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The European Smoking Bans and Mature Smokers: Can They Kick the Habit?

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ABSTRACT

Using individual level data, this paper investigates whether nationwide smoke-free legislations in Europe lead to smoking reduction and cessation among mature smokers. It exploits cross-country data and the European Union's multinational governance that provides a quasi-experimental setting. Top-down regulations on smoke-free environment by the EU mitigate the self-selection bias and endogeneity bias of smoke-free laws generally faced in other settings. The results show that comprehensive bans lower smoking propensity by approximately 7 percent and reduced smoking intensity by 10 percent. The effect persisted and increased over time. Light smokers and heavy smokers were 14.5 and 7.2 percent more likely to quit while there is no significant effect on average smokers. Those working in industry and occupation that faced with more comprehensive and strict bans were also more likely to quit, showing that comprehensive bans can increase smoking cessation even among mature smokers with well-established addiction.

Keywords
Smoking ban; cigarette consumption; public policy; quasi-experiment; addiction; tobacco control; treatment effects

Classification codes
I12, I18, C33, K32

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SECTION 1: INTRODUCTION

Smoking-free environment legislations have been a popular tool to reduce exposure to secondhand smoke for nonsmokers in the past decades. This study asks, however, whether smoking bans in shared spaces also lead to lower smoking intensity and propensity among smokers. Using individual level cross-country data in Europe, this paper examines the impact of nationwide smoke-free legislations on smoking behaviors of mature smokers. The research design exploits the fact the European Union (EU) is multinational governance with top-down regulations on smoke-free environment laws, yet the timing of legislations varies among the member countries.

The evidence of reduction in secondhand smoke exposure after a smoke-free legislation is clear with the decline in reported incidences of related health symptoms caused by secondhand smoke (European Commission, 2013). However, the effect of smoking bans on smoking reduction or smoking cessation is debatable. Some studies did not find evidences supporting the causal effects of smoking bans on the reduction of smoking prevalence (Adda and Cornaglis, 2010; Fitchenberg and Glantz, 2002; Levy and Friend 2003); while others found that smoking bans effectively reduced cigarette consumption. Comprehensive public clean air laws were shown to reduce consumption rates of the entire population by about 10 percent (Levy and Friend, 2003).

This paper investigates the effect of smoking bans in a quasi-experimental setting by exploiting the political structure of the EU. The European Commission's limited yet overarching authority over its members brought about national-level smoke-free legislations across Europe in the 2000's. The Commission had drawn a deadline in 2009 for its members to impose nationwide smoking bans. Consequently, smoke-free legislations in all the member countries were in place by 2010. The timing of nationwide smoking bans in each country, however, largely depends on their own legislation process and public attitudes towards the harm of secondhand

smoke. Their traditional stance in public health and relationship with the tobacco industry also played a major role in how soon they can implement and enforce public smoking bans.

Self-selection biases encountered in most studies when smoking bans were voluntary, and endogeneity biases existed at local-level laws are mitigated because legislations in consideration in this study were nationwide, mandatory, and top-down, as opposed to voluntary and bottom-up. The Council's recommendation is considered conditionally exogenous to smoking behavior of mature smokers in each member country. The effects of smoking bans on smoking behavior are measured by comparing smoking outcomes of individuals in countries that imposed smoking bans early in comparison to those with late smoking bans. This comparison isolates the effect of changes in smoking outcomes due to nationwide smoking ban intervention from changes as a result of overall trends, country-specific trend, individual idiosyncratic heath shocks, or demographic-specific behavior.

Analyses show that smoking bans lead to higher rates of smoking reduction and cessation among mature smokers. On average, lower smoking propensity after the bans persisted and continued to decline over time. There is also heterogeneity in the effect of smoking bans. Smoking bans were most effective at increasing smoking cessation among light smokers and very heavy smokers, while the effects on average smokers were not statistically different from zero. Those working in places with more comprehensive and strict bans are more likely to quit. However, the time spent at work for regular full time do not seem to play a big role. Smokers working part time experienced the highest reduction in smoking propensity, while those working more than 60 hours per week had the lowest reduction. Smoking propensity among employees in blue-collar or professional occupation also reduced the most, while the effects on employers in the service sector were tepid.

Literature Review

Smoking bans could potentially reduce cigarette consumption through a few different channels: 1) making it costly to smoke in certain spaces, 2) removing prior smoking cues that trigger smokers to light up, and 3) shifting public and smokers' attitudes and beliefs towards

smoking and secondhand smoke that lead to changes in smoking behavior. First, viewing smoking as a standard consumption behavior with space-time consumption bundle, clean-air laws impose constraints on spaces that smoking can take place. Clean-air laws effectively make smoking in spaces with bans become costly. Smokers who chose to violate smoking bans may face legal consequences such as fines or social punishment in the form of negative treatment from others observing their behavior.

Smokers may reduce their consumption entirely after the bans, however, whether smoking bans lead to smoking displacement is open to question. As suggested by Adda and Cornaglia (2010), smokers could also substitute away from smoking in public spaces with bans to private spaces, such as home or cars, and not necessarily reduce their total tobacco consumption. Meanwhile, other studies (Mons et al, 2013) showed evidences that smoke-free legislations did not induce smokers to smoke more in their own home. The contradictory results suggest that smoking in different spaces is not perfect substitution and substitutability varies among smokers.

In the framework of addiction consumption, smoking decision can be thought of as "cued-triggered decision process" (Bernheim and Rangel, 2004). Under the premises of Bernheim and Rangel, uses among addicts are mistake and users are sensitized to environmental cues that trigger mistaken usages. The urge to smoke is triggered when they are faced with smoking cues, for instance, when smokers are in the presence of smoking coworkers, or engaging in repetitive jobs that they habitually smoke while doing. An introduction of smoking bans imposed a shock that makes smoking in the presence of existing cues suddenly become impossible or costly. Over time, smokers become less sensitized to those cues and reduce their consumption, perhaps permanently, or quit entirely in the long run. In contrary, their consumption could also resume after a period of time if new smoking habits outside of banned spaces are developed. In the light of cued-triggered decision process, smoking bans facilitate getting rid of existing smoking cues. Nonetheless smoking displacement is still possible if new smoking cues are developed afterwards. The removal of cues from other smokers in the environment can also be viewed as peer effects. For instance, if one of smoking partners is imposed a smoking ban at his or her workplace; both partners are less likely to smoke subsequent to the ban (Cutler and Glaeser, 2007).

Lastly, the shift in attitudes towards secondhand smoke and towards the act of smoking itself could also lead to a shift in smoking behaviors. Public smoking bans could alter social norms and induce voluntary bans at home to become more prevalent, as happened in Italy after their public comprehensive bans in 2006 (Origo and Lucifora, 2013). Moreover, smoking bans in public, especially nationwide bans, could make smokers feel stigmatized (Ritchie et al, 2010) and face with more social pressure to smoke less or quit.

Without a conclusive answer from theoretical models, many empirical studies attempt to examine whether smoking bans lead to smoking reduction. However, quasi-experimental studies attempting to identify the impact of smoking bans on smoking behavior inevitably face with the question of causality: whether smoking bans, indeed, lead to the reduction in smoking prevalence or vice versa. Workplaces with a high ratio of nonsmokers or health-conscious employees may be more likely to introduce smoking bans which in turn may lead to voluntary attrition of smokers out of the workplace and matriculation of nonsmokers into the workplace. Selective and voluntary smoking bans at workplaces or certain public spaces like restaurants will allow for sorting mechanism where smokers will sort themselves to places that allow smoking. With a few exceptions, most studies did not account for the potential endogeneity biases. Evans and Farrelly (1999) addressed the biases by using simultaneous equations with the size of establishment as an instrument variable for workplace smoking policy—given that larger establishments are more likely to impose smoking bans, but not more likely to attract health-conscious workers.

The sorting mechanism is less likely when the law is passed at higher levels because of the escalated transaction costs to avoid the bans. While smokers could switch jobs in the same city if voluntary workplace bans are imposed at the firm level, it is costly for smokers to switch workplaces across states or countries to avoid state- or country-level bans. Nonetheless, endogeneity bias could still exist for local ordinances, state-level or national-level laws. The only study found to address the question of causality of smoking bans on smoking behavior with the state-level smoke-free laws is Chaloupa and Saffer (1992). With state-year time series data to measure changes in cigarette demand as a result of state's regulations, they used simultaneous equations and confirmed that states with low smoking rates are more likely to pass workplace smoking bans.

This paper provides new evidences on recently enacted smoking bans that are stricter and more widespread than those implemented in the past. Most papers studying clean air laws enacted at the state level in the United States were put into effect before 1994 when strict laws unlikely had been implemented at the time (Levy and Friend, 2003). Moreover, other quasi-experiment studies on smoking laws examined laws at local levels (Moskowitz et. al, 2000; Stephens et al, 1997; Carpenter, 2009), rather than at national level. Carpenter (2009) utilizes similar research design, exploiting differential timing of adoption of local smoking laws in different counties in Canada, using DID estimators. The results showed that local laws are effective at increasing smoking bans at workplaces, as well as reducing smoking and exposure to tobacco smoke, particularly for blue collars, but less so for white collars and service workers.

In the past few years, a few more recent studies have provided evidences on more recent comprehensive national-level smoking bans in Europe. For instance, Jones et. al (2015) used British household panel data and found that the bans have limited short-run effects on both smoking prevalence and total level of smoking. The result is in line with the most recent strand of economic literature that there is no firm evidence on the effects of smoking bans on smoking. Anger et al. (2011) examines smoking bans in Germany and found that the bans did not change smoking prevalence among the population. However, they found heterogeneous impacts among smokers, that young smokers in the urban area less likely to smoke and smoke less intensively. Furthermore, they found that smoking bans in states that are enforced more strictly are more effective at reducing smoking. This paper offers more comprehensive evidence on the impact of these national-level smoking bans by examining the impact of smoking bans in Europe using cross-country data.

For workplace smoking bans, reviews on population-based worksite studies found between a 7 and 15 percent reduction in cigarettes smoked (Woodruff et al., 1993; Glasgow et al., 1997; Farrelly et al., 1999; Farkas et al., 1999). However, these previous studies were also done when smoke-free legislations were not yet widespread or strictly enforced. Furthermore, most of them were firm-specific studies, or population-based private worksites bans (Levy and Friend, 2003) which could subject to self-selection and endogeneity biases mentioned above.

This paper focuses on older population and uses data from the Survey of Health Ageing and Retirement in Europe (SHARE) which comprises of rich health information. Most smokers

included are older, have been smoking many years, and have well-established addictions. Mature smokers are found to be well informed about the costs, or risks, and benefits of smoking (Khwaja et al, 2009). Older smokers are also less likely to change their consumption habits unless there are shocks, such as a newly diagnosed health conditions (Smith et. al, 2001), and less responsive to health publicity campaigns about the harms of smoking (Townsend et. al, 1994) and price changes (Evans and Farelly, 1998). Given their well-established addictions, mature smokers also have harder time to quit despite having expressed the desire to do so. Public smoking bans could break the habit of mature smokers by imposing constraints on spaces they can smoke and remove smoking cues which could lead to the stop of mistaken usages.

Another advantage this study has is the availability of individual level data that allows identification of the exposure to smoking bans of respondents with different demographic as well as replete health information. Individual health information and other control variables help isolate the effect of smoking bans from other factors such as health shocks that could also result in changed smoking behavior. Furthermore, employment data on employment status, such as industry, occupation, and the number of hours worked each week reveals how much a respondent is affected by smoking bans at workplaces and whether more comprehensive and strict smoking bans lead to lower smoking propensity. However, the drawback of this paper is that data used, SHARE, is representative of people age 50 and older and their partners. Therefore, the sample is not representative of working age that are affected the most by bans in workplaces.

SECTION 2: EMPIRICAL APPROACH

Background: The EU's tobacco control and smoke-free legislation

The Council put forth Recommendation (2003/54/C) calling for protection against exposure to tobacco smoke in public spaces, including indoor workplaces, public transports, and indoor public places. In the same year, the EU also adopted the World Health Organization's Framework Convention on Tobacco Control (FCTC) whose Article 8 targets protection against tobacco smoke. With this in motion, according to the EU's report in 2009, all the EU members had national-level smoke-free legislation in place to protect people against tobacco smoke

exposure in indoor workplaces, public transport and other public places. While the comprehensiveness and enforcement of bans may vary among countries, all the EU members follow the health protection guidelines by the Recommendation and the FCTC.

The European Council struggled with tobacco control front over a decade before they finally met with a partial success in 2003 and was able to put forth the Recommendation and adopted the FCTC. The success was largely contributed by international shifts in attitudes towards the harm of secondhand smoke, and the ascendency of left-leaning leaders in the EU's key countries (Duina and Kurzer, 2010). Between 1988 and 2003, the European Commission struggled with expanding its authority over its members as they ran into a "classic intergovernmental traps" where member countries took stances according to their traditional public health policies and their relationship with the tobacco industry (Keleman 2004; Duina and Kurzer, 2010). Italy and France were unwavering supporters for the smoke-free legislation as they had established traditions of state intervention in the realm of health policies and lifestyle choices (Studlar, 2004). On the other hand, Germany, the Netherlands, and Denmark tended to oppose smoke-free legislation and resorted to other tobacco-control strategies due to their more libertarian views with "the ideals of self-governing individuals and consumer freedom" (Duina and Kurzer, 2010). Under the guideline by the European Commission and the adoption of FCTC, the speed of legislating process in each country is contingent on the political and cultural backgrounds, medical communities, and the level of activism against secondhand smoke.

Enforcement of smoking bans is in place in all member states, but the comprehensiveness of bans varied. Despite the struggle in the beginning to put forth the Recommendation, the EU reported that all the member countries have introduced punishment for non-compliance and reported actual enforcement after smoking bans are imposed (European Commission, 2013). The most common sanction is fines while the severity varies. Fines for individuals are generally lower than fines imposed on enterprises. Bans are more comprehensive in educational establishments, facilities providing services for children, public transports, and in the healthcare sector. Meanwhile, smoke-free legislation imposed on the hospitality sector is the hardest to pass and the most controversial. Moreover, complicated legislation with exemptions is found to be harder to implement and enforce, and hence less effective.

Research Design

This paper uses individual-level data from the Survey of Health, Ageing and Retirement in Europe (SHARE), which includes the total of eleven initial countries across Western and Southern Europe. SHARE conducted interviews on nationally representative samples of people age 50 or older and their partners. The survey started in 2004 and is repeated every two years unless the participants dropped out or became deceased. The average age of SHARE respondents is 60 as of year 2004; 44 percent of which is male, 20 percent graduated college, and 48 percent is living with a partner (Table 2). New respondents are added in each wave as needed to keep data representative. SHARE's initial eleven countries include the Netherlands, Austria, Italy, Sweden, Spain, Belgium, France, Denmark, Germany, Switzerland and Greece. All these countries are the members of the EU except for Switzerland which was excluded from the sample.

Exploiting variation in the timing of smoke-free legislation among SHARE countries, the effect of smoking bans can be identified. After the ratification of FCTC and the Recommendation, all the member countries introduced a comprehensive smoking ban within a window of six years, between 2004 and 2010 (Figure 1). Among the eleven SHARE countries, the nationwide public smoking bans was the Netherlands in 2002. Subsequently, Austria, Italy, and Sweden introduced comprehensive bans in 2005; Spain and Belgium in 2006; France and Denmark in 2007. With the federal system, Germany introduced smoking bans at state level starting in 2007 and had it nationwide by 2009. The last SHARE country to enact public smoking bans was Greece in 2010. Table 1 outlines the timing of SHARE interviews and smoke-free legislation introduction in each country with smoking bans categorized into three types: bans in public spaces, workplaces, and restaurants and bars. More details on the legislation of smoking bans by country, including their comprehensiveness and exemptions, are presented in appendix table A1.

Summary statistics on the demographic make-up of respondents (Table 2) shows that respondents in countries that introduced smoking bans early, before 2007, are older on average, and more likely to be living with a partner. Smokers may quit smoking over time as they are older or encounter health shocks, thus regression analysis controlling for demographic variables addresses possible biases from differences between two groups.

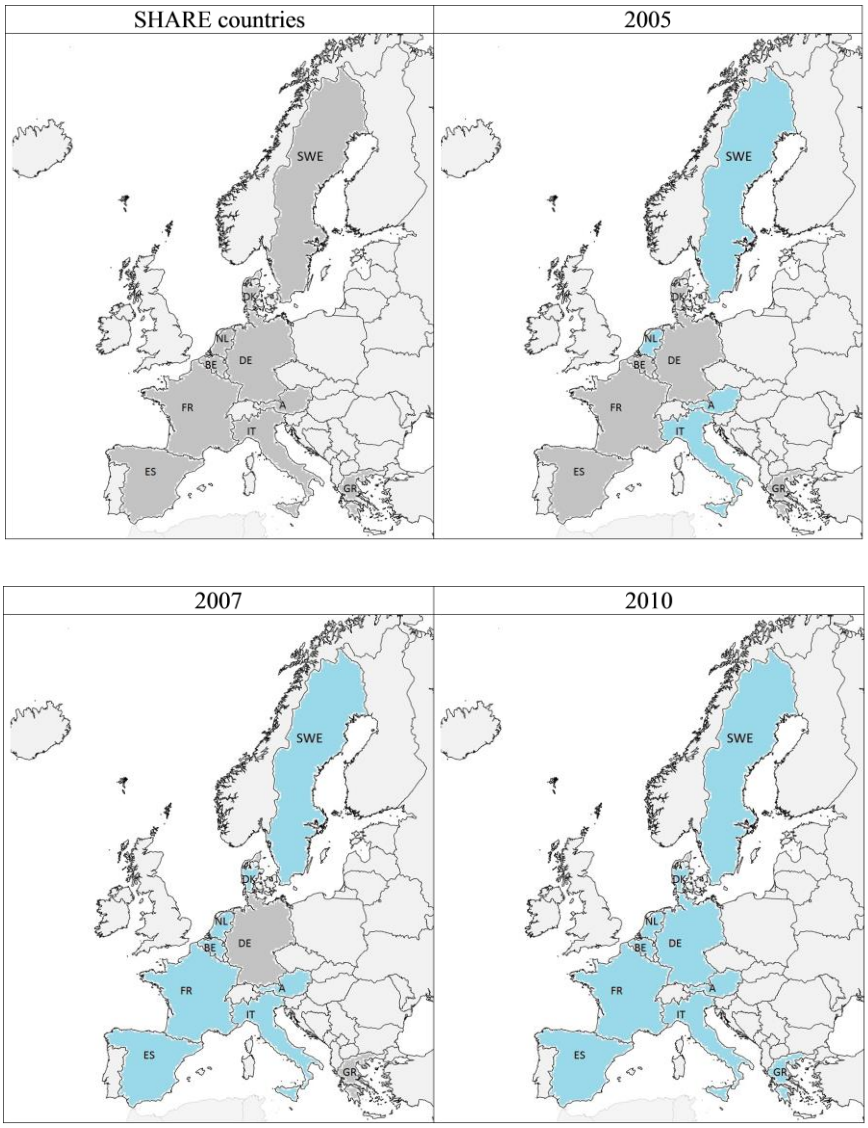

Figure 1: Research Design: Maps of SHARE Countries with Smoking Bans in 2004-2010 in grey, without nationwide smoking ban laws, and in blue with smoking ban laws.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
SHARE interviews	1		2					4		5
Austria		W,P		P						
Italy		P, H								
Sweden		H								
Spain			W,P							
Belgium			W	H	P			H		
France				P,H						
Denmark				W,P,H						
Germany					P,H					
Switzerland							W,P			
Greece							W,P,H			
P	Bans in public spaces									
W	Bans in workplaces									
H	Bans in hospitality businesses									

Table 1: Timeline of comprehensive smoking-ban legislations and SHARE interviews

	Pre-Bans	Post-Bans	P-value
All countries			
Age	61.99	59.18	0.0001
Male	0.44	0.45	0.4934
Employed	0.29	0.27	0.0341
Graduated college	0.23	0.21	0.3600
Living with a partner	0.65	0.36	0.0000
Early Bans			
Age	65.07	60.07	0.0000
Male	0.44	0.45	0.1938
Employed	0.26	0.23	0.3166
Graduated college	0.13	0.16	0.0763
Living with a partner	0.74	0.40	0.0000
Late Bans			
Age	61.25	57.57	0.0000
Male	0.45	0.45	0.6550
Employed	0.30	0.33	0.1291
Graduated college	0.25	0.29	0.3045
Living with a partner	0.63	0.29	0.0000
Number of observations	52,179	86,739	

Table 2: Summary Statistics from pre-bans and post-bans in 2004-2013

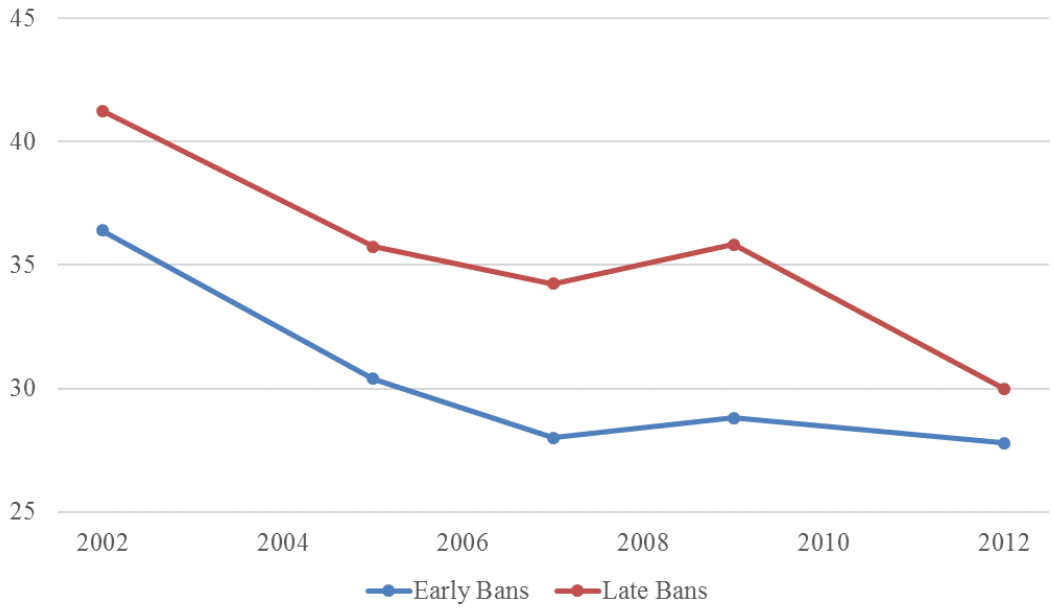

Figure 2: Trends of smoking prevalence (percent of smokers in population) in countries with early bans and late bans

Identification strategy

Initial analysis treats all the smoking bans as equivalent, measuring the effect of comprehensive smoking bans on overall level of smoking behavior. Thereafter, the model will refine smoking bans according to its coverage and its heterogeneous effects on smokers with various smoking intensity and the level of exposure to smoking bans at workplaces with employment information.

Given the timing of smoke-free legislations, the preliminary analysis is based on the first two waves of SHARE, 2004 and 2006, measuring the short-run effects. The effect of smoking bans is measured by comparing the changes in smoking behavior in the countries that smoking bans were imposed between SHARE interviews wave 1 and 2 to changes in smoking behavior in the countries that smoking bans were imposed after the SHARE interview wave 2 in 2006. Samples from the Netherlands were dropped as their smoking bans were introduced before the first SHARE interview. Countries with a comprehensive ban introduced between SHARE interviews wave 1 and wave 2 include Austria, Italy, Sweden, Spain and Belgium. The comparison countries with comprehensive bans introduced after both wave 1 and wave 2 include France, Denmark, Germany and Greece.

The outcome measures for smoking behavior are 1) smoking propensity: whether a respondent is a current smoker at the time of interview to measure the extensive-margin effect; and 2) smoking intensity if a current smoker: the average number of cigarettes smoked per day to measure the intensive-margin effect. Smoking status is determined by two questions: first, "Have you ever smoked cigarettes, cigars, cigarillos or a pipe daily for a period of at least one year?" and second, "Do you smoke at the present time?" If they ever smoked daily, they are asked, "How many cigarettes [do/did] you smoke on average per day?" Unfortunately, data on smoking intensity is not available after wave 2. Therefore, the analysis on the changes in smoking intensity among continued smokers is limited to only two years after bans.

The two-period model estimates short-run effects of smoking bans within a two-year window after the enactment. However, with only two periods, the estimated effects could be influenced by coincidental state-year shocks that happened concurrently with the policy intervention. Subsequently, SHARE interviews in 2011 and 2013 are added to the analysis. The additional SHARE interviews not only allowed for subsequent durations of ten years after smoking bans, multiple countries-periods data are also more robust to possible state-year shocks that could confound the effect of interested policy intervention. Furthermore, additional periods will allow for country-time trend estimates that represent country-specific trend for robustness checks.

Empirical Models

Short-run effects

DID regressions with two period data is

$$Y_{ist} = \gamma_s + \lambda_t + \beta D_{st} + X'_{ist}\delta + \varepsilon_{ist}, \text{ t=1 or 2.}$$

The difference-in-differences estimates measure the effect of national legislation on smoking bans in public spaces. D_{st} is a comprehensive ban indicator, equal to 1 if there is a smoke-free legislation in place in country *s* at time *t*, and otherwise 0. Y_{ist} is the outcome measures of smoking behavior, namely, if a current smoker and smoking intensity. The smoking status indicator is equal to 1 if a respondent smokes daily at time *t*, and 0 otherwise. For smokers, smoking intensity is equal to the average number of cigarettes smoked per day at time *t*, where t

is either 1 or 2. The key identifying assumption for DID estimates to have causal implication is that the trend in smoking would have been the same in both groups in the absence of the policy intervention. If the trend of smoking behavior among mature smokers in each country influences the timing of legislation, the estimations will suffer endogeneity bias then the claim about the causality of smoking bans on changes in smoking behavior cannot be made. If the pre-existed trend in smoking prevalence is declining and leads to early smoke-free legislation, DID estimates of the effects of smoking bans will be biased upwards.

As discussed above, the European Commission's Recommendation and the adoption of FCTC, to a degree, dictated the passage of nationwide smoking bans that eventually was made in every country in the sample by 2010. The timing of legislation, which is the essential part of the research design, was politically influenced by public attitudes towards the harm of secondhand smoke rather than by smoking prevalence among older population. It is the shift in attitudes towards smoking and secondhand smoke that mobilizes and precedes smoking ban legislations. Moreover, the trend in smoking behavior among mature smokers is less influenced by the shifts in public attitudes among younger smokers due to their well-established addiction and generation gap.

The passage of smoke-free legislations seems to be conditionally exogenous to smoking behavior of mature smokers, while public attitudes toward secondhand smoke and towards smoking bans are more influential to the timing of legislation. Figures A1-A4, and Table A-2 in appendix show countries presented in order of the date of their first national comprehensive smoking bans. The variations of smoking prevalence and smoking behaviors are similar in both groups (Figure A-4). There is a u-shape relationship between the passage of smoke-free legislation and population smoking prevalence. However, such relationship is not present with smoking prevalence of mature smokers from SHARE samples. Smoking behavior, whether smokers smoke at home, smoke in a car if alone, or smoke in a car if with non-smokers, are distributed equally in countries with early and late bans (Fig. A1). Attitudes towards the harm of secondhand smoke, such as perception that secondhand smoke can cause serious illnesses in the long term, are also similar in both groups (Figure A3). This perception is relevant with how active the medical community is in educating the population about the harm of smoking and the

level of activism in each country. For public attitudes towards smoking bans, both groups have similar attitudes towards smoking bans in restaurants, offices and workplaces, and indoor public spaces (Figure A-2). However, public attitudes supporting bans in bars or pubs are higher in countries with earlier bans.

Because nationwide smoke-free legislations are aggregate at the country level, the country fixed effect is essential in addressing omitted variable bias when evaluating the policy. Other intangible factors such as attitudes towards smoking bans determine how much bans influence smoking decision. Conjunction tobacco policies are also critical and could have complementary effects on smoking bans (Levy et al., 2004). Six main tobacco control strategies include public smoking bans, taxation, advertisement bans, health warning labels, supporting services for quitting, and public information campaign. Since it is hard to quantify these intangible factors, country fixed-effects, γ_s, are crucial in isolating the effect of smoking bans other concurrent tobacco control policies at the country level. A time fixed effect, λ_t, represents transnational trends that influenced all the countries at time *t*.

Sample attrition and control variables

Sample attrition and omitted variable problems could bias DID estimates. For robustness check, a comparable analysis on a balanced sample is examined, and the individual-level fixed effects are included to address the possible omitted variable problem. Examining a balanced subsample offers the benefits of getting rid of between variation and isolating changes in smoking behavior to only within variation for a respondent. The smaller sample size of a balanced subsample, however, leads to less precise estimates. More importantly, the results are more sensitive to measurement errors. Possible measurement errors are spotted in data, for instance, nonsmokers in wave 1 becomes smokers in wave 2, and resume to being a non-smoker, which is quite irregular for a person at older age to pick up smoking habits and quit. The changes in smoking status could be either a relapse or measurement errors. To address the problem, later analyses only choose to follow smokers interviewed in wave 1 and analyze changes in their behavior later on. This rules out measurement errors for respondents that reported being nonsmokers and picked up smoking in the middle.

However, a drawback of following smokers in wave 1 and not adding new smokers is the attrition of smokers. Usually people quit smoking over time as they are older or encounter more health issues. Moreover, the demographic of the group with early bans and late bans should be similar to ensure that they would have parallel trends in smoking cessation over time. As shown in table 2, countries with early bans have older sample, less college graduates, and more of them living with a partner or spouse. To address this problem, the analysis also includes detail demographic and health information.

Individual level information is included to account for other factors that influence smoking behavior. Demography, such as age, gender, occupation, employment status, living situation and health information are all important factors that influence smoking propensity and smoking intensity. Control variables include age, living situation, employment status, gender, and college attainment. Furthermore, individual fixed effects are included for potential omitted variables that could bias smoking behavior.

Health variables included in the analysis consist of general health issues, the presence of chronic illnesses, and smoking-related health issues or chronic illnesses of which conditions may be worsened from smoking. General health issues included are whether they have a long-term illness, limitation in Activities of Daily Living (ADL), whether they have had a heart attack, stroke, high blood pressure, chronic lung diseases, Parkinson, asthma, or having both smoking-related and non-smoking related cancer.

Long-term effects

This section extends the two-period model to four periods and explores a different specification of smoking ban variables in order to relax the assumption that the effect of bans is discrete and instantaneous. The annex of SHARE wave 4 and 5 resulted in a total of four periods: 2004, 2006, 2011, and 2013. SHARE wave 3 consists of different modules that do not contain relevant variables and hence excluded. All the countries in the sample introduced comprehensive bans nationwide by the interview in 2013. The benefit of including additional periods is that the results are more robust to possible state-year shocks that potentially confound the effect of smoking bans in the two-period model.

The OLS probability estimation of *i* being a smoker at time *t* is

$$Y_{ist} = \gamma_s + \lambda_t + \beta Duration_{ist} + X'_{ist}\delta + \varepsilon_{ist},\ t = 1,2,3,or\ 4,$$

where *s* indexes countries. The outcome measure is smoking status, whether respondent *i* is a smoker at time *t*. Since the availability of smoking intensity data is limited to only two periods, the analyses on changes in smoking intensity among continued smokers are limited to only the short-term effects. $Duration_{ist}$ is the number of years from the time a comprehensive smoking ban was introduced in country *s* to the time when the respondent *i* is interviewed at time *t*, and is equal to zero if the time of interview is before comprehensive bans were introduced. $Duration_{ist}$ captures the impact of smoking bans over time after the introduction where time is measured in months and scaled to a year unit. The coefficient β is equivalent to an annualized rate of changes in smoking propensity after comprehensive bans are introduced. Under this specification, it is assumed that the effect of smoking bans is linear and continuous; and the longer the bans are in place, the more likely a smoker will quit smoking. Alternative specifications are to include the quadratic term, or dummy variables indicating how long bans have been in place. Additionally, having more than two periods allows for the estimation of country-time trend, and the inclusion and exclusion of country-time trend variables for robustness check.

With this ban specification, the population difference-in-differences is

$$(E[Y_{ist}|s = E, t = K] - E[Y_{ist}|s = E, t = J]) - E[Y_{ist}|s = L, t = K] - E[Y_{ist}|s = L, t = J])$$
$$= \beta[(Duration_{iEK} - Duration_{iEJ}) - (Duration_{iLK} - Duration_{iLJ})]$$

Suppose compare Austria, an early ban introducer in 2005, and Greece, a late ban introducer in 2010, the population difference-in-differences is equal to $\beta Duration_{Austria,2}$ (omitting *i* for a representative respondent), while the population difference-in-differences between time period one and three is $\beta(Duration_{Austria,3} - Duration_{Greece,3})$. The coefficient β can be interpreted as the reduction of smoking prevalence in the sample each year after a comprehensive ban is introduced assuming that the effect is linear.

Extensions: Heterogeneity in the ban effects

Smoking intensity

Besides varying effects of smoking bans over time in the short run and long run, the effects can also differ over spaces. Smoking bans can be categorized into three main types according to its coverage: 1) workplaces, 2) public spaces, and 3) hospitality establishments. Public spaces include public transports, public building, educational establishments and healthcare facilities, while hospitality establishments include restaurants, bars, cafes and hotels. Note that two types of bans could intersect. For example, smoking bans in public transports, which is a ban in public spaces, also apply to those working in public transport facilities, hence a form of workplace smoking ban.

Workplace bans

The probability of quitting or changed smoking behavior depends on the exposure of smokers to smoking bans and how strict the bans are. Workplace bans can be expected to have high impact on employed smokers as they spend most of their days at workplaces. Smoking bans in public spaces will affect almost everyone but the effect could be moderate as time spent in public establishments may not account for much each day. Meanwhile, smoking bans in restaurants and cafes may affect those dining out more often while bans in bars affect smokers who frequent bars and habitually smoke while drinking. Individual data can address the heterogeneity in the exposure to smoking bans and potential heterogeneity in the effects; for example, identification of employment status, industries in which being employed, and the number of weekly hours worked could lead to varied levels of exposure to bans.

SECTION 3: RESULTS

The analyses begin with two-wave data to investigate the short-term effects within two years after smoking bans. Then the analysis extends to the long-term effects spanning over nine years after comprehensive bans were implemented.

3.1 Difference-in-Differences tables

Table 3 presents smoking prevalence among respondents in the SHARE sample, for the overall samples, countries where smoking bans were introduced before SHARE wave 2, and comparison countries where smoking bans were introduced after SHARE wave 2. The top row shows that overall smoking prevalence declined by 0.27 percent from wave 1 to wave 2, or a 1.41 percent decline in the number of smokers from previously 19.05 percent smoking prevalence in wave 1.

	Smoking Prevalence		
Sample	**Wave1**	**Wave2**	**Differences**
All groups	0.1905	0.1878	-0.0027
	(.0113)	(.0133)	(0.0041)
Early bans before wave 2	0.1723	0.1608	-0.0115***
	(.0034)	(.0045)	(0.0038)
Late bans after wave 2	0.2133	0.2171	0.0038
	(.0210)	(.0203)	(0.0078)
Difference	-0.0410*	-0.0563***	-0.0153*
Early- Late	(0.0211)	(0.0206)	(0.0086)

Table 3: Difference-in-differences of smoking prevalence in 2004 and 2006
Note: Standard errors clustered by NUTS1 (nomenclature of territorial units for statistics level 1, 56 clusters)
*** Significant at the 1 percent level, ** 5 percent level, and * 10 percent level

Rows 2 and 3 show that smoking prevalence declined in both groups, but the group that introduced smoking bans earlier between SHARE interviews wave 1 and 2 has larger decline in smoking rates. Smoking prevalence significantly reduced by 1.15 percent in countries that imposed smoking bans by 2006, equivalent to a 6.67 percent reduction in the number of smokers from the previous smoking prevalence of 17.23 percent. On the other hand, smoking prevalence did not significantly decline in countries that imposed smoking bans later. Their smoking prevalence lowered by 0.38 percent on average, which is equivalent to 1.79 percent reduction from the previous smoking prevalence of 21.33 percent.

This preliminary statistic suggests that smoking bans may lead to less smoking prevalence. The bottom row shows estimated differences in smoking prevalence between the two groups. The early group has lower smoking prevalence than the late group in both wave 1 and wave 2 by 4.10 percent and 5.63 percent respectively. The estimated difference-in-

differences as a result of comprehensive smoking bans is 1.53 percent in smoking reduction ($p < 0.10$). This shows that comprehensive smoking bans had a modest but statistically significant impact on smoking prevalence.

3.2 DID regression analysis

3.2.1 Baseline Regressions

The analysis up to now has not controlled for possible country-specific and individual-specific characteristics. Smoking ban policy is aggregate at the country level. Therefore, the country fixed effects are essential in addressing other possible confounding effects. Time fixed effects capture transnational trends of smoking prevalence across countries. To address the correlation in the group error terms that may lead to understated standard errors and 'placebo' significant effect in DID analysis as cautioned in Bertrand et. al (2004), standard errors are clustered by Nomenclature of territorial units for statistics (NUTS) classification level 1. Due to the small number of countries in the sample, only 9 clusters, NUTS classification is chosen to refine the cluster level that can more accurately reflect local legislation, culture, norms, and public policies at the regional level. Due to confidentiality issues, smaller units NUTS level 2 and 3 are not available in some SHARE countries; hence NUTS1 is chosen as the clustering unit. Demographic control variables including age, gender, college attainment, employment, and living status with a partner, and other health conditions are included in all regression analyses. Moreover, individual fixed effects are included and excluded in specifications for robustness check.

Table 4 compares the OLS probability estimations of respondents being smokers in wave 1 and 2 under different specifications in models I to V. The sample only includes smokers in wave 1 who were also interviewed in wave 2. The coefficient of DID estimates is the changes in smoking propensity of smokers in wave 1 due to the introduction of public smoking bans. The estimates show that comprehensive smoking bans lead to about 6.51 to 7.19 percent ($p <.05$) less in smoking propensity of mature smokers. The estimates remain robust throughout different specifications.

Dependent variable	Smoke (I)	Smoke (II)	Smoke (III)	Smoke (IV)	Smoke (V)	Number of cigs (VI)
Smoking banXPost Ban	-0.0651**	-0.0651**	-0.0715***	-0.0648**	-0.0719***	-0.1124
	(0.0288)	(0.0287)	(0.0264)	(0.0283)	(0.0255)	(0.2867)
Demographic variables	Yes	Yes	Yes	Yes	Yes	Yes
Health variables	No	No	No	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country trend	No	Yes	No	No	No	No
Individual fixed effects	No	No	Yes	No	Yes	Yes
Number of observations	7593	7593	7593	7593	7593	6501
Number of clusters	54	54	54	54	54	54

Table 4: DID regression analysis for the effect of smoking bans in 2004-2007
Note: Standard errors in parenthesis clustered by NUTS level 1
**** Significant at the 1 percent level, ** 5 percent level, and * 10 percent level*

The effect of smoking bans on cigarette consumption per day for continued smokers is estimated using the same model with the number of cigarettes as a dependent variable and assuming individual fixed effects (model VI). The result reveals that on average continued smokers reduced cigarette consumption by 1.39 cigarettes per day from wave 1 to wave 2, while the introduction of smoking bans led to an additional reduction of 0.11 ($p>0.10$) cigarettes per day, or equivalently an additional 10 percent reduction in smoking intensity from the pre-existed trend. The result is consistent with previous studies. Reviews on population-based worksite studies found between a 7 percent and 15 percent reduction in cigarettes smoked (Woodruff et al., 1993; Glasgow et al., 1997; Evans et al., 1999; Farkas et al., 1999). The large standard error suggests that the impact could be heterogeneous among smokers, which lead to the next analysis of the effects on smokers with varied smoking intensity.

3.2.2 Heterogeneity among Smokers with Varying Intensity

Numbers of cigarettes smoked in wave 1	Changes in no. of cig in wave 2		Percent change of no. of cig in wave 2		Number of Observation
0 to 5	-1.4690**	(0.5864)	-0.4720**	(0.1442)	263
6 to 10	-0.7907	(0.5802)	-0.1169*	(0.0386)	463
11 to 15	-0.0819	(0.4647)	-0.014	(0.0195)	395
16 to 20	0.0274	(0.6540)	-0.0005	(0.0185)	596
21 to 25	-1.5070*	(0.8967)	-0.0713	(0.0221)	194
26 to 30	-1.1021	(1.0692)	-0.0688	(0.0247)	144
31 to 35	2.4607	(4.0789)	-0.1624	(0.0811)	20
36 to 40	-1.4049	(1.9276)	-0.0715	(0.0310)	124
more than 40	-7.3920**	(8.6140)	-0.2449**	(0.0819)	51

Table 5: Changes in cigarette consumption in 2004 and 2006 after a comprehensive smoking ban, varied by smoking intensity in wave 1
Note: Standard errors in parenthesis clustered by NUTS level 1
**** Significant at the 1 percent level, ** 5 percent level, and * 10 percent level*

Heterogeneity in changes of cigarette consumption among continued smokers is investigated (Table 5). Outcome measures are the changes in the number of cigarettes consumed per day and the percent change in cigarette consumption between wave 1 and wave 2. The sample includes smokers who were interviewed in both wave 1 and wave 2 stratified by the number of cigarettes smoked per day at wave 1 interview. Changes in cigarette consumption among continued smokers after comprehensive bans are estimated using first-difference estimators conditional on the same control variables in the previous section, including demographic variables, health variables and time fixed effects, and individual fixed effects.

The result reveals that among continued smokers, light smokers and heavy smokers reduced their cigarette consumption the most in the short run following comprehensive bans. Meanwhile, average smokers who continued to smoke did not significantly lessen their cigarette consumption. Heavy smokers, smoking more than 40 cigarettes per day, had the highest reduction in cigarette consumption, cutting down 7 cigarettes ($p<0.05$) per day on average, or equivalent to 24.49 percent reduction ($p<0.05$). Very light smokers, smoking less than 5 cigarettes per day, are the next group with the highest reduction in cigarette consumption. They lowered smoking by about 1.5 cigarettes per day ($p<0.05$), or equivalent to 47.2 percent reduction ($p<0.05$).

3.2.4 Long-term effects of smoking bans

This analysis also uses the subsample of smokers that appear in wave 1 and follows them to wave 5. Table 6 shows OLS probability estimations of the likelihood that smokers in wave 1 continued to be smokers in subsequent waves. A few alternative representations of smoking ban duration are explored, with dummy indicators of the number of years after the bans (model III), and duration variables in the number of years after smoking bans were enacted (model IV-V). In the absence of the bans, smokers will have 16 percent probability of quitting in wave 2, while smoking bans policy intervention added an additional 4.62 percent ($p<.10$) probability to quit in the years following the bans (Model I).

Estimations also show that the longer the bans have been in place, the more likely a smoker will quit over time. Using the number of years that bans have been in placed shows that each subsequent year after the smoking bans adds 2.67 percent ($p<.05$) probability of quitting conditional on control variables including time fixed effects, country fixed effects, demographic, and health variables (Model IV-V). Testing for diminishing marginal returns in the effect of smoking bans on smoking prevalence over time by including the quadratic terms (Model V) shows that the ban could have diminishing returns over time, but the diminishing return is small and not statistically different from zero. When using the dummy variables to find the impulse rate of the effects on smoking propensity (Model III), it also shows that smoking propensity reduces over time after smoking bans have been in place.

The next analysis stratifies smokers in wave 1 by their smoking intensity and investigates heterogeneity in the probability of quitting after the bans. Table 7 shows the instantaneous probability of quitting in the short-run, long run, and annual rates of quitting over the subsequent years. The results are similar to the previous section, suggesting that light and heavy smokers are more affected by the bans, while the impacts on average smokers are smaller. In the short run, very light smokers, those smoking less than 5 cigarettes per day, are 14.48 percent ($p<0.01$) more likely to quit following the ban. However, if they did not quit within the first two years, the chance of them quitting is lower in the long run. The effects of bans on smoking propensity are smaller in the long run than short runs for light smokers suggesting that there is a relapse in this group. In contrary, the probability of quitting among heavy smokers, those smoking more than 30 cigarettes per day, increased over time following bans.

	(I)	(II)	(III)	(IV)	(V)
Comprehensive ban	-0.0462*	-0.0481*	-0.046		
	(0.0252)	(0.0263)	(0.0452)		
1 year after the ban			-0.0229		
			(0.0454)		
3 year			-0.2663***		
			(0.0525)		
5 year			-0.0510**		
			(0.0239)		
7 year			-0.0696**		
			(0.0275)		
Time duration after bans (year)				-0.0267**	-0.0276*
				(0.0107)	(0.0164)
Squared of time duration					0.0001
					(0.0012)
Demographic variables	Yes	Yes	Yes	Yes	Yes
Health variables	Yes	No	No	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Country trend	No	No	No	No	No
Individual fixed effects	Yes	Yes	No	Yes	No
Number of observations	10904	10904	10904	10904	10904
Number of clusters	54	54	54	54	54

Table 6: Long run effects of smoking bans on smoking cessation among mature smokers from 2004 to 2013

Note: Standard errors in parenthesis , clustered by NUTS level 1

**** Significant at the 1 percent level, ** 5 percent level, and * 10 percent level*

Smoking Intensity	Short run	N	Long run	Annualized rate	N
0 to 5	-0.1448***	994	-0.0848*	-0.0587**	1470
6 to 10	-0.0367	1466	-0.0358	0.0036	2156
11 to 15	-0.0428	1245	-0.0367	-0.0256	1823
16 to 20	-0.0551*	1804	-0.0263	-0.0352**	2553
21 to 25	-0.0455	525	-0.0673**	-0.0302	731
26 to 30	-0.0425	396	-0.0015	-0.0107	547
31 or more	-0.0723*	530	-0.0909**	0.0057	673

Table 7: Short-term and long-term effects of bans on smoking cessation and heterogeneity in smoking intensity

**** Significant at the 1 percent level, ** 5 percent level, and * 10 percent level*

3.2.5 Smoking Bans at Workplaces

This section investigates the impact of workplace bans. Given information on employment, exposure to smoking bans at workplaces can be quite clearly identified using respondents' employment status, such as the sectors they work in, occupation types, work hours, and time pressure at work. On the other hand, the impact of other types of bans such as bans in restaurants is hard to identify due to the lack of data for inference of interviewees' exposure to those establishments.

Table 8 shows estimates of the effect of workplace bans on smokers with different employment status (Table 8). The Comprehensive bans variable indicates the presence of nationwide public bans while the bans in workplaces variable indicates that the ban includes oversight at workplaces. The results show that the comprehensive bans with oversight at workplaces have much stronger effects, unconditional on employment status of respondents. This is because not only current employees are subject to workplace bans, but also other smokers who may be exposed to those establishments. Moreover, enforcement and implementation at workplaces in general is easier than at other public spaces.

In the long run, general comprehensive bans lead to a 1.12 ($p>0.10$) percent reduction in smoking prevalence (Table 8, Model I). However, comprehensive bans that also include oversight at workplaces could lead to an additional 5.76 percent ($p<0.05$) reduction in smoking propensity among smokers, and an additional of 2.23 ($p>0.10$) percent reduction in smoking prevalence among smokers who were also employed. Meanwhile, Given that 28 percent of the sample is employed, smoking propensity of employees reduced by 7.9 percent following a workplace ban conditional on the presence of other smoking bans.

When decomposing the effect of workplace bans by industry, using the interaction term of workplace ban indicators with the industry that respondents are employed, the results show that smoking propensity decreased the most in electricity, gas and water supply; agricultural, hunting, mining and quarrying, and followed by public administration, education and health and social work. Note that the industry fixed effects and individual fixed effects are included in the analysis for robustness check to capture a possible latent quality of those choosing to be in certain industry (Model I and II). Industries with comparatively high smoking rates following the workplace bans are construction, and other community and social and personal work. These could reflect laxer enforcement in these industries or the move of smokers to these industries.

When looking at the impact of smoking bans by occupational types, occupations with the highest reduction in smoking propensity following bans are skilled agricultural, and fishery workers, plant and machine operators, and professional and technician or associate professional. The specification also includes occupational fixed effects, and individual fixed effects for robustness check (Model III and IV)

Comprehensiveness of smoking bans is a crucial factor that would affect smoking propensity. For example, due to resistance from industry, smoking bans in hotel and restaurants are usually laxer and offer exceptions. The estimates show that there is little or no impact on workers in this industry (Model I and II). On the other hand, educational establishments in most countries imposed strict smoking bans and we can see smaller smoking propensity among education workers following workplace bans by almost 10 percent. Yet the large standard errors are due to variations in laws between countries, for instance, some countries allow for smoking rooms for teaching personals. For some, smoking is completely banned in lower education institutions, while smoking or smoking rooms are allowed in higher education institutions (European Commission, 2013). This confirms that more comprehensive bans more effectively increase smoking cessation among the employed while exceptions in smoking bans lead to harder implementation and less impact on smoking reduction.

Time spent at work and time pressure

How much time spent at work is also expected to affect the likelihood of quitting after workplace bans. Intuitively, those spent longer time at work might be more affected by the bans, however, the analysis shows that the number of hours spent at work does not show statistically different impact on smoking propensity. Table 9 shows estimates of smoking propensity conditional on employment status, working hours each week, and time pressure at work with the subsample of all respondents.

The only group with noticeable reduction in smoking propensity are those working part time (spending only less than 10 hours a day at work.) On the other hand, there is potentially a reverse effect of the bans on those spend longer time at work (working more than 60 hours a week). Smoking propensity may even increase among this group after the ban imposition. The result is robust after controlling for individual fixed effects and other related variables. Another finding that goes along with the finding above is that smoking bans could have a reverse effect

on smoking propensity on those reported to have a lot of time pressure at work. The magnitude of the estimates is of the same size: the introduction of universal workplace bans led those who work under time pressure or long hours with higher smoking propensity by approximately 10 percent ($p<0.10$). Working with long hours and under a lot of time pressure could be more stressful and smoking cigarettes may offer higher marginal benefits to these smokers to relieve stress as nicotine is a natural relaxant. However, the mechanism that smoking bans could lead to higher smoking propensity is unclear. This might correlate with the industry or occupation effects.

Other factors: life expectancy and cohabitant

The role of life expectancy on responses to smoking bans, as well as living status of smokers are also important factors to smoking behavior. SHARE data includes both information on the respondents' life expectancy and their partners. An initial analysis shows that life expectancy does not affect the impact of smoking bans on smokers. On the other hand, whether a person living with a spouse and a partner plays a major role in smoking propensity. Those living with a partner or spouses are more responsive to smoking bans, having a higher reduction in smoking propensity than those living by themselves. Further analysis to see the dynamic how spouses and partners affects each other smoking behavior and responses to smoking bans would be of interest.

	(I)	(II)		(III)	(IV)
Comprehensive Bans	-0.0112	-0.0112		-0.0109	-0.0106
	(0.0214)	(0.0186)		(0.0188)	(0.0189)
Bans in workplaces	-0.0576**	-0.0601***		-0.0601***	0.0039
	(0.0217)	(0.0178)		(0.0182)	-0.0587***
Workplace bans X being	-0.0223				-0.0057
employed	(0.0224)				(0.0172)
Workplace bans X Industry			**Workplace ban X Occupation**		
agriculture, hunting and	-0.3006	-0.0958	Legislator, senior	0.0805	0.0841
mining and quarrying	(0.1890)	(0.1358)	or manager	(0.0961)	(0.0949)
manufacturing	-0.0598	-0.0354	Professional	-0.0918	-0.0877
	(0.1077)	(0.1058)		(0.0816)	(0.0859)
electricity, gas	-0.5099***	-0.3141	Technician or associate	-0.0845	-0.0807
	(0.1274)	(0.1940)	Professional	(0.1021)	(0.0970)
Construction	0.1229	0.1841*	Clerk	-0.0149	-0.0109
	(0.0906)	(0.1043)		(0.0414)	(0.0425)
Wholesale and retail	-0.0311	0.0001	Service worker	0.0003	0.0042
	(0.0750)	(0.0914)		(0.0827)	(0.0805)
Hotels and restaurants	-0.0053	0.0602	Skilled agricultural	-0.423	-0.4189
	(0.1046)	(0.1045)	and fishery worker	(0.2856)	(0.2876)
Transport, storage	-0.0733	-0.0163	Craft and related trade	0.0857	0.0896
	(0.0802)	(0.0842)		(0.0775)	(0.0789)
Financial intermediary	-0.059	-0.0112	Plant and machine operator	-0.1385	-0.1349
	(0.1694)	(0.1689)		(0.1657)	(0.1690)
Real estate, rent	0.1827	0.0952	Elementary occupation	0.1720**	0.1756**
	(0.2065)	(0.1669)		(0.0654)	(0.0711)
Public administration	-0.1305	-0.0842			
	(0.0854)	(0.1220)			
Education	-0.0969	-0.0842			
	(0.0770)	(0.0963)			
Health and social	-0.1034	-0.0749			
	(0.0680)	(0.0482)			
Other community	0.0572	0.1086***			
	(0.0704)	(0.0375)			
Number of observations	10904	10904	Number of observations	10904	10904
Number of clusters	54	54	Number of clusters	54	54

Table 8: The Effect of smoking bans on smoking propensity in workplaces by occupation types or industry

Note: Standard errors in parenthesis clustered by NUTS level 1

**** Significant at the 1 percent level, ** 5 percent level, and * 10 percent level*

	(I)	(II)	(III)	(IV)
Comprehensive Bans	-0.01	-0.0107	-0.0133	-0.012
	(0.0185)	(0.0186)	(0.0198)	(0.0194)
Bans in workplaces	-0.0550***	-0.0560***	-0.0580***	-0.0629***
	(0.0197)	(0.0198)	(0.0185)	(0.0175)
Workban X being employed	-0.0968		-0.0991*	
	(0.1008)		(0.0577)	
Workplace bans X number of hours worked				
- 1-10 hours	-0.068	-0.1640*		
	(0.1596)	(0.0955)		
- 11 to 29 hours	0.1012	0.0062		
	(0.1219)	(0.0578)		
- 30 to 39 hours	0.0763	-0.0192		
	(0.1021)	(0.0296)		
- 40 to 49 hours	0.0722	-0.0229		
	(0.1049)	(0.0419)		
- 50 to 59 hours	0.0674	-0.0274		
	(0.1098)	(0.0595)		
- 60 hours or more	0.1952*	0.1009*		
	(0.1128)	(0.0572)		
Work ban X Work under time pressure				
- Strongly agree			0.1846**	0.0926*
			(0.0738)	(0.0479)
- Agree			0.066	-0.0266
			(0.0639)	(0.0274)
- Disagree			0.0845	-0.0089
			(0.0599)	(0.0222)
- Strongly disagree			0.1387*	0.048
			(0.0698)	(0.0467)
N	10900	10900	10900	10900
No. Obs.	54	54	54	54

Table 9 Heterogeneous effects of smoking bans on employees with varying hours spent working
Note: Standard errors in parenthesis , clustered by NUTS level 1

*** Significant at the 1 percent level, ** 5 percent level, and * 10 percent level

SECTION 5: CONCLUSIONS

Nationwide public smoking bans, as found in this study, can lead to higher rates of smoking reduction and cessation. The results show that the probability of quitting would be higher over time after bans have been in place. When looking at continued smokers by their smoking intensity at the baseline interview, smoking bans are shown to be effective at increasing smoking cessation among light smokers and very heavy smokers. However, there is no statistically significant effects among average smokers. The probability of quitting after smoking bans among heavy smokers increases over time, while the probability of quitting among light smokers declined after two years following the bans. Moreover, smoking cessation persists over time for almost all smokers except for very light smokers that may quit initially after the bans and picked up the habit again later.

There is also heterogeneity in the effect depending on respondents' exposure and employment status. Those working in places with more comprehensive bans are less likely to continue smoking subsequent to workplace bans. Furthermore, legislations that include oversight at workplaces tend to be more effective at reducing smoking propensity among both the employed and non-employed, possibly due to stricter implementation and enforcement in those establishments. Nationwide workplace bans decreased smoking propensity for all smokers by approximately 6 percent ($p<0.01$), while reducing about an additional 10 percent ($p>0.10$) among smokers who were employed at the time. Furthermore, smoking cessation persists. Lower smoking propensity in both the short run and long run implies that most smokers who quitted did not relapse back to smoking again.

Comprehensiveness of smoking bans is a crucial factor that would affect smoking propensity. When examining the heterogeneity among industry and occupation, smoking propensity decreased the most in electricity, gas and water supply industry; agricultural, hunting, mining and quarrying, followed by public administration, education and health and social work. Industry with the most resistance to smoking bans is hotel and restaurants as smoking bans could affect their revenues, hence bans in hotels and restaurants are often laxer and offer exceptions. Consequently, workplace bans had little or no impact on workers in this industry. On the other

hand, educational establishments in most countries imposed strict smoking bans and we can see smaller propensity to smoke among education workers following workplace ban by almost 10 percent.

Exposure to bans, social pressure, and life expectation are other factors that influence smoking behavior. This study examines affected smoking behavior given varying time spent at work. The only group with noticeable reduction in smoking propensity are those working part time. On the other hand, those spend more than 60 hours a week at work or working under time pressure may even increase smoking. Smoking responses to bans are not found to vary by life expectancy. However, those living with a partner have less smoking propensity after the bans.

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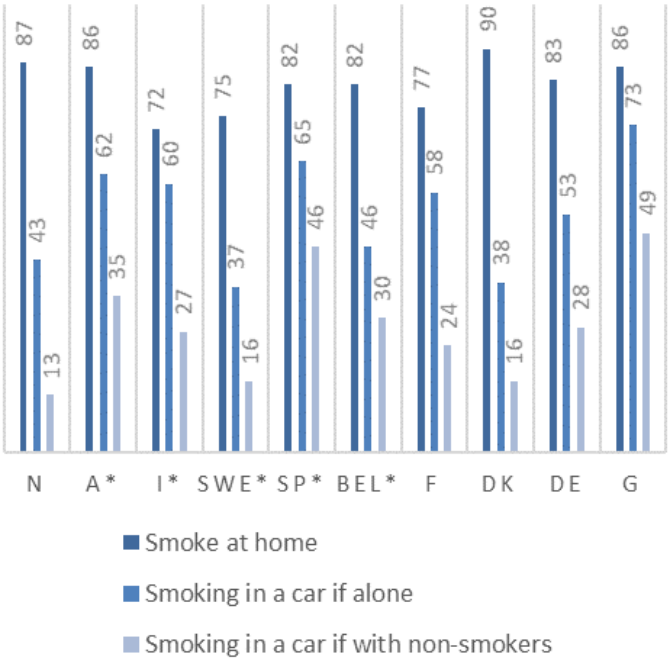
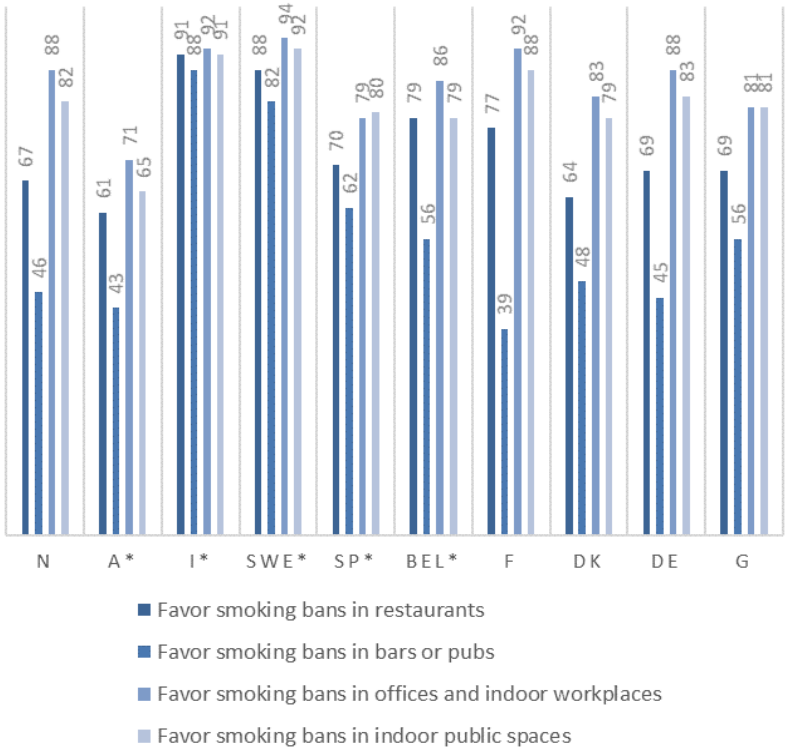
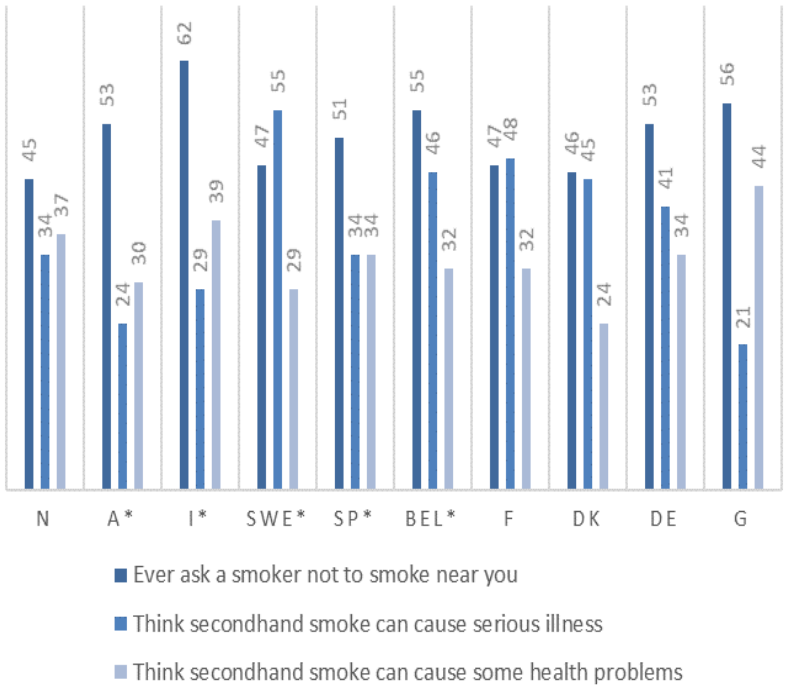
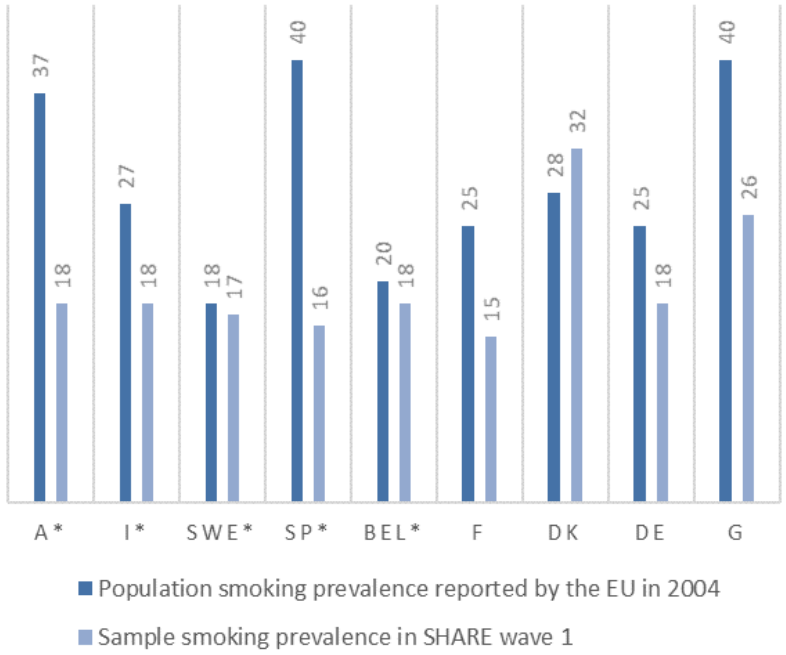
APPENDIX

Figure A1-A4: Smoking prevalence, attitudes and smoking behavior in SHARE countries in 2004.









*Countries ordered by the timeline of smoke-free legislation; corresponding Table (A-2) in appendix.

Table A-1: Smoke-free laws and exemptions by country

Country	Date of bans	Types of bans	Comments	Exceptions
Austria	2005	Public and private non-hospitality workplaces, as well as health care and educational facilities.		
_	2007	Public transport (train/station)		
	2009	Restaurants and bars	Larger establishments need only provide a non-smoking section.	Small cafes and eateries under 50 square metres (500 square feet)
Belgium	2006	Workplace		
	2007	Restaurants and bars		Restaurants serving light meals
	2008	Workplace, enclosed public spaces. restaurants, health care, edu, public transport, hotels, residential care	Total bans in education establishments and public transport.	
	2011	Bars and restaurants	Complete bans with no exceptions	
Denmark	2007	Workplaces and public places	Allowed smoking rooms in workplaces, restaurants and bars	No bans in health care facilities and hotels . Allow smoking in long-term care, psychiatric facilities, private offices and small bars.
France	February 2007	Schools, government buildings, airports, offices, and factories.		
	2008	Hospitality venues, restaurant, bar, cafe, casino.	allow for smoking rooms. total ban in healthcare, edu and public	

Country	Date of bans	Types of bans	Comments	Exceptions
Greece	September 2010	Offices, public transport, restaurants, bars and cafes.		
	March 2014	Bill under provision to extend to casinos, night clubs, live music venues.		
Italy	October 2005	Public indoor spaces, restaurants, bars, clubs and cafes	Allow smoking rooms and outdoor smoking in restaurants	
The Netherlands	2004	Public transport, non-hospitality workplaces.		
	2008	Shopping malls, gaming, convention centers, restaurants, bars, cafes, tents, nightclubs	allow for smoking room with no employees	
	2009	U-turn on smoking bans on small cafes and bars with no staff working		
	2014	Reinstated smoke-free laws in small restaurants, bars, and cafes except for enclosed areas with no service		
Spain	2006	Workplaces, public places, schools, hospitals, public transport	Not total ban in hotels, residential care, and prisons.	
	2011	Restaurants, bars and cafes		
Sweden	June 2005	Restaurants, bars, cafes, Nightclubs	Allow smoking rooms	
		Workplaces and public spaces	Allow designated smoking areas	

Table A-2: Smoking prevalence, and attitudes towards secondhand smoke and smoking bans by country

Country	N	A*	I*	SWE*	SP*	BEL*	F	DK	DE	G
Year of the first comprehensive smoking bans	2002	2005	2005	2005	2006	2006	2007	2007	2008	2010
Prices of the most popular cigarettes per pack in 2003 (in Euros)	3.04	3.00	2.07	4.11	1.95	3.36	5.00	4.03	3.37	2.50
Tobacco control scale in 2005 (0-100)	52	31	57	60	31	50	56	45	36	38
Smoking prevalence										
Smoke packed cigarette, EU	19	37	27	18	40	20	25	28	25	40
Smoke daily, SHARE	24	18	18	17	16	18	15	32	18	26
Attitudes towards secondhand smoke										
Ever ask a smoker not to smoke near you	45	53	62	47	51	55	47	46	53	56
Think second hand smke can cause serious illness	34	24	29	55	34	46	48	45	41	21
SHS can cause some health problem	37	30	39	29	34	32	32	24	34	44
Smoke at hom e	87	86	72	75	82	82	77	90	83	86
Smoke in car if alone	43	62	60	37	65	46	58	38	53	73
Smoke in car if with non-smoker	13	35	27	16	46	30	24	16	28	49
Favor smoking bans in restaurants	67	61	91	88	70	79	77	64	69	69
Favor smoking bans in bars or pubs	46	43	88	82	62	56	39	48	45	56
Favor smoking bans in offices and indoor workplaces	88	71	92	94	79	86	92	83	88	81
Favor smoking bans in indoor public spaces	82	65	91	92	80	79	88	79	83	81
Often bothered by exposure to tobacco smoke	39	49	54	23	46	45	38	32	33	43
Units are in percent (0 to 100) unless otherwise noted.										
* Countries that introduced smoking bans before SHARE wave 2.										

Source: Eurobarometer, 2003, Tobacco Control Scale in 2005 (Joossens and Raw, 2006)