussed above. The treatment group is formed of ever-smokers, who are respondents classified as current or former smokers, whose alcohol consumption is presumed to be indirectly affected by the smoking ban. The control group is composed of never-smokers, that is, individuals whose alcohol consumption was not influenced by the smoking ban. We assume that the majority of individuals started smoking before the age of eighteen and that, if they had not started by that age, they were unlikely to do so in later years.

4 Main results

4.1 Smoking

The estimates listed in Table 2 indicate a significant and negative decline in both numbers of cigarettes smoked and percentage of smokers after the application of the smoking ban in Italy. We estimate a reduction of cigarette consumption of 0.36 (s.e. = 0.075) and about 2 points (s.e. = 0.446) in the percentage of smokers. According to the covariates of equation 1, women as well as individuals with high education or practising physical exercise are less likely to be smokers. Employed and married individuals are more likely to be smokers than unemployed or single individuals. In addition, having a strenuous job increases the probability of smoking. Conversely, strenuousness of work at home and a better financial situation negatively affect smoking habits. As expected, the covariates show consistent signs and magnitudes when we use the number of cigarettes smoked as outcome.

Figure 3 shows the estimates of the smoking ban effect on selected subsamples of the population, compared with our baseline estimates. To make the comparison clear, we add an horizontal line corresponding to the effect estimated at the whole sample average. Note that the point estimate is represented by dots, and vertical spikes show the confidence intervals. Clearly, some coefficients differ, in terms of both level and variability, from the baseline estimates. Concerning the number of cigarettes, a greater effect is estimated for men (-0.512), employees (-0.431), unoccupied (-0.434), low educated (-0.511) and individuals living in the North of Italy (-0.716). In addition, although we find a lower, but significant effect for women (-0.301), the smoking ban did not affect unemployed, high-educated individuals and those living in the Center or South of Italy. Estimates of the effect of the CIAL according to the percentage of smokers (panel b) show patterns similar to those obtained according to the number of cigarettes smoked and, for the sake of simplicity, they are omitted from our discussion.

Although our results do not clearly differ from those of the previous literature, it is interesting to analyse the variability of the effects across individuals with differing socio-demographic and economic characteristics. Employees are more likely to reduce cigarette consumption, because they must respect the restrictions of the smoke-free law in their workplaces for longer periods than other individuals. This result is in line with the findings of Glasgow et al. (1997), who estimated that employees who worked in smoke-free workplaces were over 25% more likely to make a serious attempt to quit smoking, and over 25% more likely to achieve that goal than those who worked in places which permitted smoking. Evaluations of workplace smoking policies in Canada (Bauer et al. 2005) and Finland (Helakorpi et al. 2007) led to similar results. Instead, the fact that unoccupied individuals' smoking habits are affected significantly by the smoking ban appears to be due to the composition of this group, which includes students, has the youngest age structure, and is formed of individuals with a great propensity toward changing smoking habits, because they have been exposed to addictive behaviors for less time.

Gender differences are also significant in the Italian case. As argued in Gallus et al. (2006), men's smoking habits are more likely to be affected than women's, because the former category is associated with higher employment rates and frequency of eating out at pubs and restaurants. In addition, from the results of the literature cited above, we would expect to find a greater reduction in smoking habits in the highly educated: this hypothesis is based on the assumption that individuals belonging to this group are more oriented toward the future. Instead, we find that less well educated individuals show a larger reduction in terms of smoking habits. This unexpected result is explained by the fact that the smoking ban is an exogenous restriction on smoking habits, which is presumed to affect more severely individuals who are not likely to quit for other (personal) reasons. Also, the 2005 smoking ban was introduced in workplaces as an extension of the already existing anti-smoking law in private office rooms, and affected only common areas, for example, warehouses, which are usually more frequently populated by poorly educated workers.

Another interesting result is that the smoking ban had significant effects only in the North of Italy; in the Center and South, it did not turn out to be effective in reducing smoking habits. Again, this result is in line with previous findings about the effects of $CIALs$ on regional smoking habits (Gallus et al. 2006), according to which heterogeneous regional effects are explained by differences in regional employment rates and, in addition, by differences in climatic conditions. In fact, the lower average temperature in Northern Italy increases exposure to smoking ban restrictions for individuals living in these regions. For example, restaurants, cafés and pubs have fewer opportunities to exploit outside areas than those in southern regions.

4.2 Alcohol consumption

Table 2 lists the DID estimates of the smoking ban effect on alcoholic beverages. When we consider beer (column 1), we note how, after the introduction of the smoking ban, consumers do not change their habits significantly (-0.531; s.e.=0.336). As expected, ever-smokers (treatment group) are more likely, by about 4 percentage points, to be habitual drinkers of such beverage than never-smokers (control group). The coefficient measuring the interaction effect between the smoking ban and beer consumption is not significant either, meaning that consumption of this alcoholic beverage does not change between treatment and control groups. The percentage of habitual wine consumers (column 2) increases significantly, by almost 2 percentage points, in the post-ban period. In addition, we find that ever-smokers are more likely to be habitual wine drinkers, by about 5 percentage points, than never-smokers. Our estimates also reveal that ever-smokers habitually consuming wine increase (i.e., 1 percentage point) compared with the control group of never-smokers.

At first glance, this empirical result may seem counter-intuitive. We saw that the application of the anti-smoking law caused a reduction in smoking habits. The increase in wine consumption, which we find here, suggests the existence of a substitution effect between these goods. However, analysing the effect of smoking changes on other categories of alcohol consumption may also be useful in reconciling our results with the usual findings of complementarity effects between alcohol consumption and smoking. The hypothesis we propose here is that the large share of wine consumed at home (i.e., 90% of wine is consumed in Italian homes; UNICAB (2008)) is indirectly increased by a re-allocation effect with respect to other alcoholic beverages, which are negatively affected by the anti-smoking policy. Columns (3) to (6) of Table 2, list the estimates for the other alcoholic beverages analysed. Column (3), in particular, reports the DID coefficients when the percentage of habitual drinkers of apéritifs is used as outcome variable in equation 2. This category does not show any variation, either in absolute terms or according to the effect of treatment. Instead, column (4) highlights a negative and significant relation between smoking and consumption of alcohol outside meals. According to our estimates, in the post-ban period, ever-smoker consumers decreased more rapidly (-0.84 percentage points) than never-smokers. The percentage of habitual drinkers of bitters, (column 5) also shows similar patterns, with an estimated reduction of the percentage of ever-smoker habitual drinkers of -0.567 percentage points, compared with never-smokers. Lastly, the category of spirits (column 6) does not show significant differences among the consumption patterns of the treatment and control groups.

Figure 4 shows the range plots of the DID estimates, according to selected groups. To save space, we comment only on the panels related to those alcoholic beverages for which we estimate a significant effect. The causal effect of smoking on habitual consumers of wine (panel d) is higher, both using the percentage of quitters and the average number of cigarettes smoked, for men (2.06 percentage points), employees (1.53 percentage points), low-educated (1.24 percentage points) and individuals living in the North of Italy (1.44 percentage points). The effects on habitual consumers of alcohol outside meals (panel f) and bitters (panel g) have opposite signs with respect to those estimated for habitual wine consumers, and support the validity of the re-allocation hypothesis among alcoholic beverages. We do find that ever-smoker wine consumers increase the most, with respect to never-smokers, in those subsamples where also ever-smokers consumers of alcohol outside meals and bittérs decrease the most, always with respect to never-smokers. This result, associated with the fact that these categories are also those for which smoking habits decreased most, proves evidence of the existence of a ''causal link" between smoking and alcohol consumption.

Table 1: Estimates of smoking ban on smoking habits

Variables	**Number of cigarettes**	**Percentage of smokers**
	(1)	(2)
Smoking ban	-0.3607***	-2.0465***
	(0.075)	(0.446)
Female	-2.6917***	-11.1261***
	(0.055)	(0.465)
Employed	0.8045***	5.1415***
	(0.056)	(0.309)
High-educated	-1.3095***	-7.6844***
	(0.082)	(0.605)
Married	0.6156***	4.3699***
	(0.060)	(0.285)
Physical activity	-1.3412***	-5.6303***
	(0.059)	(0.345)
Job strenuousness	0.1536***	0.6724***
	(0.045)	(0.230)
Strenuousness of work at home	-0.5659***	-3.1512***
	(0.044)	(0.249)
Financial resources: excellent	-2.0593***	-10.9677***
	(0.226)	(1.264)
Financial resources: good	-2.2825***	-11.3057***
	(0.106)	(0.644)
Financial resources: poor	-1.3173***	-6.5484***
	(0.101)	(0.613)
Constant	1.8667***	25.0145***
	(0.312)	(1.876)
Observations	168,903	168,903
R-squared	0.06	0.04
Adj. R-squared	0.06	0.04

*Notes: All models are estimated including a quadratic polynomial in age, quadratic time trends and regional dummies. Significant levels: p-value *** $\leq$ 0.01, ** $\leq$ 0.05, * $\leq$ 0.1.*

Table 2: Estimates of smoking ban on alcohol consumption

Variables	**Beer**	**Wine**	**Aperitifs**	**Outside meals**	**Bitters**	**Spirits**
	(1)	(2)	(3)	(4)	(5)	(6)
Smoking ban	-0.5309	2.5734***	0.3684	0.2304	0.4849*	0.2658
	(0.336)	(0.567)	(0.279)	(0.371)	(0.282)	(0.238)
Ever-smoker	4.0090***	5.5036***	3.7409***	6.3692***	3.4557***	2.9244***
	(0.179)	(0.293)	(0.144)	(0.193)	(0.151)	(0.126)
Smoking ban × Ever-smoker	-0.1409	1.0713***	-0.0423	-0.8461***	-0.5676***	-0.2418
	(0.251)	(0.411)	(0.212)	(0.277)	(0.214)	(0.181)

*Notes: All models are estimated including a quadratic polynomial in age, quadratic time trends and regional dummies. Significant levels: p-value *** $\leq$ 0.01, ** $\leq$ 0.05, * $\leq$ 0.1.*

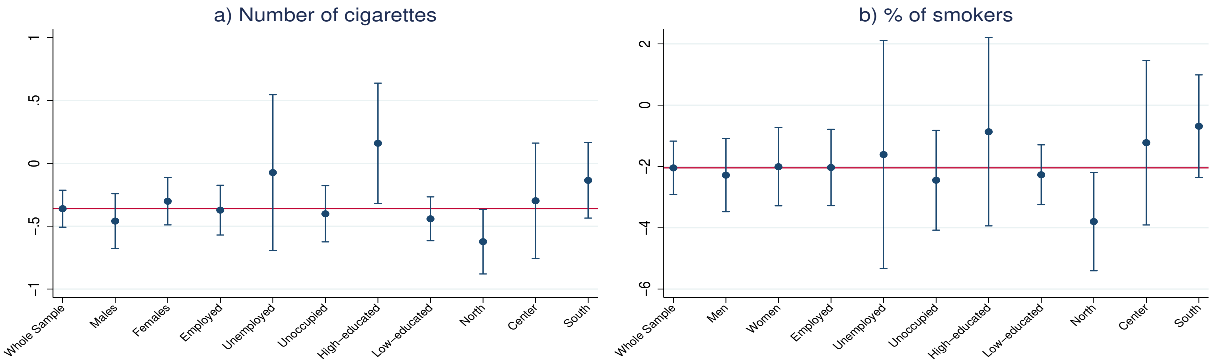


Figure 3: Effect of Italian CIAL on number of cigarettes and percentage of smokers

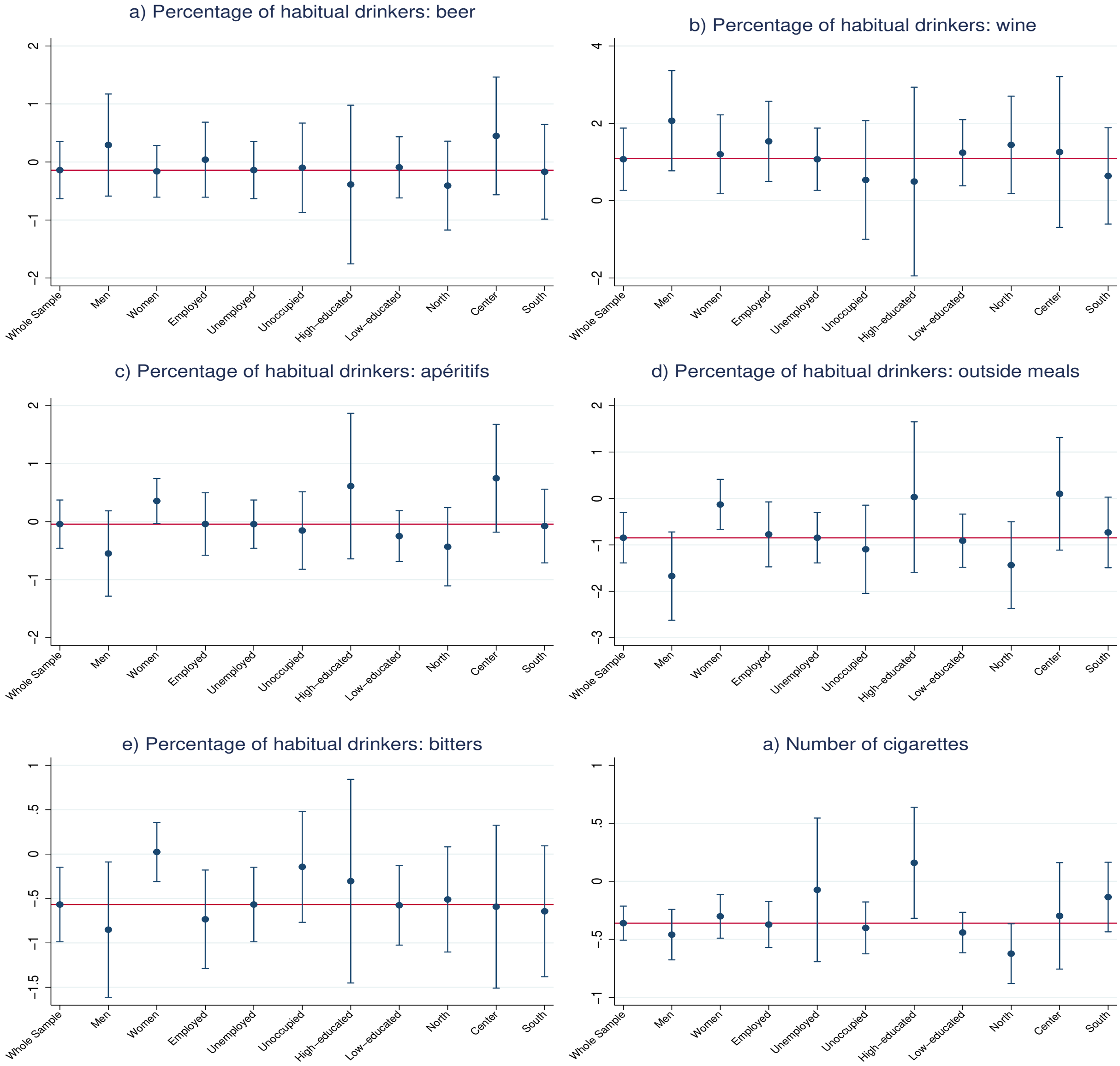


Figure 4: Effect of Italian CIAL on alcoholic beverages

4.3 Robustness checks

In this section, we check the robustness of our estimated effects of the Italian $CIAL$ on smoking and drinking habits. The Italian smoking ban came into force in January 2005, but choosing another year, as the date of its introduction may lead to estimates of larger variations in smoking or alcohol consumption, casting doubt on the effectiveness of the identification strategy based on the smoking ban. If we do not find that the estimated reduction in cigarette consumption is highest when the threshold is set at the true date of introduction of the ban, other unobservable variables may be affecting smoking patterns. Figure 5 shows the estimated parameters associated with the smoking ban effect on smoking and alcohol consumption (equations 1 and 2), by varying the date of introduction of ban in the period 2001-2007. We find that, consistently with our expectations, the only significant change in the key variables of our model appears precisely in 2005, the year when the smoking ban was introduced. More interestingly, again consistently with our expectations, this relation is not confirmed for some alcoholic beverages which, according to our estimates, were not affected by the smoking ban (i.e., beer, apéritifs and spirits).

As already discussed in section 2, we present here a robustness check of our baseline estimates to different specifications, as in Lochner & Moretti (2004). Results are listed in Table 3. Specification A) reports the base case estimates of the smoking ban effect on smoking and alcohol consumption, from Tables 1 and 2, for ease of comparison. The following four models aim at absorbing trends which are specific to the region of residence, to account for geographic differences in smoking and alcohol consumption over time. Specification B) includes the interactions between region of residence and quadratic time trends, Specification C) the interactions between region of residence and linear trends in year of birth, and Specification D) the interaction of effects of region of residence and cohort of birth. Lastly, Specification E) allows the cohort effects to vary with age, capturing the possibility that age-related smoking and drinking patterns vary over time. Overall, the estimates of the various specifications, listed in Table 3, are similar to the base case. Our findings indicate that other unobserved time-varying factors are not likely to be empirically important after controlling for age, time trends and region of residence.

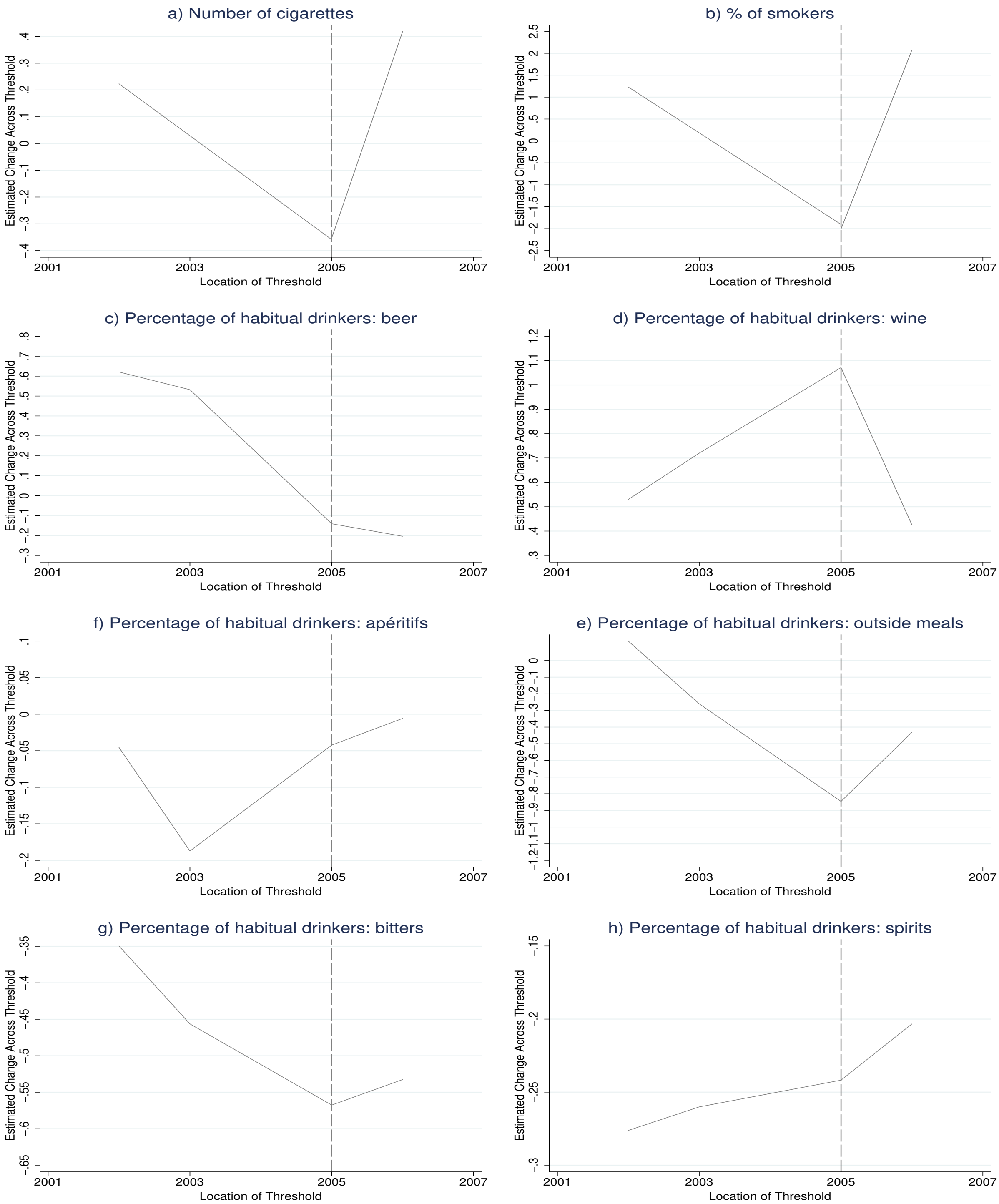


Figure 5: Location test for smoking and alcohol variables.

Table 3: Smoking ban effect on smoking and alcohol consumption - robustness checks

	Ncigs	**Psmokers**	**Beer**	**Wine**	**Aperitifs**	**Outside meals**	**Bitters**	**Spirits**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Base case	-0.3607***	-2.0465***	-0.1409	1.0713***	-0.0423	-0.8461***	-0.5676***	-0.2418
	(0.075)	(0.446)	(0.251)	(0.411)	(0.212)	(0.277)	(0.214)	(0.181)
B. Region × time trend	-0.3527***	-1.9994***	-0.1458	1.0921***	-0.0473	-0.8609***	-0.5619***	-0.2608
	(0.073)	(0.440)	(0.252)	(0.412)	(0.212)	(0.277)	(0.215)	(0.181)
C. Region × cohort trend	-0.3381***	-2.0547***	-0.1634	1.2727***	0.0871	-0.7741***	-0.5732***	-0.1942
	(0.075)	(0.441)	(0.256)	(0.416)	(0.217)	(0.281)	(0.219)	(0.184)
D. Region × cohort effects	-0.3654***	-2.0690***	-0.1964	1.3340***	0.1447	-0.6887**	-0.5532**	-0.1468
	(0.075)	(0.438)	(0.255)	(0.416)	(0.216)	(0.280)	(0.218)	(0.184)
E. Age × cohort effects	-0.3556***	-2.1334***	-0.2001	1.3256***	0.1509	-0.6835**	-0.5431**	-0.1508
	(0.075)	(0.445)	(0.255)	(0.416)	(0.217)	(0.281)	(0.218)	(0.185)

*Note: Significant levels: p-value *** $\leq$ 0.01, ** $\leq$ 0.05, * $\leq$ 0.1.*

5 Cost-effectiveness analysis of the 2005 CIAL

In this section, we focus attention on a cost-effectiveness analysis of the Italian anti-smoking legislation, borrowing some exogenous parameters from previous literature findings. In particular, we compare government savings from quitting smoking with the loss in terms of tax revenues deriving from reductions of cigarette sales. A scenario analysis is used to evaluate the expected positive economic externalities.

From the health economics tradition, we use the incremental cost-effectiveness ratio (ICER) to compare the monetary cost-benefits from a given treatment, corrected for quality-adjusted life-years (QALYs)[3]. The equation defining ICER is the following:

$$ICER = \frac{Cost_{SB}/N_Q - Cost_{\overline{SB}}/N_Q}{QALY_{SB} - QALY_{\overline{SB}}} \tag{3}$$

where we define $Cost_{SB}$ as the indirect unitary cost (i.e., for each quitter, N_Q) of the smoking ban, which we identify as lost tax revenues for the government, and $Cost_{\overline{SB}}$ as the costs which the health service would have to sustain to treat those individuals continuing to smoke, instead of quitting, if the smoking ban had not been implemented. This quantity, also defined as the extra cost per smoker, is then divided by the gains in terms of health, which are represented by the difference in terms of QALYs for quitters

[3]QALY is a measure of disease burden, including both the quality and quantity of life lived. See, for a discussion, Weinstein et al. (1980) and Nord (1993).

($QALY_{SB}$) compared with those of smokers ($QALY_{\overline{SB}}$). Equation 3 yields the minimum number of quitters necessary to maintain the willingness to pay (WTP) per QALY gained, lower than a fixed threshold.

In order to perform this analysis, we use some exogenous parameters: first, we obtain from national statistics the average price of a pack of 20 cigarettes in Italy, which was 4 euro in 2005. Second, we estimate an average growth rate of 62.6% for the price of cigarettes in the period 1996-2005, which roughly corresponds to an annual growth rate of 6.26%, and propose three scenarios. Scenario (A) uses the estimated annual growth rate to generate tax revenues for 15 years; scenarios (B) and (C) consider, respectively, the estimated annual growth rate increased or decreased by 5 percentage points (i.e., 11.26 and 1.26, respectively). Note that a time horizon of 15 years is generally accepted as the period necessary for the human organism to overcome all the effects of smoking. Lastly, we use the estimates of Flack et al. (2007) who, using a cohort simulation in the UK, assessed the extra costs of smokers and the QALYs gained from quitters. The authors above estimated that quitters on average gain 2.03 more life-years (LYs) and 0.91 more quality-adjusted life-years (QALYs), assuming a quitting rate of 2%, which is very close to our baseline estimated parameter of 2.05% (see Table 1), and an extra cost per smoker of 2,222.36 euro. Using these parameters as in Flack et al. (2007), we assume that an ICER of 25,000 euro per QALY is affordable by the health service in order to promote a given anti-smoking campaign, and calculate the minimum number of quitters N_q necessary to achieve the fixed ICER.

The estimates from our sample indicate that the anti-smoking policy reduced the number of smokers by 314,000 individuals. As Table 4 shows, even in the most drastic scenario (B), in which the price of cigarettes increases by 11.26% yearly, the number of quitters necessary to maintain ICER under 25,000 euro is 260,426. In all the other cases, estimates are even lower, and amount to 170,406 for baseline scenario (A) and 114,377 for the most parsimonious case (C). We can also determine the minimum ICER, necessary to breakeven, given the estimated number of quitters from our model, which is 10,075 euro in the baseline case (A) and ranges from 6,105 euro in scenario (B) to 16,454 euro in scenario (C). Lastly, Table 4 lists the annual growth rate for the price of cigarettes which guarantees an ICER of 25,000 euro, estimated at 11.6%.

Table 4: Cost-effectiveness analysis of the Italian 2005 smoking ban

	Scenario A**	**Scenario B****	**Scenario C ****
Average annual growth rate of price of cigarettes	6.26%	11.26%	1.26%
Lost tax revenues due to smoking ban after 15 years	$4.212*10^9$	$6.438*10^9$	$2.827*10^9$
Minimum number of quitters for break-even point, (with ICER under 25,000 euro)	170,406	260,426	114,377
Minimum ICER for break-even point	10,075 euro	16,454 euro	6,105 euro
Maximum yearly growth rate of price of cigarettes	11.6%		

*Notes: ** Scenario A calculated with 1995-2005 growth rate (i.e., 6.26%) to estimate price of cigarettes for next 15 years. Scenario B increases 1995-2005 growth rate by 5 percentage points. Scenario C decreases 1995-2005 growth rate by 5 percentage points. Scenario analysis obtained by calculating price of 20-cigarette pack as 4 euro in 2005 and estimated quitting rate of 2.05%. Exogenous parameters are obtained from Flack et al. (2007).*

6 Conclusions

This paper estimates the effect on smoking and alcohol habits of the 2005 Italian anti-smoking legislation. We find that CIAL increases the probability of quitting smoking by about 2 percentage points and reduces the daily number of cigarettes smoked by slightly less than half a cigarette. A heterogeneous change in smoking habits is found for specific subgroups of the population. The smoking ban has greater effects on employees and men, because the extension of the law to common areas in workplaces, means that these groups must respect the restrictions imposed by the ban for longer periods of time.

Findings concerning the effects of the smoking ban on alcohol consumption are more complex. Using estimates based on the ever-smoker treatment group, we show that the smoking ban increased wine consumption. This result is explained by the fact that, in Italy, wine is widely consumed at home, while the smoking ban prevalently affected consumption of alcohol outside meals and bitters, so that, in aggregate, our results provide support for a complementary relation between smoking and alcohol consumption.

Our estimates confirm the perspective that policy interventions for reducing smoking, in order to limit the negative consequences on health of both smokers and non-smokers, produce positive effects by reducing alcohol consumption. In particular, the CIAL stimulates wine consumption at home through the substitution effect with alcoholic beverages outside the home. This evidence also tells us that the anti-smoking law stimulated in Italy a safe and healthful consumption of wine at home. Addressed to the current policy-makers interests in alcohol-related issues, a focus of the significance of these interaction effects should be validated on the younger cohorts. This topic will be taken into accounts for future studies.

Lastly, the estimated social savings of quitting smoking deriving from our results appear to be substantial. Although we use conservative parameters, one great benefit of the smoking ban is shown by the cost-effectiveness analysis, with positive implications in terms of costs to the health service.

Acknowledgements

We acknowledge the participants of the ‘’2012 European Congress of Epidemiology”, 05-08 September 2012, University of Porto Medical School, Portugal, for their comments and suggestions.

References

Anger, S., Kvasnicka, M. & Siedler, T. (2011), 'One last puff? public smoking bans and smoking behavior', *Journal of Health Economics* **30**(3), 591–601.

Anonymous (2005), 'Ireland's smoking ban is an admirable achievement', *Lancet* (365), 1282.

Bauer, J., Hyland, A., Li, Q., Steger, C. & Cummings, M. (2005), 'A longitudinal assessment of the impact of smoke-free worksite policies on tobacco use', *American Journal of Public Health* **95**(6), 1024–1029.

Crost, B. & Guerreo, S. (2012), 'The effect of alcohol availability on marijuana use: Evidence from the minimum legal drinking age', *Journal of Helath Economics* **forthcoming**.

Dee, T. S. (1999), 'The complementarity of teen smoking and drinking', *Journal of Health Economics* **18**(6), 769–793.

Eriksen, M. & Chaloupka, F. (2007), 'The economic impact of clean indoor air laws', *A Cancer Journal for clinicians* **57**(6), 367–378.

Federico, B., Mackenbach, J. P., Eikemo, T. A. & Kunst, A. E. (2012), 'Impact of the 2005 smoke-free policy in italy on prevalence, cessation and intensity of smoking in the overall population and by educational group', *Addiction* **107**(9), 1677–1686.

Fichtenberg, C. & Glantz, S. (2004), 'Effect of smoke-free workplaces on smoking behavior: Systematic review', *British Medical Journal* (325), 188–194.

Flack, S., Taylor, M. & Trueman, P. (2007), Nice rapid review: Cost-effectiveness of interventions for smoking cessation: Mass media interventions. supplementary report + a rapid review of: The cost-effectiveness of mass media policies for smoking cessation in england final report, Technical report, York Health Economics Consortium.

Fong, G., Hyland, A., Borland, R., Hammond, D., Hastings, G., McNeill, A., Anderson, S., Cummings, K., Allwright, S., Mulcahy, M., Howell, F., Clancy, L., Thompson, M., Connolly, G. & Driezen, P. (2006), 'Reductions in tobacco smoke pollution and increases in support for smoke-free public places following the implementation of comprehensive smoke-free workplace legislation in the republic of ireland: findings from the itc ireland/uk survey', *Tobacco Control* **15**, 51–58.

Gallus, S., Pacifici, R. & Colombo, P. e. a. (2006), 'Prevalence of smoking and attitude towards smoking regulation in italy, 2004', *Eur. J. Cancer Prev.* **15**, 77–81.

Glasgow, R. E., Cummings, K. M. & Hyland, A. (1997), 'Relationship of worksite smoking policy to changes in employee tobacco use: Findings from commit', *Tobacco Control* **6**(2), 44–48.

Helakorpi, S., Martelin, T., Torppa, J., Patja, M., Kiiskinen, U. A., Vatiainen, E. & Uutela, A. (2007), 'Did the tobacco control act amendment in 1995 affect daily smoking in finland ? effects of a restrictive workplace smoking policy', *Journal of Public Health* pp. 1–8.

Jones, A., Laporte, A., Rice, N. & Zucchelli, E. (2011), A model of the impact of smoking bans on smoking with evidence from bans in england and scotland, Health, Econometrics and Data Group (HEDG) Working Papers 11/05, HEDG, c/o Department of Economics, University of York.

Kennedy, R. D., Behm, I., Craig, L., Thompson, M. E., Fong, G. T., Guignard, R. & Beck, F. (2012), 'Smoking cessation interventions from health care providers before and after the national smoke-free law in france', *European Journal of Public Health* **22**(1), 23–28.

Liu, F., Zhang, N., Cheng, K.-W. & Wang, H. (2010), 'Reduced smoking and rising obesity: Does smoking ban in the workplace matter?', *Economics Letters* **108**(3), 249–252.

Lochner, L. & Moretti, E. (2004), 'The effect of education on crime: Evidence from prison inmates, arrests, and self-reports', *American Economic Review* **94**(1), 155–189.

Nagelhout, G. E., de Vries, H., Boudreau, C., Allwright, S., McNeill, A., van den Putte, B., Fong, G. T. & Willemsen, M. C. (2012), 'Comparative impact of smoke-free legislation on smoking cessation in three european countries', *European Journal of Public Health* **22**(1), 4–9.

Nord, E. (1993), 'The trade-off between severity of illness and treatment effect in cost-value analysis of health care', *Health Policy* **24**(3), 227–238.

UNICAB (2008), Il vino nei locali italiani di qualit & il consumo del vino degli italiani in casa e fuori casa, Technical report.

Weinstein, M. C., Shepard, D. S. & Pliskin, J. S. (1980), 'The economic value of changing mortality probabilities: A decision-theoretic approach', *The Quarterly Journal of Economics* **94**(2), 373–96.

Yörük, B. K. & Yörük, C. E. (2011), 'The impact of minimum legal drinking age laws on alcohol consumption, smoking, and marijuana use: Evidence from a regression discontinuity design using exact date of birth', *Journal of Health Economics* **30**(4), 740–752.

APPENDIX A

Table A.1: Descriptive statistics

Variable	Description	Mean	%
Smoking	Number of cigarettes smoked daily	3.89	
	Percentage of smokers	27.5	
Alcohol consumption	Percentage of habitual drinkers: beer	7.24	
	Percentage of habitual drinkers: wine	28.97	
	Percentage of habitual drinkers: apéritifs	9.23	
	Percentage of habitual drinkers: outside meals	4.96	
	Percentage of habitual drinkers: bitters	5.09	
	Percentage of habitual drinkers: spirits	3.56	
Age		39.8	
Gender	Male		49.32
	Female		50.68
Occupation	Employed		64.69
	Unoccupied		35.31
Education	Degree or more		11.32
	Secondary or less		88.68
Marital status	Married		32.79
	Single		67.21
Physical activity	Yes		19.89
	No		80.11
Job strenuousness	High		24.26
	Moderate or low		75.74
Strenuousness of	High		31
work at home	Moderate or low		69
Financial resources	Excellent		1.35
	Good		63.77
	Poor		30.38
	Insufficient		4.49