Deutsches Institut für
Wirtschaftsforschung

DIW BERLIN

Discussion Papers

992

Silke Anger • Michael Kvasnicka • Thomas Siedler

One Last Puff?
Public Smoking Bans and Smoking Behavior

Berlin, March 2010

IMPRESSUM

DIW Berlin
German Institute for Economic Research
Mohrenstr. 58
10117 Berlin
Tel. +49 (30) 897 89-0
Fax +49 (30) 897 89-200
http://www.diw.de

ISSN print edition 1433-0210
ISSN electronic edition 1619-4535

Available for free downloading from the DIW Berlin website.

Discussion Papers of DIW Berlin are indexed in RePEc and SSRN.
Papers can be downloaded free of charge from the following websites:

http://www.diw.de/de/diw_01.c.100406.de/publikationen_veranstaltungen/publikationen/diskussionspapiere/diskussionspapiere.html
http://ideas.repec.org/s/diw/diwwpp.html
http://papers.ssrn.com/sol3/JELJOUR_Results.cfm?form_name=journalbrowse&journal_id=1079991

One Last Puff?
Public Smoking Bans and Smoking Behavior

Silke Anger
DIW Berlin

Michael Kvasnicka
RWI

Thomas Siedler
DIW Berlin and
University of Essex

March 30, 2010

Abstract

This paper investigates the short-term effects of public smoking bans on individual smoking behavior. In 2007 and 2008, state-level smoking bans were gradually introduced in all of Germany's sixteen federal states. We exploit this variation in the timing of state bans to identify the effect that smoke-free policies had on individuals' smoking propensity and smoking intensity. Using rich longitudinal data from the German Socio-Economic Panel Study, our difference-in-differences estimates show that the introduction of smoke-free legislation in Germany did not change average smoking behavior within the population. However, our estimates also point to important heterogeneous effects. Groups that go out more often, and hence are more exposed to the constraints of public smoking bans in everyday life, did adjust their smoking behavior. Specifically, we find that young, unmarried individuals, and those living in urban areas are groups that are both less likely to smoke and smoke less intensively following the introduction of public smoking bans. Furthermore, effects on individual smoking habits proved stronger in states that had more strict smoking bans. Public smoking bans, therefore, have important health benefits over and above the reduction in exposure of non-smokers to second-hand smoke that is their immediate and prime objective.

JEL codes: I12, K32, I18, C33
Keywords: Public smoking bans; smoking, cigarette consumption, treatment effects

Acknowledgements:

We would like to thank Jörg Breitung, Julien Grenet, Peter Haan, Magne Mogstad, Steve Pischke, Imran Rasul, Kostas Tatsiramos, and participants of the SOEP Brownbag Seminar for their useful comments and discussions. We also thank Thomas Apolke and Quirin Schimeta for their excellent research assistance.

Corresponding author: Thomas Siedler, DIW Berlin, SOEP Department, Mohrenstr. 58, 10117 Berlin, Germany, tsiedler@diw.de, Tel: +49-30-89789-464.

1. Introduction

Smoking has important health repercussions. Indeed, active and passive smoking are seen as one of the leading causes of preventable deaths (World Health Organization, 2009). In recent years, a growing awareness of the deadly effects of smoking has led most industrialized countries to enact tobacco control policies. Public smoking bans, in particular, have proliferated as a means of reducing the exposure of non-smokers to second-hand smoke. Public smoking bans, however, may well also have an effect on smokers. Smoking bans may affect smoking initiation rates among younger age cohorts, overall smoking prevalence within the population, and smoking intensity among smokers. However, to date, surprisingly little research has been done on whether people change their smoking habits as a result of smoking bans.

This paper investigates the short-term effects of public smoking bans on individual smoking behavior in Germany, a country with relatively high smoking rates among industrialized countries (Tobacco Atlas, 2009). In 2007 and 2008, smoking bans were gradually introduced at the federal state level in Germany. We exploit the fact that smoking bans were introduced on different dates in different states to identify the effects that smoking bans had on individuals' smoking propensity and intensity. The individual-level data employed in this study is taken from the German Socio-Economic Panel Study (SOEP), an annual household panel of roughly 20,000 individuals in around 11,000 households.

Our results show that the introduction of smoke-free policies in Germany did not change the population's average smoking behavior in the short term: on average, individuals were neither less likely to smoke, nor did they smoke less following the introduction of smoking bans. However, there appear to be important heterogeneous effects for different socio-demographic groups. Specifically, we find that young adults, men, unmarried individuals, and city dwellers smoke less and less intensively following the introduction of state smoking bans. These groups traditionally go out more often and hence, in everyday life, are more exposed to the constraints imposed by public smoking bans on their smoking behavior.[1] For young adults aged 30 or less, there is a negative effect on both the likelihood of smoking and the propensity to be a regular smoker (smoking ten or more cigarettes per day on average). For this age group, the propensity to smoke decreases by about three percentage points following the introduction of public smoking bans. With a smoking rate among young adults of about 39 percent in 2006, this corresponds to a reduction in smoking propensity of

[1] Summary statistics on the frequency of going out of individuals in Germany by gender, age, residence (urban vs. rural area), and marital status are provided in Section 5.

seven percent. Smoke-free policies also appear to have had a more significant effect on individual smoking behavior in urban areas than in rural areas and among unmarried than among married individuals. For example, our estimates suggest that smoking bans decreased the probability of being a regular smoker in urban areas by almost four percentage points. Finally, we find stronger effects on individual smoking habits in states that enacted stricter state smoking bans. In states which did not permit smoking rooms in dance clubs, both the average smoking propensity and the average smoking intensity in state populations declined. Stricter state smoking bans also proved to be more effective in changing average smoking behavior among young adults and unmarried individuals.

These findings have important policy implications. First, strictly enforced smoking bans can reduce smoking prevalence and smoking intensity within the general population. Second, even if smoking bans are less strictly enforced and ineffective in influencing the population's average smoking behavior, they may, nevertheless, be an effective tobacco control policy for certain subgroups. As such, public smoking bans can still have potentially important health benefits on top of the reduction in exposure of non-smokers to second-hand smoke that is their immediate and prime objective.

This study makes several contributions to the existing literature. Our study is the first to investigate the effects of smoking bans on smoking behavior in a country with high smoking prevalence. Existing research has mainly concentrated on the United States, where smoking prevalence is considerably lower than in European countries, particularly among young adults aged 18-25 (Tobacco Atlas, 2009).[2] Smoke-free laws, however, may have different effects on individual smoking behavior when overall smoking prevalence in a country is high and potential peer group effects are, consequently, stronger. Furthermore, smokers in a country with low smoking prevalence, like the US, are likely to have different characteristics to smokers in European countries, where smoking is more widespread, (still) more socially acceptable, and less of a lower-class phenomenon.[3] Second, our data contains a wealth of information on individuals' socio-economic characteristics and their frequency of going out. This information enables us to examine whether the effects of smoking bans vary across different groups of individuals. Knowledge of such group-specific heterogeneous effects is important, as it can help to target future tobacco control policies more effectively. Third, to identify the causal effects of public smoking bans, we are able to exploit the

[2] Smoking prevalence in continental European countries such as Germany, France, Belgium and the Netherlands ranges from 30 to 39 percent, compared to only 23.6 percent in the US (Tobacco Atlas, 2009). With about 35 percent of adults smoking, the smoking prevalence in Germany exceeds that of the US by nearly 50 percent.
[3] For example, more than 50 percent of all health professionals in Germany smoked in 2004. In the US, the respective share was less than 10 percent (Tobacco Atlas, 2009).

variation in the exposure to smoking bans over time, across states, and also within states. Smoking bans have gradually been introduced in all German federal states within a relatively short period of time. Our data enables us to separate time and reform effects as the interview months of survey respondents in the SOEP vary within states. Exploiting this variation reduces the risk of potential unobserved effects, which coincide with the introduction of public smoking bans and influence individuals' smoking behavior, biasing our estimates. Fourth, smoking bans in Germany also varied in their scope of enactment. This additional variation across federal states allows us to shed light on whether the stringency of smoking bans influences an individual's smoking behavior.

The remainder of the article is structured as follows. Section 2 discusses the timing and coverage of smoking bans in bars and restaurants in Germany and provides some background information on business compliance with the new laws. Section 3 reviews the relevant literature, and Section 4 describes the data. Section 5 presents our estimation methods and results. Several robustness checks are discussed in Section 6. Finally, Section 7 summarizes our main findings and concludes.

2. Institutional background

The implementation of smoking bans in Germany is the responsibility of the individual federal states. On 22 March 2007, state health ministers convened and agreed to introduce public smoking bans in state buildings, hospitals, hotels, schools, restaurants and bars (Blum, 2007). As a result, smoke-free policies were implemented in all of Germany's sixteen federal states. Individual state smoking bans, however, varied in their enforcement dates, and, to some extent, also in their scope.[4] Table 1 presents the dates that individual state laws were enforced and documents the scope of the different smoking bans in each of Germany's sixteen federal states. Baden-Wuerttemberg was the first to implement a state smoking ban (in August 2007). It was joined in October 2007 by Hesse, in November 2007 by Lower Saxony and in January 2008 by Bavaria, Hamburg and Schleswig-Holstein. In February 2008, Rhineland-Palatinate and Saxony imposed state smoking bans, followed by six further states, in July 2008 (Berlin, Brandenburg, Bremen, North-Rhine Westphalia, Saxony-Anhalt and

[4] Kvasnicka (2010) reports that smoking bans in Germany varied not only in their pre-announced enforcement dates, violations of which were fined, but also in their formal introduction dates. For example, in Brandenburg, a state smoking ban was introduced in January 2008. This ban, however, was only enforced (factually mandatory) when fines for its violation were imposed, from July 2008 onwards. In nine out of the sixteen federal states, however, the introduction dates and enforcement dates coincided. In the robustness section below, we discuss estimates of the effects of smoking bans when these are defined on the basis of their introduction dates rather than their enforcement dates.

Thuringia). Mecklenburg-Western Pomerania was the last to ban smoking, in August 2008. All states, except Bavaria, continued to allow smoking in separate smoking rooms in bars and restaurants, if this was possible, and ten permitted smoking in specially designated smoking rooms in dance clubs (see columns 3 and 4 in Table 1).[5]

Due to the various exceptions granted, state smoking bans in Germany should be judged less comprehensive than those introduced in other countries such as the United States, England, Ireland, or Scotland. Furthermore, compliance was less strictly enforced than elsewhere. As noted by the *Spiegel online international* on 17 October 2008: "Germany may now have smoking bans [...], but that isn't keeping smokers from enjoying their habit. As well as straight civil disobedience, many bars and restaurants have come up with novel ways around the prohibition."[6] Other newspapers also reported that smoking restrictions were weakly enforced and that many premises ignored smoking bans altogether (see, for example, *The New York Times* on July 31, 2008). Yet, first empirical evidence suggests that cigarette sales at vending machines in bars and restaurants declined, on average, by 15 percent following the introduction of state smoking bans in Germany (Kvasnicka, 2010).

Despite the exemptions and rather lax implementation, opposition to smoking bans in Germany was fierce from the start. Bar owners even filed a constitutional complaint against the bans in two states (Berlin and Baden-Wuerttemberg). Furthermore, in July 2008, the German Federal Constitutional Court ruled parts of the smoking ban legislation unconstitutional on the grounds that it discriminates against small pubs which cannot establish separate rooms for smokers. Federal states had until 31 December 2009 to modify their smoking bans. Up until this date, bars smaller than 75 square meters were allowed to declare themselves as smoking pubs if young people aged 18 or less were denied entry, and food was not served.

3. Previous literature

A large and growing body of literature has examined the effects of different tobacco control policies on smoking and health-related outcomes. Among other topics, previous work has investigated the effects of price changes or increases in excise taxes on cigarette consumption (see, for example, Wasserman et al., 1991; Becker et al., 1994), the impact of legal restrictions on youth access to tobacco products (Chaloupka and Grossman, 1996; Gruber and Zinman, 2000), the dissemination of information on the adverse health effects of smoking

[5] In addition, several state laws allowed for the establishment of smoking clubs (Hamburg, Bavaria, Hesse, and North-Rhine Westphalia, not shown in Table 1).

[6] See < http://www.spiegel.de/international/zeitgeist/0,1518,529305,00.html> for further information. This website was accessed on 4 November 2009.

(Chaloupka and Warner, 2000), and the effects of public smoking bans on the exposure of non-smokers to second-hand smoke (Adda and Cornaglia, 2010; Carpenter, 2009).

More closely related to our paper are studies that have explored the effects of workplace smoking bans. One of the first papers on workplace smoking bans is the study by Evans et al. (1999). The authors find that workplace bans in the United States significantly reduced smoking prevalence and daily tobacco consumption among employed smokers. A comprehensive review by Fichtenberg and Glantz (2002) also concludes that workplace smoking restrictions were effective in reducing cigarette consumption and smoking prevalence.

Closest in focus to our work are studies on the effects of public smoking bans on individual smoking behavior. Work in this area, however, has produced ambiguous findings and mainly focused on the US. Early research from the beginning of the 1990s on the impact of indoor air legislation on smoking behavior produced inconclusive results (e.g., Keeler et al., 1993; Sung et al., 1994; Wasserman et al., 1991; Chaloupka and Grossman, 1996; Chaloupka, 1992; Chaloupka and Saffer, 1992). The same applies to more recent studies (Yurekli and Zhang, 2000; Tauras, 2006; Adda and Cornaglia, 2010). The latter employed a quasi-experimental framework that is similar to ours. They use regional variation in the timing of smoking ban legislation to identify the effect of public smoking bans on smoking prevalence and smoking intensity.[7] Tauras (2006) finds that smoke-free air laws reduced the average smoking intensity of adult smokers but did not strongly affect overall smoking prevalence. Yurekli and Zhang (2000), using state panel data, also find a significant negative effect of public smoking bans on states' per capita cigarette consumption. Adda and Cornaglia (2010), in contrast, do not find any evidence that smoking bans in the US had a direct causal impact either on smoking prevalence or on smoking cessation. Note, however, that none of these three papers investigated heterogeneous effects of the impact of smoking bans on smoking behavior. A unique aspect of our work is that we use detailed information on the propensities of going out of different subgroups to study the existence and magnitude of such potential heterogeneous effects. Depending on how often they go out, individuals are differentially exposed in everyday life to the restrictions imposed by smoking bans. As a consequence, individuals may well react differently, both in terms of their likelihood of changing their smoking habits and in terms of the degree of any adjustment they undertake.

[7] The public smoking bans examined by Yurekli and Zhang (2000) and Tauras (2005) cover government and private workplaces, grocery stores, shopping malls, bars and restaurants, health facilities, public transportation, and other public places.

4. Data

We use data from the German Socio-Economic Panel (SOEP), an annual ongoing household panel of roughly 20,000 individuals in around 11,000 households (Wagner et al., 2007). Adult household members are regularly interviewed on their socio-economic and demographic characteristics, such as education, income, employment, and health. In the years 2002, 2004, 2006 and 2008, respondents were also asked whether they currently smoked, and if so, how many cigarettes they smoked, on average, per day. Exploiting this information, we consider three outcome measures in the empirical analysis: (i) whether an individual currently smokes (*smoking*), (ii) whether an individual is a regular smoker who smokes on average ten or more cigarettes per day (*smoking 10+*), and (iii) the average daily cigarette consumption of an individual (*number of cigarettes*).

The SOEP also provides information on the interview months of survey respondents. The majority of survey respondents are interviewed in February and March. However, interview months do vary to some extent, ranging from January to November. This introduces variation in smoking ban coverage in 2008 even within states, which we can exploit for identification of the causal effects of state smoking bans on smoking behavior (see Section 5.1 for a more thorough discussion of this point).

Table 2 provides descriptive statistics for key explanatory variables, both for the entire sample and separately by state smoking ban coverage. The average age of individuals in the entire sample (survey years 2002, 2004, 2006 and 2008) is 48 years[8], 47 percent are male, 61 percent are married, and slightly less than 30 percent live in a city with at least 100,000 inhabitants. Individuals who are not covered by a smoking ban when surveyed are similar to those who are covered in terms of gender and marital status. Note, however, that there are significant mean differences between the two groups in their respective area of residence (urban vs. rural area) and age.[9]

[8] The youngest person in the sample is aged 16 years, and the oldest person 98 years. In unreported regressions, we restricted our sample to individuals aged 65 (70) years and younger. These sample restrictions do not change any of our estimates. The SOEP first interviews individuals in the year they turn 17. The SOEP data does not, therefore, allow us to study the smoking behaviour of young people aged 15 or younger.

[9] Unreported two-sample mean-comparison tests suggest that the means for age and residence (columns 2 and 3 in Table 2) differ from one another at the 1 percent significance level.

5. Empirical strategy and results

5.1 Empirical strategy

To estimate the effects of the state-level public smoking bans in Germany on the smoking behavior of individuals we run the following reduced-form baseline regressions:

$$smoke_{ist} = \beta_1 ban_{ist} + X_{it}\gamma + \varepsilon_{ist}, \quad (1)$$

where $smoke_{ist}$ represents one of the three smoking outcomes described above for individual i living in federal state s at survey time t. The variable ban_{ist}, our prime variable of interest, is a dichotomous variable which equals one if a smoking ban is in force in individual i's federal state s at survey time t, and zero otherwise. In survey years 2002, 2004 and 2006, that is prior to the introduction of state smoking bans, ban_{ist} takes the value zero for all individuals. In the survey year 2008, ban_{ist} takes the value one for all individuals who live in a state that had already introduced a smoking ban prior to the date of interview at time t, and zero otherwise.

For the outcome *smoking* (*smoking 10+*) the key coefficient β_1 measures the average change in the probability of smoking (ten or more cigarettes) due to the introduction of a smoking ban. For the outcome *number of cigarettes*, in turn, β_1 captures the average change in the number of cigarettes smoked per day due to a smoking ban.[10] In our baseline specification, the vector X_{it} includes individuals' age, age-squared, a male dummy, a maximum set of federal state dummies, time (month-year) dummies, and dummies for the different SOEP sub-samples.[11] We include state fixed effects to control for time-invariant differences in smoking prevalence and smoking patterns between states, and year-month fixed effects to account for potential common time trends in smoking behavior across states.

In the robustness section below, we also control for further explanatory variables that have been found to be correlated with cigarette consumption such as education, employment status, marital status, and household size (Tauras, 2006; Hahn et al., 2008). We also control for annual state characteristics that might impact on individuals smoking behavior (e.g., the state-level unemployment rate, the proportion of migrants, and the proportion of singles within the state population).

[10] We use, as an outcome measure, the average number of cigarettes consumed by individuals in a given survey year (unconditional demand) rather than the average number of cigarettes among smokers (conditional demand), since conditional effects do not have a causal interpretation (Angrist and Pischke, 2009).

[11] To date, the SOEP consists of eight different sub-samples (e.g. West German sample, Guest worker sample, East German sample, etc.). These sub-samples vary partially in the date they were drawn and also in their sampling schemes (see, for example, Kroh (2009) and references therein for detailed information on these sub-samples). We dropped the high income sample from the analysis, as it over-sampled rich households.

The key identifying assumption of equation (1) is that, in the absence of a smoking ban, the estimated coefficient β_1 will be zero, i.e., there are no significant differences in smoking behavior between the treated (ban_{ist}=1) and the non-treated (ban_{ist}=0). The difference-in-differences approach we use, therefore, assumes that there are no other policy changes or regional shocks which coincide with the introduction of a smoking ban and affect individuals' smoking outcomes. Identification, therefore, requires that relative trends in the outcome variables would have had to be the same across federal states, had a smoking ban not been introduced.[12] Although SOEP respondents are regularly surveyed in spring, survey times vary somewhat, a spread that provides us with variation in smoking ban coverage in 2008 also across individuals that live in one and the same state.[13] This additional variation makes it very likely that our key identifying assumption holds.

A first and commonly used, albeit descriptive, test of the validity of this identifying assumption is to compare pre-treatment trends in the smoking behavior of individuals who live in a federal state where a smoking ban is in force at the time of their interview in 2008 (treatment group) with those individuals who live in federal states with no smoking ban in force at the time of their interview in 2008 (control group). Figure 1 provides strong visual evidence that the assumption of a common time trend for the treatment and control group holds for all three outcome measures. The data reveal similar and parallel downward trends in the pre-ban smoking behavior of individuals who live in states where a smoking ban is in force at the time of their interview in 2008 and individuals who do not. Note also that there are no significant differences between the groups in their respective changes in overall smoking behavior between 2006 and 2008, the last pre-ban and first post-ban sampling points in the SOEP. If anything, the decline over this period appears slightly stronger for individuals who are not yet covered by a smoking ban, a difference that seems, however, not significant.[14] Although merely descriptive, this finding suggests that average smoking propensities and the average number of cigarettes consumed within state populations have not been markedly affected by the introduction of state smoking bans. It remains to be seen, of course, whether regression-adjusted analyses support this view.

[12] In Section 6, we discuss several robustness checks that we conducted to see whether this assumption seems to be plausible in the context of this study.
[13] In 2008, we observe individuals in six states both before and after the introduction of a public smoking ban. These states are Berlin, Brandenburg, North Rhine-Westphalia, Saxony-Anhalt, and Thuringia.
[14] We also distinguished between early adopter states (federal states which implemented smoking bans in 2007) and late adopters (federal states which implemented smoking bans in 2008). In line with Figure 1, the unreported graphs also indicated that the assumption of a common time trend for early and late adopting states is very likely to hold.

5.2 Results

Overall effects

Table 3 presents the results of our baseline regressions. The table shows OLS estimates of the effects that public smoking bans had on our three different smoking outcomes: whether a respondent currently smokes (*smoking*), whether he or she is a regular smoker and smokes on average ten or more cigarettes per day (*smoking 10+*) and the average daily consumption of cigarettes (*number of cigarettes*). The main parameters of interest are those on the dummy variable *smoking ban*, which give us an indication of whether state smoking bans in Germany were effective in reducing the smoking propensity (outcome 1) and smoking intensity (outcomes 2 and 3) within the population. In all three regressions, we control for individuals' age, age squared, gender, SOEP sample dummies, a full set of federal state and year-month fixed effects, and a constant. The linear probability estimates in Table 3 show negative, yet small and statistically insignificant effects of state smoking bans on our three outcomes measures.[15] State smoking bans in Germany, therefore, do not appear to have altered average smoking behavior within the population at large.

Our baseline results, however, also point to important differences in the smoking behavior of certain subgroups of individuals. Older individuals are significantly more likely to smoke and they tend to smoke more cigarettes. Moreover, men have a seven percentage point higher probability of smoking than women, and men also smoke around two cigarettes per day more than women. These results are in line with Wasserman et al. (1991) and Tauras (2006), and they are also consistent with recent smoking patterns in many countries (Tobacco Atlas, 2009). Such marked group-specific differences in smoking behavior naturally raise the question as to whether smoking bans affect certain groups of individuals more than others, that is whether smoking bans have heterogeneous effects. In particular, one would expect individuals that are more sociable (and, hence, also more exposed to public smoking bans) to be more likely to adjust their smoking habits than individuals who do not go out very often. In terms of socio-demographic characteristics, we would expect the smoking behavior of unmarried individuals, the young, males, and city dwellers – groups that we find to be more

[15] We checked the robustness of these results to the use of alternative estimation methods (probit regressions for the two dichotomous outcome measures and tobit regression for the cigarette demand equation) and found similar results. We also estimated regressions with standard errors clustered at the state-time level (Angrist and Pischke, 2009). These estimates produce slightly larger standard errors, but do not change our general conclusions. Results are available from the authors upon request.

sociable – to be more affected by smoking bans. To date, however, little is known about how the smoking behavior of these groups is affected by public smoking bans.

First supportive evidence for this conjecture can be found in our data. In the years 2003 and 2008 (but not 2002, 2004, and 2006), the SOEP asked respondents how often they go out to cafes, bars, or restaurants. Table 4 reports average going-out frequencies by gender, age group, residence (urban and rural areas), and marital status. For both years, the table displays striking differences in the frequency that individuals go out to cafes, bars or restaurants. For example, every fourth man reports weekly visits to restaurants, bars, and cafes, but only 15 percent of females. Likewise, almost 40 percent of those aged 30 or younger report that they go out to cafes, bars, or restaurants at least once a week, compared to only 16 percent of individuals who are aged 50 or older. Individuals living in a city with at least 100,000 inhabitants are, on average, also more likely to go out frequently: roughly every fourth city dweller reports that they go out at least once a week, but only every sixth individual in rural areas. Finally, the lower panel of Table 4 shows that the proportion of individuals who go out to cafes, bars, or restaurants at least once a week is considerably larger among unmarried than among married individuals. These marked differences suggest that the effects of state smoking bans in Germany may have varied across subgroups of the populations. This appears all the more likely, as the frequency of going out within these subgroups has only changed slightly between 2003 and 2008. Smokers who tend to go out a lot may react in three ways to the introduction of smoking bans: go out less often (yet smoke pretty much the same as before), go out as often as before (but reduce smoking when going out), or opt for a combination of the two. Evidence in Table 4 suggests that subgroups with a high frequency of going out in 2003 had only marginally changed their "going out" behavior by 2008. Furthermore, these changes over time are also of the same magnitude as the changes that are observable for groups with a low frequency of going out. (e.g., females, older individuals). Male and young smokers, those that are unmarried, and individuals residing in a city, hence, do not appear to have adjusted their frequency of going out significantly following the introduction of state smoking bans. As these groups did not change their frequency of visits to restaurants, bars and cafes, they may have changed their smoking habits instead.

Heterogeneous effects by age and gender

In light of the significant direct effects of age and gender on smoking behavior documented in Table 3 and the distinct gender and age group patterns of the frequencies of going out shown

in Table 4, we start our analysis of the potential heterogeneous effects of smoking bans by examining these two dimensions in greater detail. Panel A of Table 5 displays heterogeneous effects by gender. The estimated coefficient of the interaction term (male*smoking ban) is negative in all three regressions, and is statistically significant for the outcomes *smoking 10+* and *number of cigarettes*. Moreover, there is also a significant main effect of state smoking bans for these two outcome variables. The estimates suggest that the probability of being a regular smoker fell by 4 percentage points for men, and men smoked almost 0.9 cigarettes less per day following smoking bans. The laws reduced the propensity to be a regular smoker by almost 2 percentage points and the daily demand for cigarettes by about 0.4 cigarettes for women.

In Panel B of Table 5 we distinguish between young adults (individuals aged 30 or less) and individuals aged 31 or older. It is evident that the estimates point to considerable differences between these age cohorts in the magnitude of the effects that smoking bans exerted on their smoking behavior. Whereas public smoking bans had no impact on the smoking habits of individuals aged 31 or older, they had a sizeable negative and statistically significant effect on the smoking propensity of the younger age group. For example, the results in column 1 of Table 5 suggest that the likelihood of smoking among individuals aged 30 or younger decreased by nearly 3 percentage points with the introduction of public smoking bans. Similarly, public smoking bans had a statistically significant negative effect on the likelihood of being a regular smoker only for the younger age group. The estimates in the last column of Table 5 also point to a reduction in the average daily number of cigarettes consumed by individuals aged 30 and younger.

Heterogeneous effects by marital status and residence (urban vs. rural area)

The fact that smoking prevalence is higher both in urban than in rural areas and among unmarried than married individuals has been widely documented (e.g., Idris et al., 2007; Hahn et al., 2008). These differences are also apparent in our data. For instance, in 2006, i.e., prior to the implementation of state smoking bans, the average self-reported smoking prevalence in major cities such as Hamburg and Berlin was 33 percent, compared to only 29 percent in the rest of the country. Figure 2 displays smoking prevalence rates separately for those living in urban and rural areas and for unmarried and married individuals in 2006. Again, the descriptive findings from our data are in line with previous studies that report a higher smoking prevalence in cities and among unmarried individuals.

Table 6 presents the heterogeneous effects of public smoking bans by residence (urban vs. rural area) and by marital status. Panel A reports estimates of the effects of public smoking bans on our three smoking outcomes for individuals that live in cities with at least 100,000 inhabitants (urban areas) and for individuals that do not (rural areas). The estimates in Panel A suggest that the introduction of smoking bans significantly reduced both smoking participation among city dwellers and the average number of cigarettes they consumed per day. The estimated coefficients of the interaction term *City*smoking ban* and of the main effect *smoking ban* in column 1 show that the propensity to smoke fell by more than 5 percentage points for those living in cities. For individuals living in rural areas, in contrast, the decline was much more moderate (slightly more than 2 percentage points). Similarly, in column 2, the estimated coefficient of interest is negative and significantly different from zero at the 1 percent level. It suggests that – with the introduction of a state smoking ban – the likelihood of smoking 10 or more cigarettes per day decreased by almost 6 percentage points among city dwellers. Among individuals in the countryside, the respective drop was, again, much smaller (2 percentage points). Furthermore, as shown in column 3 of Table 6, state smoking bans reduced average cigarette consumption in cities by more than one cigarette per day. For all three outcome measures, therefore, the estimates in Panel A suggest that the introduction of state smoking bans affected the smoking behavior of city dwellers much more than it affected the smoking behavior of individuals living in rural areas.

Panel B of Table 6 reports the estimated impacts of state smoking bans by respondents' marital status. The estimated coefficient of the interaction term (*not married* smoking ban*) is negative in all three regressions. Among unmarried individuals, the propensity to be a regular smoker decreased by 1.6 percentage points. Similarly, unmarried individuals smoked on average 0.3 cigarettes less following the introduction of a state smoking ban. Note, however, that this effect is only statistically significant at the 10 percent level. Unmarried individuals, therefore, appear to have been somewhat responsive in adjusting their smoking behavior. Married individuals, in contrast, show no discernable change in their smoking habits.

In sum, therefore, our results show that the introduction of state smoking bans in Germany reduced neither the average smoking propensity nor the average smoking intensity within the overall population. However, we do find evidence for such effects for several subgroups of individuals that exhibit a greater proclivity to go out regularly.

Heterogeneous effects by scope of smoking bans and socio-demographic characteristics

Public smoking bans in Germany were less strictly enforced than in other countries which recently introduced smoking bans. Most federal states allowed for a number of exceptions, such as separate smoking rooms in bars and restaurants or specially designated smoking rooms in dance clubs (see Table 1). In the following, we exploit this variation in the scope of individual state smoking bans to investigate whether the stringency of smoking bans had an impact on their effect on individual smoking behavior. Specifically, we confine our analysis to those federal states with relatively strict public smoking bans that also prohibited smoking rooms in dance clubs.[16] Table 7 presents average effects of public smoking bans in these states for our three outcome variables (Panel A), as well as heterogeneous effects by gender, age, residence and marital status (Panels B to E).

Estimates reported in Panel A of Table 7 suggest that public smoking bans which allowed for fewer exemptions were more effective in changing average smoking habits (cf. previous estimates reported in Table 3). For instance, stricter smoking bans reduced the average smoking intensity of individuals in state populations: the likelihood of being a regular smoker fell by 2.4 percentage points and average daily cigarette consumption decreased by almost 0.4 cigarettes. Both effects are statistically significant at the 1 percent level.

Panel B of Table 7 shows that, for men, both the propensity to smoke and average smoking intensity decreased.[17] The likelihood of men smoking fell by 2 percentage points and the propensity to smoke ten or more cigarettes by 3.5 percentage points. Their average daily cigarette demand declined by 0.6 cigarettes. Compared to our results for the entire sample in Table 5, the smoking propensity for men in states with stricter smoking bans, thus, now shows a decline (previously no change), while the effects on the other two outcomes are somewhat weaker. For women, in contrast, none of our three outcome measures now appears to have been affected (both measures of smoking intensity showed declines in the unrestricted sample of states).

Estimates reported in Panel C also point to stronger effects of smoking bans on the smoking behavior of the young in the restricted than in the unrestricted state sample (Table 5). Indeed, the coefficients of the interaction term *Aged ≤ 30*smoking ban* in Panel C of Table 7 are almost twice as large as the corresponding ones in Table 5. In this age group, the probability of being a (regular) smoker was reduced by almost 5 percentage points, and the

[16] These are Bavaria, Brandenburg, Lower Saxony, Mecklenburg-Western Pomerania, Saxony, and Saxony-Anhalt (see Table 1).

[17] In the entire sample of federal states (see Table 5), smoking bans only affected smoking intensity for men.

average daily demand for cigarettes decreased by almost 0.8 cigarettes. As before, however, older individuals do not appear to have changed their smoking habits.

Panel D documents the heterogeneous effects of public smoking bans by residence. Here, and in stark contrast to the results for the whole state sample in Table 6, the interaction term *City*smoking ban* is never statistically significant. This finding can be explained by the fact that major German cities like Berlin, Hamburg (both are city states), Cologne (in North Rhine-Westphalia), and Frankfurt (in Hesse), are now not included in the estimation sample, as all of these allowed for smoking in separate rooms in dance clubs. Consistent with this explanation, the main negative effects of state smoking bans on all three outcome variables are now twice as large as for the unrestricted sample in Table 6. On average (across both city dwellers and individuals in rural areas), the propensity to (regularly) smoke fell by 4 (5) percentage points and the average daily consumption of cigarettes by 0.7 cigarettes.

Panel E reports the estimated effects of public smoking bans on smoking behavior by respondents' marital status. In all three regressions, the estimated coefficient of the interaction term (*Not married* smoking ban*) points to a larger and statistically more significant effect than in corresponding estimates in the entire sample in Table 6. In the restricted state sample, the propensity of unmarried individuals to be a regular smoker fell by 3.5 percentage points and the likelihood of them smoking at all by 2.7 percentage points. These findings provide further evidence that unmarried individuals tended to respond more strongly to smoking bans by adjusting their smoking behavior because these bans affected them more in everyday life than married individuals who do not go out that frequently.

Overall, the above analyses shows that more strictly applied state smoking bans in Germany have led to more significant changes in the smoking habits of individuals. Within overall state populations, strict state smoking bans did (and less strict bans did not) reduce both the average smoking propensity and smoking intensity. Furthermore, in such states the effects on the smoking behavior of groups of individuals that tend to go out more often and, hence, are also more affected in everyday life by the laws, proved to be generally stronger. This is particularly the case for young adults and unmarried individuals.

6. Robustness section

For a causal interpretation of our results, we have to rule out that any other factors than the ones considered might drive our estimates. This section discusses several robustness checks that we carried out. Tabulated results are provided in the Appendix.

State-specific time trends: the present estimates are identified through a difference-in-differences design. One potential concern with this estimation method is that the introduction of state smoking bans might be correlated with other state-level changes that occurred at the same time (e.g., changes in anti-smoking sentiment, or changes in local labor market conditions) and also influenced smoking behavior, which would bias our estimates. We estimated models that also control for state-specific linear time trends and squared time trends (e.g., Wolfers, 2006). The inclusion of these time trends in our regressions, however, does not change any of our estimates (Table A1). We also checked whether there were any other policy interventions or state-specific changes that coincided with the respective dates that individual state smoking bans went into effect. The first thing to note is that cigarette prices in Germany, unlike in the US, do not vary across states or regions. All taxes on cigarettes, such as sales tax and tobacco tax, are federal taxes and, as such, uniform across federal states. Furthermore, the tobacco tax was constant between 2006 and 2008 (it was last increased in September 2005), and the sales tax was only increased once, in January 2007, a country-wide level effect that we control for in our regression analysis through the inclusion of time dummies as explanatory variables. There were also no state-specific changes in the regulations circumscribing tobacco advertising during this period. Cigarette ads on radio and television had already been banned in Germany since 1975, and ads in newspapers, magazines, and on the internet - again for the whole of the country - since 2006.[18] Our observation period did see an increase in the minimum legal smoking age (from 16 to 18) in September 2007, and the introduction, in January 2007, of technical devices in cigarette vending machines for the electronic verification of customers' age. All of these changes, however, again applied to the entire country and their impact should be captured by the time fixed effects.

State-level characteristics: in Table A2, we also control for several time-varying potential confounders at the state level that might have changed at the same time that state smoking bans were introduced. In particular, we control for annual state unemployment and poverty rates, state GDP and the proportion of singles in state populations. However, our estimates are barely affected by the inclusion of these variables.

Individual socio-economic characteristics: previous studies point to a significant relationship between employment status, education, family size and the smoking behavior of individuals (e.g., Wasserman et al., 1991; Tauras, 2006). As a sensitivity analysis, we re-

[18] Another initiative of the German Federal Government, that came into effect on 1 September 2007, was a smoking ban in public transport facilities and federal buildings. Again, this ban applied throughout Germany. Its effects should, therefore, also be captured by our time dummy variables.

estimated the regressions of Tables 3, 5 and 6, now controlling also for these individual socio-economic characteristics. In line with the previous literature, our results point, for example, to a negative and statistically significant relationship between education and individuals' smoking behavior. However, the inclusion of these additional controls does not change any of our results considerably (Table A3).

Cross-border shopping and going out: smokers living in federal states with recently introduced smoking bans may be traveling to locations abroad or to federal states that still permit smoking in bars and restaurants to avoid having to make any compromises in their smoking behavior when going out. A recent study by Adams and Cotti (2008) for the US reports that more people have been caught driving while under the influence of alcohol after the passage of smoking bans because smokers drive longer distances to bars in states with no smoking bans. Indeed, on 31 July 2008, the *New York Times* reported on the introduction of smoking bans in Germany: "Local newspapers in eastern border regions published articles at the start of the year about smokers fleeing for their evening drinks to Polish pubs, where smoking was still permitted." In regressions reported in Table A4, we checked for the importance of such behavior for our results by restricting our estimation sample to individuals that live in counties which do not border other German states or neighboring countries that did not have smoking bans in force. Our coefficients are barely affected by this potential bias. Note, however, that some of the estimates are less precisely estimated.

Geographic mobility: our estimates would also be biased if individuals moved to another federal state to circumvent a pending or recently introduced state smoking ban. However, we do not find any evidence in the data that individuals systematically moved away from federal states in which smoking bans were introduced early to states that implemented bans later. This finding is, in fact, unsurprising as any benefit from such a change in residence would certainly be very short lived (only twelve months separate the first and last state smoking ban introduction in Germany). In any case, geographic mobility between federal states during the relevant time period that smoking bans came into force is very low: less than two percent of all individuals in our sample moved to another state between 2006 and 2008.

Non-random sample attrition: as outlined by Fitzgerald et al. (1999), non-random sample attrition of individuals might be a concern when using panel data. In our context, there is, for example, the potential risk of smokers being more likely to drop out of the panel than non-smokers. This would mean that the proportion of smokers in the survey would decrease over time as a result of panel attrition, rather than due to the smoking ban implementation. We do not find significant differences in the drop-out rates for individuals who smoked in 2006,

compared to those who did not smoke in 2006.[19] This suggests that non-random panel attrition is unlikely to be a concern for our estimates.

State smoking ban introduction dates: As previously mentioned, smoking bans in Germany varied not only in their enforcement dates (pre-announced dates from which violations were fined), but also in their formal introduction dates. In seven federal states, public smoking bans were enforced only several months after having been formally enacted. We estimated the effects of smoking bans when these are defined on the basis of their introduction dates rather than their actual enforcement dates (Table A5). The estimates show that using the introduction dates rather than enforcement results in weaker effects on individuals' smoking behavior.

Overall, our sensitivity analysis shows that the estimates are robust to various potentially confounding influences, including unobserved state-level characteristics and state-level trends, policy-related geographic mobility of smokers, panel attrition, cross-border drinking and going out, and changes in other potentially important state characteristics (e.g., the unemployment rate, GDP growth, and changes in state population structures).

7. Conclusions

In this paper, we have examined the effects of state smoking bans in bars and restaurants on the smoking propensity and smoking intensity of individuals in Germany. The implementation of smoking bans in Germany varied across time and federal states. Using this variation, we find no significant reduction in either the average smoking propensity or the average smoking intensity within the population in the short term. However, we do find evidence of sizeable effects for several subgroups of the population. Our estimates point to a strong impact of public smoking bans on the smoking behavior of males. The probability of being a regular smoker fell by 4 percentage points for men, and males' cigarette demand was reduced by 0.9 cigarettes. Similarly, for young adults, the smoking propensity declined by roughly 3 percentage points. Declines in smoking propensity and in the demand for cigarettes were also more pronounced for individuals in urban areas and among unmarried individuals. In the countryside, in contrast, smoking intensity showed no change. Finally, among unmarried individuals, the propensity to be a regular smoker fell by around two percentage

[19] We estimated a probit regression of participation in the SOEP survey in 2008 (dependent variable) on individual smoking status in 2006, controlling also for individuals' age, gender, marital status, and residence (urban vs. rural area) in 2006, a maximum set of federal state dummies, and a constant. The estimated coefficient on being a smoker in 2006 does not suggest significant differences in the drop-out rates of smokers and non-smokers.

points. Among married individuals, in contrast, it remained unaltered. Therefore, we conclude that smoking propensity and smoking intensity is reduced, in the short term, among various subgroups of the population by the introduction of the smoking ban. Our result of heterogeneous effects may be explained by the greater exposure of these groups, in everyday life, to the constraints of public smoking bans. This is supported by the data showing that males, the young, unmarried, and individuals living in urban areas clearly go out more often.

We also find that the impact of public smoking bans on individual smoking habits is stronger if these bans are stricter. In states which did not permit smoking rooms in dance clubs, state smoking bans have reduced both the average smoking propensity and the average smoking intensity in overall state populations. Furthermore, stricter smoking bans proved to be also more effective in changing average smoking behaviors within several subgroups, in particular among young adults (aged 30 or less) and unmarried individuals.

Overall, our findings suggest that the recent introduction of state smoking bans in Germany was successful in reducing the smoking propensity and intensity of certain subgroups of the population. These findings have important policy implications: even if smoking bans are not comprehensive and are ineffective in reducing average smoking prevalence and smoking intensity within the whole population (as in Germany), they may, nevertheless, be an effective tobacco control policy for certain groups, in particular young individuals, singles, and city dwellers. As such, public smoking bans have the potential to realize important health benefits over and above any reduction in the exposure of non-smokers to second-hand smoke.

8. References

Adams, S. and Cotti, C. (2008), Drunk driving after the passage of smoking bans in bars, *Journal of Public Economics*, 92, 1288-1305.

Adda, J. and Cornaglia, F. (2010), The effect of bans and taxes on passive smoking, *American Economic Journal: Applied Economics*, 2(1), 1-32.

Angrist, J. D. and Pischke, J-S. (2009), Mostly harmless econometrics. An Empiricist's Companion, Princeton University Press.

Becker, G. S., Grossman, M. and Murphy, K. M. (1994), An empirical analysis of cigarette addiction, *American Economic Review*, 84(3), 396-418.

Blum, K. (2007), Ban on smoking in Germany: A never ending story? Health Policy Monitor. Available online at <http://www.hpm.org/survey/de/b10/3>.

Carpenter, C. S. (2009), The effects of local workplace smoking laws on smoking restrictions and exposure to smoke at work, *Journal of Human Resources*, 44(4), 1023-1046.

Chaloupka, F.J. (1992), Clean indoor air laws, addiction and cigarette smoking, *Applied Economics*, 24, 193–205.

Chaloupka, F.J. and Grossman, M. (1996), Price, tobacco control policies and youth smoking, NBER Working Paper, No. 5740, National Bureau of Economic Research: Cambridge, MA.

Chaloupka, F.J. and Saffer, H. (1992), Clean indoor air laws and the demand for cigarettes, *Contemporary Policy Issues*, 10, 72–83.

Chaloupka, F. J. and Warner, K. E. (2000), The economics of smoking, in Culyer, A. J. and Newhouse, J. P. (eds.), Handbook of Health Economics, Chapter 29, 1541-1627.

DEHOGA (2008), Nichtraucherschutzgesetze in den Bundesländern Synopse zu den Landesgesetzen, Deutscher Hotel- und Gaststättenverband (DEHOGA): Berlin, Germany.

Evans, W. N., Farelly, M. C. and Montgomery, E. (1999), Do workplace smoking bans reduce smoking?, *American Economic Review*, 89(4), 728-747.

Fichtenberg, C. M. and Glantz, S. A. (2002), Effect of smoke-free workplaces on smoking behaviour: systematic review, *BMJ*, 325(7357), 1-7.

Fitzgerald, J., Gottschalk, P. and Moffit, R. (1999), The impact of attrition in the PSID on intergenerational analysis, *Journal of Human Resources*, 33(2), 300-344.

Gruber J. and Zinman, J. (2000), Youth smoking in the U.S.: evidence and implications, NBER Working Paper, No. 7780, National Bureau of Economic Research: Cambridge, MA.

Hahn, E. J., Rayens, M. K., Butler, K. M., Zhang, M., Durbin, E. and Steinke, D. (2008), Smoke-free laws and adult smoking prevalence, *Preventive Medicine*, 47, 206-209.

Idris, B. I., Giskes, K., Borrell, C., Benach, J., Costa, G., Federico, B., Helakorpi, S., Helmert, U., Lahelma, E., Moussa, K. M., Östergren, P.-O., Prättälä, R., Rasmussen, N. Kr.,

Mackenbach, J. P. and Kunst, A. E. (2007), Higher smoking prevalence in urban compared to non-urban areas: Time trends in six European countries, *Health & Place*, 13, 702-712.

Keeler, T. E., The-Wei, H., Barnett, P. G. and Manning, W. G. (1993), Taxation, regulation and addiction: a demand function for cigarettes based on time series evidence, *Journal of Health Economics*, 12, 1-18.

Kroh, M. (2009), Documentation of sample sizes and panel attrition in the German Socio-Economic Panel (SOEP) (1984 until 2008), DIW Data Documentation 47, DIW: Berlin.

Kvasnicka, M. (2010), Public smoking bans, youth access laws, and cigarette sales at vending machines, Ruhr Economic Papers, 173.

Sung, H.-Y., The-Wei, H. and Keeler, T. E. (1994), Cigarette taxation and demand: an empirical analysis, *Contemporary Economic Policy*, 12, 91-100.

Tauras, J. (2006), Smoke-free air laws, cigarette prices, and adult cigarette demand, *Economic Inquiry*, 44(2), 333-342.

Tobacco Atlas (2009), The Tobacco Atlas, 3rd Edition. Available online at: *http://www.tobaccoatlas.org*.

Wagner, G. G., Frick, J. R. and Schupp, J. (2007), The German Socio-Economic Panel Study (SOEP) – Scope, Evolution and Enhancements, *Schmollers Jahrbuch*, 127(1), 139-169.

Wasserman, J., Manning, W. G., Newhouse, J.P. and Winkler, J.D. (1991), The effect of excise taxes and regulations on cigarette smoking, *Journal of Health Economics*, 10, 43-64.

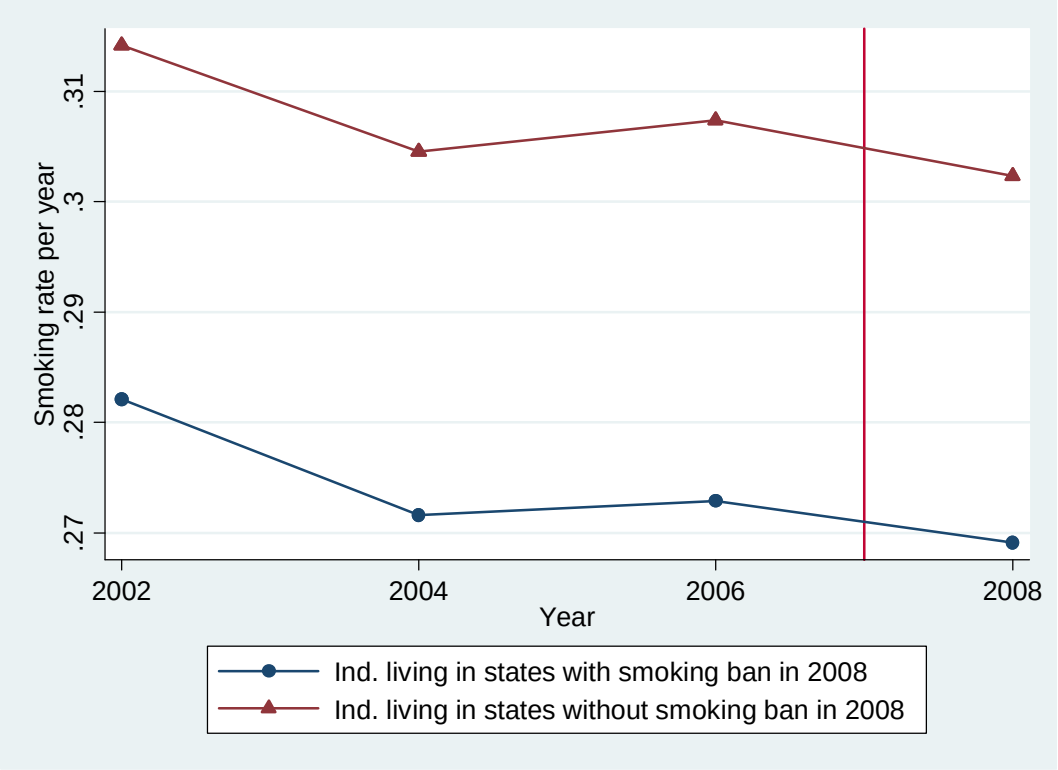
Wolfers, J. (2006), Did unilateral divorce laws raise divorce rates? A reconciliation and new results, *American Economic Review*, 96(5), 1802-1820.

World Health Organization (2009), WHO report on the global tobacco epidemic, 2009. Implementing smoke-free environments. WHO: Geneva.

Yurekli, A. A., and Zhang, P. (2000), The impact of clean indoor-air laws and cigarette smuggling on demand for cigarettes: an empirical model, *Health Economics*, 9, 159-170.

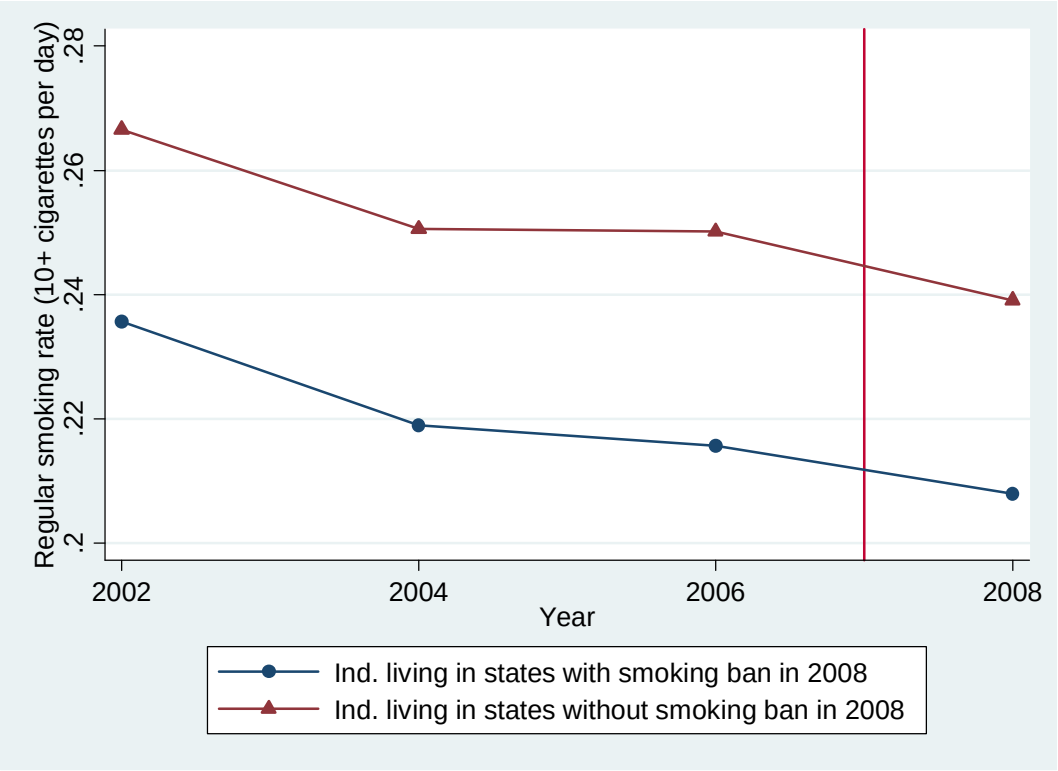
9. Figures and tables

Figure 1a: Pre-ban and post-ban smoking rates, by exposure to the smoking ban at the time of the interview in 2008



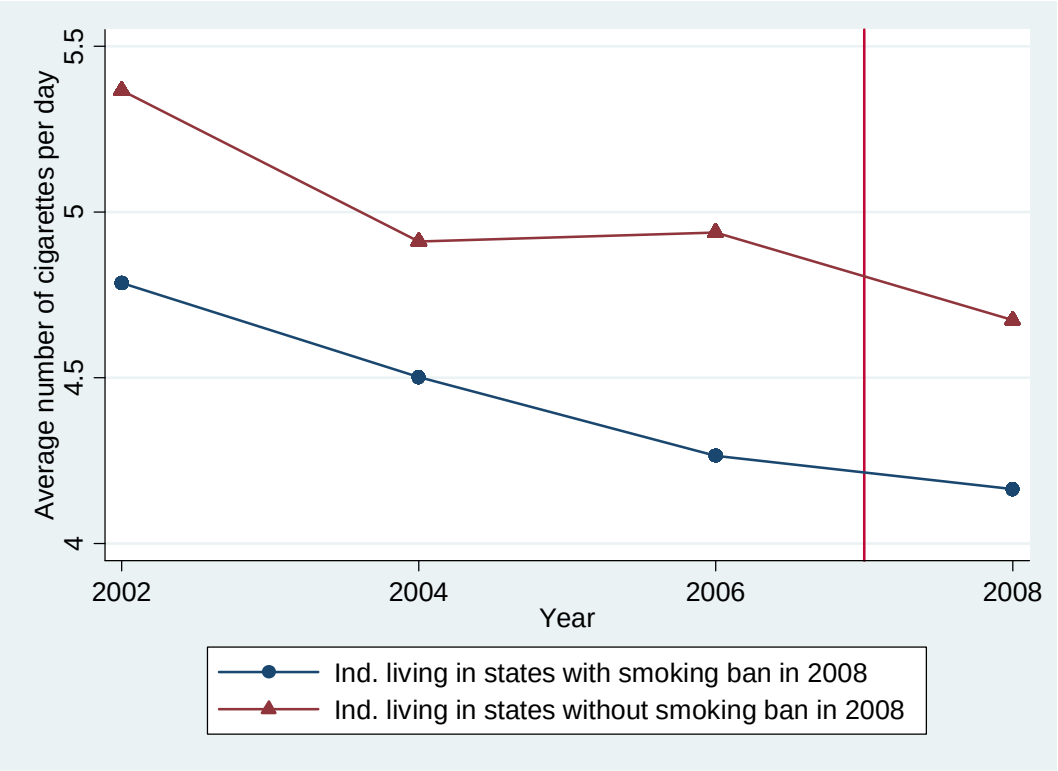
Notes: The first state smoking ban in Germany was introduced in 2007, indicated by the vertical line.

Figure 1b: Pre-ban and post-ban proportion of regular smokers, by exposure to the smoking ban at the time of the interview in 2008



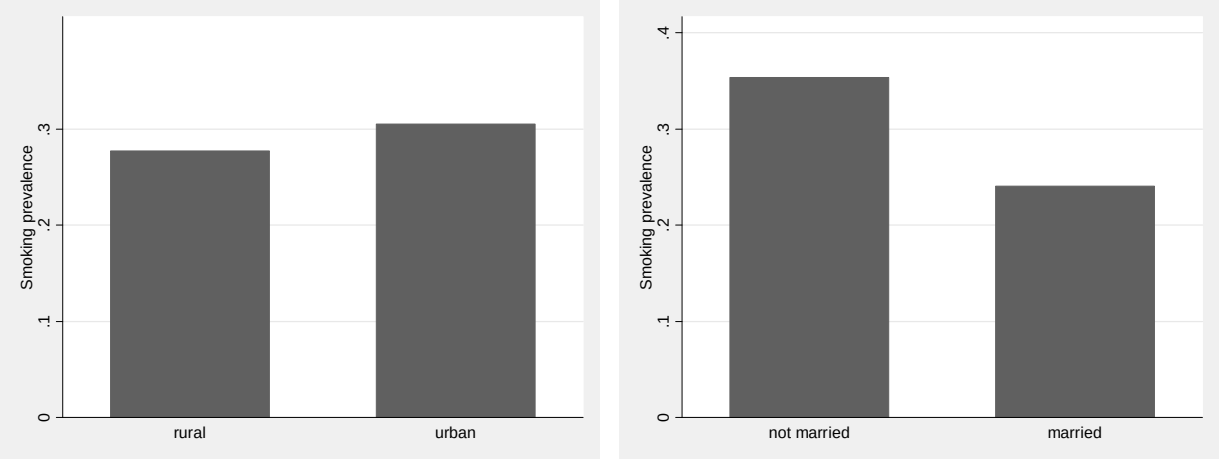
Notes: The first state smoking ban in Germany was introduced in 2007, indicated by the vertical line.

Figure 1c: Pre-ban and post-ban cigarette consumption, by exposure to the smoking ban at the time of the interview in 2008



Notes: The first state smoking ban in Germany was introduced in 2007, indicated by the vertical line.

Figure 2: Smoking prevalence rates in 2006 by residence (urban vs. rural area) and marital status



Notes: Urban areas are defined as regions with at least 100,000 inhabitants. Own calculations based on data from the SOEP wave 2006.

Table 1: Dates of enforcement and scopes of state smoking bans in Germany

Federal state:	Enforcement of state smoking bans:	Smoking rooms permissible: Bars and restaurants	Dance clubs
Baden-Wuerttemberg	August 2007	Yes	Yes
Bavaria	January 2008	No	No
Berlin	July 2008	Yes	Yes
Brandenburg	July 2008	Yes	No
Bremen	July 2008	Yes	Yes
Hamburg	January 2008	Yes	Yes
Hesse	October 2007	Yes	Yes
Lower Saxony	November 2007	Yes	No
Mecklenburg-West Pomerania	August 2008	Yes	No
North Rhine -Westphalia	July 2008	Yes	Yes
Rhineland-Palatinate	February 2008	Yes	Yes
Saarland	June 2008	Yes	Yes
Saxony	February 2008	Yes	No
Saxony-Anhalt	July 2008	Yes	No
Schleswig-Holstein	January 2008	Yes	Yes
Thuringia	July 2008	Yes	Yes

Note: Information on individual states was compiled from original law texts and from a survey of state-level smoking ban legislation by the German Hotels and Restaurants Federation (DEHOGA, 2008). All smoking bans were enforced at the start of the month with the exception of Rhineland-Palatinate, which introduced the smoking ban on 15 February 2008.

Table 2: Descriptive statistics for key explanatory variables

Variable	Full sample	Smoking ban not enforced [a]	Smoking ban enforced [b]
	(1)	(2)	(3)
Male	0.47	0.47	0.47
Age	47.69	47.50	48.76
	(17.14)	(17.09)	(17.36)
Age categories			
Aged ≤ 30	0.18	0.18	0.17
Aged 31-40	0.20	0.20	0.17
Aged 41-50	0.20	0.20	0.21
Aged >50	0.42	0.42	0.44
Married[c]	0.61	0.61	0.61
Living in a city (≥ 100,000 inhabitants) [a]	0.29	0.31	0.23
Person-year observations	73,382	62,661	10,721

Notes: SOEP waves 2002, 2004, 2006 and 2008. Table shows means, with standard deviations in parentheses.

[a] Subsample includes all individuals surveyed in 2002, 2004 and 2006, and individuals that were surveyed in 2008 at a time when they were not yet covered by a state smoking ban.

[b] This subsample includes only individuals that were surveyed in 2008 at a time when they were already covered by a state smoking ban.

[c] Measured in previous year (at t-1).

Table 3: The effects of public smoking bans on smoking behavior

Outcome variables	Smoking	Smoking 10+	Number of cigarettes
Age	0.004**	0.007**	0.210**
	(5.37)	(10.23)	(14.92)
Male	0.069**	0.084**	2.065**
	(12.61)	(16.48)	(19.37)
Smoking ban	-0.005	-0.007	-0.099
	(0.90)	(1.40)	(0.94)
Observations	73,382	73,382	73,382

Notes: SOEP waves 2002, 2004, 2006 and 2008. OLS regressions. Robust t-statistics in parentheses. Standard errors are clustered at the individual level. * significant at 5%; ** significant at 1%. Regressions also control for age-squared, a maximum set of state dummies, time (month-year) dummies, dummies for the different SOEP samples, and a constant.

Table 4: The frequency of visits to restaurants, bars and cafes in 2003 and 2008, by personal characteristics

	2003			2008		
	Never	At least once a month	At least once a week	Never	At least once a month	At least once a week
Gender						
Male	0.09	0.65	0.26	0.10	0.66	0.24
Female	0.12	0.72	0.16	0.13	0.72	0.15
Age categories						
Aged ≤ 30	0.05	0.58	0.37	0.04	0.58	0.38
Aged 31-40	0.05	0.73	0.22	0.07	0.73	0.20
Aged 41-50	0.10	0.72	0.18	0.09	0.74	0.17
Aged >50	0.14	0.70	0.16	0.16	0.68	0.16
Residence						
Living in a rural area	0.11	0.71	0.18	0.13	0.71	0.16
Living in a city	0.09	0.65	0.26	0.10	0.65	0.25
Marital status						
Married	0.10	0.76	0.14	0.11	0.76	0.14
Not married	0.11	0.59	0.30	0.13	0.60	0.26
Observations		22,209			19,628	

Notes: Table shows weighted means. *Sample*: SOEP waves 2003 and 2008.

Table 5: The effects of public smoking bans on smoking behavior by gender and age groups

Outcome variables	Smoking	Smoking 10+	Number of cigarettes
Panel A			
Male	0.071**	0.087**	2.139**
	(12.47)	(16.46)	(19.28)
Male *Smoking ban	-0.011	-0.022**	-0.507**
	(1.42)	(3.05)	(3.60)
Smoking ban	-0.011	-0.019**	-0.368**
	(1.53)	(2.82)	(2.72)
Panel B			
Aged ≤ 30	0.114**	0.067**	0.803**
	(15.98)	(10.24)	(6.48)
Aged ≤ 30*Smoking ban	-0.028*	-0.026*	-0.433*
	(2.35)	(2.38)	(2.29)
Smoking ban	0.001	-0.001	0.018
	(0.25)	(0.22)	(0.17)
Observations	73,382	73,382	73,382

Notes: SOEP waves 2002, 2004, 2006 and 2008. OLS regressions. Robust t-statistics in parentheses. Standard errors are clustered at the individual level. * significant at 5%; ** significant at 1%. Regressions also control for age, age-squared (Panel A), gender (Panel B), a maximum set of state dummies, time (month-year) dummies, dummies for the different SOEP samples, and a constant.

Table 6: The effects of smoking bans by residence (urban vs. rural area) and marital status

	Smoking	Smoking 10+	Number of cigarettes
Panel A			
City	0.036**	0.032**	0.731**
	(5.80)	(5.51)	(6.03)
City*Smoking ban	-0.031**	-0.036**	-0.802**
	(3.20)	(4.10)	(4.70)
Smoking ban	-0.021**	-0.021**	-0.350**
	(2.94)	(3.20)	(2.76)
Observations	73,382	73,382	73,382
Panel B			
Not married	0.112**	0.104**	2.222**
	(17.57)	(17.29)	(17.06)
Not married *Smoking ban	-0.014	-0.016*	-0.266
	(1.63)	(2.02)	(1.73)
Smoking ban	-0.000	-0.002	-0.003
	(0.03)	(0.29)	(0.03)
Observations	73,382	73,382	73,382

Notes: SOEP waves 2002, 2004, 2006 and 2008. OLS regressions. Robust t-statistics in parentheses. Standard errors are clustered at the individual level. * significant at 5%; ** significant at 1% level. Regressions also control for age, age-squared, gender, a maximum set of state dummies, time (month-year) dummies, dummies for the different SOEP samples, and a constant.

Table 7: The effects of 'stricter' public smoking bans on smoking behavior

	Smoking	Smoking 10+	Number of cigarettes
Panel A			
Age	0.003*	0.006**	0.174**
	(2.47)	(5.43)	(8.37)
Male	0.073**	0.089**	2.012**
	(8.71)	(11.47)	(13.07)
Smoking ban	-0.009	-0.024**	-0.377*
	(0.93)	(2.69)	(2.37)
Panel B			
Male	0.077**	0.095**	2.110**
	(8.83)	(11.76)	(13.29)
Male *Smoking ban	-0.021*	-0.035**	-0.552**
	(2.05)	(3.61)	(3.06)
Smoking ban	0.002	-0.007	-0.113
	(0.15)	(0.73)	(0.65)
Panel C			
Aged ≤ 30	0.137**	0.085**	1.108**
	(12.28)	(8.44)	(6.14)
Aged ≤ 30*Smoking ban	-0.046**	-0.045**	-0.776**
	(2.71)	(2.92)	(2.98)
Smoking ban	-0.001	-0.016	-0.239
	(0.10)	(1.78)	(1.46)
Panel D			
City	-0.012	-0.019*	-0.352
	(1.18)	(2.04)	(1.92)
City*Smoking ban	-0.001	0.006	0.098
	(0.04)	(0.50)	(0.47)
Smoking ban	-0.038**	-0.054**	-0.708**
	(3.28)	(5.00)	(3.62)
Panel E			
Not married	0.123**	0.111**	2.360**
	(12.40)	(12.06)	(12.22)
Not married *Smoking ban	-0.027*	-0.035**	-0.535**
	(2.29)	(3.21)	(2.63)
Smoking ban	0.002	-0.010	-0.160
	(0.22)	(1.05)	(0.94)
Observations	30,579	30,579	30,579

Notes: The sample only includes federal states that also prohibited smoking rooms in dance clubs. These are: Bavaria, Brandenburg, Lower Saxony, Mecklenburg-West Pomerania, Saxony, and Saxony-Anhalt. See also Table 1. SOEP waves 2002, 2004, 2006 and 2008. OLS regressions. Robust t-statistics in parentheses. Standard errors are clustered at the individual level. * significant at 5%; ** significant at 1%. Regressions also control for age (Panels B, D, E), age-squared (except Panel C), gender (Panels C, D, E), a maximum set of state dummies, time (month-year) dummies, dummies for the different SOEP samples, and a constant.

Appendix

Table A1
Regressions with state-specific time trends as additional control variables

	Smoking	Smoking 10+	Number of cigarettes	Smoking	Smoking 10+	Number of cigarettes
Panel A						
Age	0.004**	0.007**	0.210**	0.004**	0.007**	0.210**
	(5.37)	(10.24)	(14.92)	(5.37)	(10.24)	(14.92)
Male	0.069**	0.084**	2.064**	0.069**	0.084**	2.064**
	(12.59)	(16.47)	(19.35)	(12.59)	(16.47)	(19.35)
Smoking ban	0.007	-0.011	-0.174	0.007	-0.011	-0.174
	(0.26)	(0.43)	(0.36)	(0.26)	(0.43)	(0.36)
Panel B						
Male	0.071**	0.087**	2.139**	0.071**	0.087**	2.139**
	(12.46)	(16.45)	(19.27)	(12.46)	(16.45)	(19.27)
Male*Smoking ban	-0.011	-0.022**	-0.512**	-0.011	-0.022**	-0.512**
	(1.45)	(3.07)	(3.63)	(1.45)	(3.07)	(3.63)
Smoking ban	0.013	-0.001	0.068	0.013	-0.001	0.068
	(0.45)	(0.02)	(0.14)	(0.45)	(0.02)	(0.14)
Panel C						
Aged ≤ 30	0.114**	0.067**	0.804**	0.114**	0.067**	0.804**
	(15.98)	(10.23)	(6.48)	(15.98)	(10.23)	(6.48)
Aged ≤ 30*Smoking ban	-0.027*	-0.026*	-0.433*	-0.027*	-0.026*	-0.433*
	(2.31)	(2.39)	(2.29)	(2.31)	(2.39)	(2.29)
Smoking ban	0.011	-0.007	-0.104	0.011	-0.007	-0.104
	(0.39)	(0.27)	(0.21)	(0.39)	(0.27)	(0.21)
Panel D						
Not married	0.112**	0.104**	2.222**	0.112**	0.104**	2.222**
	(17.57)	(17.29)	(17.06)	(17.57)	(17.29)	(17.06)
Not married *Smoking ban	-0.013	-0.016*	-0.263	-0.013	-0.016*	-0.263
	(1.57)	(2.01)	(1.71)	(1.57)	(2.01)	(1.71)
Smoking ban	0.014	-0.003	-0.045	0.014	-0.003	-0.045
	(0.50)	(0.14)	(0.09)	(0.50)	(0.14)	(0.09)
Panel E						
City	0.004**	0.007**	0.211**	0.004**	0.007**	0.211**
	(5.46)	(10.32)	(15.00)	(5.46)	(10.32)	(15.00)
City*Smoking ban	-0.069**	-0.084**	-2.069**	-0.069**	-0.084**	-2.069**
	(12.64)	(16.52)	(19.41)	(12.64)	(16.52)	(19.41)
Smoking ban	0.030**	0.027**	0.586**	0.030**	0.027**	0.586**
	(4.50)	(4.41)	(4.49)	(4.50)	(4.41)	(4.49)
Linear state-specific time trend	Yes	Yes	Yes	Yes	Yes	Yes
Quadratic state-specific time trend	No	No	No	Yes	Yes	Yes
Observations	73,382	73,382	73,382	73,382	73,382	73,382

Notes: SOEP waves 2002, 2004, 2006 and 2008. OLS regressions. Robust t-statistics in parentheses. Standard errors are clustered at the individual level. * significant at 5%; ** significant at 1%. Regressions also control for age, age-squared (except Panel C), gender, a maximum set of state dummies, time (month-year) dummies, dummies for the different SOEP samples, and a constant.

Table A2
Regressions with additional time-varying state level variables

	Smoking	Smoking 10+	Number of cigarettes
Panel A			
Age	0.004**	0.007**	0.210**
	(5.37)	(10.23)	(14.92)
Male	0.069**	0.084**	2.065**
	(12.60)	(16.48)	(19.36)
Smoking ban	-0.001	-0.002	0.040
	(0.12)	(0.36)	(0.36)
Panel B			
Male	0.071**	0.087**	2.139**
	(12.46)	(16.45)	(19.28)
Male*Smoking ban	-0.011	-0.022**	-0.509**
	(1.43)	(3.07)	(3.62)
Smoking ban	0.004	0.008	0.280
	(0.64)	(1.29)	(2.26)*
Panel C			
Aged ≤ 30	0.114**	0.067**	0.802**
	(15.98)	(10.23)	(6.47)
Aged ≤ 30*Smoking ban	-0.028*	-0.026*	-0.431*
	(2.34)	(2.38)	(2.29)
Smoking ban	0.006	0.005	0.165
	(1.02)	(0.79)	(1.43)
Panel D			
Not married	0.112**	0.104**	2.222**
	(17.56)	(17.29)	(17.06)
Not married*Smoking ban	-0.014	-0.016*	-0.267
	(1.62)	(2.02)	(1.74)
Smoking ban	0.004	0.004	0.137
	(0.64)	(0.62)	(1.12)
Panel E			
City	0.030**	0.027**	0.606**
	(4.60)	(4.44)	(4.76)
City*Smoking ban	-0.025**	-0.032**	-0.670**
	(2.66)	(3.64)	(3.96)
Smoking ban	-0.014*	-0.018**	-0.254*
	(2.04)	(2.86)	(2.13)
Observations	73,382	73,382	73,382

Notes: SOEP waves 2002, 2004, 2006 and 2008. OLS regressions. Robust t-statistics in parentheses. Standard errors are clustered at the individual level. * significant at 5%; ** significant at 1%. Regressions also control for age, age-squared (except Panel C), gender, a maximum set of state dummies, time (month-year) dummies, dummies for the different SOEP samples, annual state-level unemployment rate, proportion of foreigners and singles within the general population and the proportion of employed individuals, and a constant.

Table A3
Regressions with additional individual socio-economic variables

	Smoking	Smoking 10+	Number of cigarettes
Panel A			
Age	0.004**	0.007**	0.200**
	(4.80)	(8.63)	(12.30)
Male	0.083**	0.096**	2.291**
	(14.59)	(18.15)	(20.74)
Smoking ban	-0.006	-0.008	-0.116
	(0.99)	(1.40)	(1.10)
Panel B			
Male	0.085**	0.099**	2.365**
	(14.37)	(18.09)	(20.61)
Male*Smoking ban	-0.010	-0.022**	-0.510**
	(1.31)	(3.11)	(3.63)
Smoking ban	-0.001	0.003	0.124
	(0.13)	(0.47)	(1.06)
Panel C			
Aged ≤ 30	0.134**	0.090**	1.286**
	(17.55)	(12.77)	(9.64)
Aged ≤ 30*Smoking ban	-0.023	-0.022*	-0.391*
	(1.91)	(1.98)	(2.02)
Smoking ban	0.000	-0.002	-0.008
	(0.05)	(0.35)	(0.07)
Panel D			
Not married	0.099**	0.093**	2.014**
	(14.30)	(14.30)	(14.30)
Not married*Smoking ban	-0.015	-0.017*	-0.319*
	(1.72)	(2.17)	(2.07)
Smoking ban	0.000	-0.001	0.013
	(0.04)	(0.12)	(0.11)
Panel E			
City	0.047**	0.045**	0.992**
	(7.53)	(7.71)	(8.04)
City*Smoking ban	-0.027**	-0.034**	-0.705**
	(2.79)	(3.86)	(4.13)
Smoking ban	-0.024**	-0.024**	-0.446**
	(3.47)	(3.68)	(3.51)
Observations	70,709	70,709	70,709

Notes: SOEP waves 2002, 2004, 2006 and 2008. OLS regressions. Robust t-statistics in parentheses. Standard errors are clustered at the individual level. * significant at 5%; ** significant at 1%. Regressions also control for age, age-squared (except Panel C), gender, a maximum set of state dummies, time (month-year) dummies, dummies for the different SOEP samples, dummies for being full-time and part-time employed, years of education, number of adults living in the household, number of children in certain age categories, and a constant.

Table A4
Public smoking bans and cross-border shopping

	Smoking	Smoking 10+	Number of cigarettes
Panel A			
Age	0.003	0.006	0.195
	(4.02)**	(8.33)**	(13.03)**
Male	0.069	0.084	2.075
	(12.31)**	(16.06)**	(18.92)**
Smoking ban	-0.007	-0.010	-0.115
	(1.13)	(1.61)	(0.98)
Panel B			
Male	0.071**	0.087**	2.146**
	(12.31)	(16.24)	(19.04)
Male*Smoking ban	-0.015	-0.029**	-0.617**
	(1.66)	(3.48)	(3.69)
Smoking ban	-0.000	0.004	0.172
	(0.02)	(0.59)	(1.30)
Panel C			
Aged ≤ 30	0.117	0.071	0.878
	(15.67)**	(10.36)**	(6.76)**
Aged ≤ 30*Smoking ban	-0.023	-0.011	-0.366
	(1.60)	(0.87)	(1.63)
Smoking ban	-0.003	-0.007	-0.030
	(0.39)	(1.09)	(0.25)
Panel D			
Not married	0.108	0.099	2.140
	(16.41)**	(15.98)**	(15.99)**
Not married*Smoking ban	-0.009	-0.009	-0.238
	(0.94)	(0.99)	(1.31)
Smoking ban	-0.004	-0.006	-0.032
	(0.57)	(0.98)	(0.24)
Panel E			
City	0.035	0.032	0.517
	(5.67)**	(5.46)**	(2.53)*
City*Smoking ban	-0.031	-0.036	-1.095
	(3.03)**	(3.72)**	(2.72)**
Smoking ban	-0.021	-0.020	0.027
	(2.67)**	(2.79)**	(0.09)
Observations	69,102	69,102	69,102

Notes: SOEP waves 2002, 2004, 2006 and 2008. OLS regressions. Robust t-statistics in parentheses. Standard errors are clustered at the individual level. * significant at 5%; ** significant at 1%. Regressions also control for age, age-squared (except Panel C), gender, a maximum set of state dummies, time (month-year) dummies, dummies for the different SOEP samples, and a constant.

Table A5
Using state smoking ban introduction dates

	Smoking	Smoking 10+	Number of cigarettes
Panel A			
Age	0.004**	0.007**	0.210**
	(5.37)	(10.22)	(14.92)
Male	0.069**	0.084**	2.065**
	(12.61)	(16.48)	(19.36)
Smoking ban	-0.001	0.003	0.083
	(0.11)	(0.45)	(0.68)
Panel B			
Male	0.071**	0.088**	2.155**
	(12.43)	(16.48)	(19.19)
Male*Smoking ban	-0.009	-0.020**	-0.494**
	(1.32)	(3.18)	(4.03)
Smoking ban	0.003	0.012	0.314*
	(0.47)	(1.81)	(2.42)
Panel C			
Aged ≤ 30	0.113**	0.067**	0.785**
	(15.65)	(10.11)	(6.25)
Aged ≤ 30*Smoking ban	-0.013	-0.019	-0.248
	(1.20)	(1.92)	(1.46)
Smoking ban	0.004	0.009	0.192
	(0.63)	(1.40)	(1.54)
Panel D			
Not married	0.111**	0.102**	2.201**
	(17.32)	(17.00)	(16.73)
Not married*Smoking ban	-0.005	-0.005	-0.102
	(0.65)	(0.79)	(0.76)
Smoking ban	0.001	0.005	0.119
	(0.13)	(0.72)	(0.92)
Panel E			
City	0.037**	0.034**	0.773**
	(6.05)	(5.90)	(6.29)
City*Smoking ban	-0.028**	-0.035**	-0.759**
	(3.53)	(4.78)	(5.26)
Smoking ban	-0.009	-0.003	-0.164
	(1.11)	(0.37)	(1.12)
Observations	73,382	73,382	73,382

Notes: SOEP waves 2002, 2004, 2006 and 2008. OLS regressions. Robust t-statistics in parentheses. Standard errors are clustered at the individual level. * significant at 5%; ** significant at 1%. Regressions also control for age, age-squared (except Panel C), gender, a maximum set of state dummies, time (month-year) dummies, dummies for the different SOEP samples, and a constant.