Int J Public Health (2014) 59:859–866
DOI 10.1007/s00038-014-0585-3

SSPH+ SWISS SCHOOL OF PUBLIC HEALTH +

ORGINAL ARTICLE

Adoption and compliance in second-hand smoking bans: a global econometric analysis

Richard Perkins · Eric Neumayer

Received: 10 January 2014 / Revised: 29 June 2014 / Accepted: 1 July 2014 / Published online: 19 August 2014

Abstract
Objectives We examine the determinants governing both countries' enactment of smoking bans in public places and their ability to successfully put these bans into effect.
Methods Using a large sample ($N = 99$–184) of low-, middle- and high-income countries, econometric techniques are used to estimate the influence of several variables on cross-national variations in the adoption and compliance of second-hand smoke laws (2010).
Results We find similarities in the determinants of adoption and compliance. Yet more notable are the differences, with several political economy factors which have a statistically significant influence on countries' level of compliance with existing smoke-free laws in public places found not to consistently influence their propensity to adopt bans in the first place. Possible explanations for this discrepancy are that governments are motivated to adopt smoking bans for reasons other than protecting the health of their citizens and that the real costs of smoking bans are predominantly borne at the compliance stage.
Conclusions More effort needs to be made to ensure that governments realize their existing policy commitments through effective enforcement of bans.

Keywords Smoking · Second-hand smoke · Ban · Adoption · Compliance · Global

Introduction

A growing body of epidemiological work has implicated exposure to second-hand smoke in many of the same diseases associated with first-hand smoking (Laumbach and Kipen 2014). Responding to escalating concerns about these public health consequences, governments have introduced rules, regulations and laws banning smoking in various public places. The adoption of smoke-free legislation was given further impetus in 2003 with the advent of the World Health Organization's Framework Convention on Tobacco Control (FCTC) which, amongst others, compels signatories to enact comprehensive smoking bans. As of the end of 2012, 176 countries were party to the FCTC.

The existence of bans remains geographically uneven, both in terms of their stringency (i.e. whether there are partial restrictions, e.g. allowing smoking rooms, or completely smoke-free bans) and comprehensiveness (i.e. the number of public places covered), see Table 1 of the Electronic Supplementary Material. Nevertheless, judged by laws alone, efforts to restrict exposure to second-hand smoke have been a remarkable global success story. Smoking bans have been widely adopted in developed economies (Minardi et al. 2014). More surprising, however, is the large number of low- and middle-income countries which have introduced such bans (Christopoulou et al. 2013; Feldman and Bayer 2011; Usmanova and Mokdad 2013). In fact, in the only other previous study to use a globally representative sample ($N = 100$–117) to investigate the determinants of smoke-free laws, it was

Electronic supplementary material The online version of this article (doi:10.1007/s00038-014-0585-3) contains supplementary material, which is available to authorized users.

R. Perkins (✉) · E. Neumayer
Department of Geography and Environment, London School of Economics and Political Science, Houghton Street, London WC2A 2AE, UK
e-mail: r.m.perkins@lse.ac.uk

E. Neumayer
e-mail: e.neumayer@lse.ac.uk

found that less wealthy countries actually were more likely to have bans in place prior to the FCTC in the early 2000s (Gallet 2009).

Yet the promulgation of smoke-free policies does not by itself guarantee improvements in public health outcomes. What matters is not only adoption, but also, and more importantly, the degree of compliance (Lazuras et al. 2012). Crucially, the latter has varied widely, with expert assessments indicating that some countries have a much worse record of complying with their own bans than others. As can be inferred from Supplementary Table 1, these cross-national variations do not map onto variations in adoption, suggesting that the factors which drive countries to enact bans do not always lead them to achieve high levels of compliance.

There are a number of possible reasons for these discrepancies. One is that, despite a genuine value commitment to reducing smoking-related diseases, governments may lack the technical, financial and bureaucratic resources to effectively enforce bans (Drope 2010; Feldman and Bayer 2011). Likewise, purposeful enforcement efforts may be undermined by resistance from regulatory targets, including smokers themselves (Gonzalez and Glantz 2013). Alternatively, it could be that governments are motivated to adopt smoke-free laws for reasons other than protecting the health of their citizens, or at least additional to these concerns, namely in order to gain from an improved international reputation or to relieve themselves from internal or external pressures to take real action (Hathaway 2002; Simmons 2010). In the absence of effective monitoring and sanctioning, governments lacking strong instrumental motives may fail to enforce their own policy commitments, resulting in non-compliance.

Given that the administrative or legislative act of promulgating bans may be decoupled from the bureaucratic act of implementation, it is perhaps surprising that the existing quantitative literature concerned with understanding cross-national variations in smoke-free laws has largely ignored the issue of compliance. Instead, the central focus has been on adoption, and mostly of policies across various European states (Gallet and Catlin 2009; Studlar et al. 2011; Toshkov 2012). To our knowledge, none of these studies directly examines the degree of compliance with smoking bans, or how compliance is shaped by domestic characteristics. Addressing this gap, and novel to the literature, we explore the factors which influence countries' adoption of, and compliance with, smoking bans. Moreover, we use a sample which includes high-, middle- and low-income countries, thereby going beyond the predominant focus on adoption decisions by governments within high-income Europe.

Methods

Dependent variables

For the analysis regarding the determinants of adoption, the dependent variables capture the existence of absolute bans (i.e. 100 % smoke-free laws, as defined under Article 8 of the FCTC), in force as of December 2010. We examine two types of dependent variable constructed from WHO (2011) data. The first measures the existence of a smoking ban. Our main dependent variable of interest refers to a smoking ban in either restaurants or bars—using a dummy set to 1 for countries with a ban in these establishments and 0 for those without. The rationale for selecting restaurants and bars is that public opposition to bans has invariably been strongest in these establishments (Hersch et al. 2004; Toshkov 2012). Indeed, restaurants and bars have been amongst the last indoor public places subject to smoke-free laws in many jurisdictions, with only 28 countries in the sample having bans in place. These establishments therefore constitute a good measure of public resolve to tackle the health damage from second-hand smoke. However, we additionally analyze with separate dependent variables smoking bans in health-care facilities, educational facilities, indoor offices and public transport, respectively.

For the analysis into the determinants of compliance, the dependent variable is a measure taken from WHO (2011), referring again to the situation in 2010. The variable runs from 0 to 10 with 0 for minimally and 10 for fully enforced policies. In order to calculate the score, the WHO uses independent assessments by up to five experts regarding whether compliance with existing smoke-free legislation is "minimal", "moderate" or "high" (pg. 85) (WHO 2011). The experts are drawn from national health ministries, non-governmental organizations, health professionals, public health universities and WHO country offices. Importantly, with perhaps the exception of the first of these groups, the incentive for the respective experts to under- or over-state compliance is likely to be small.

Explanatory variables

We examine the influence of four political economy variables hypothesized to affect the adoption of, and compliance with, smoking bans. All data refer to 2010 or, where non-existent, the latest available year. The first is income per capita (p.c.). Assuming that health is a normal good, societal demand for smoke-free laws and their effective enforcement should increase with income, while higher income countries should also have more resources to enforce bans (Christopoulou et al. 2013; Gallet and Catlin 2009; Studlar et al. 2011). Data from the World

Bank (2012) are used on the natural log of income p.c. at purchasing power parity (PPP).

A second, more theoretically ambiguous, variable is smoking prevalence (Gallet and Catlin 2009). On the one hand, a higher number of smokers should increase the aggregate health benefits derived from bans, increasing the incentives for governments to adopt and enforce smoke-free laws (c.f. Clark 2013). On the other hand, more smokers means a larger constituency of consumers motivated to resist the introduction and enforcement of bans, together with greater resistance from tobacco-related industries. The measure comprises WHO (2011) estimates on current cigarette smoking prevalence among both sexes, which come from the most recent survey available. Smoking prevalence is potentially endogenous to the existence of smoking bans and their enforcement. In additional estimations, we therefore instrument for smoking prevalence with the share of population that is above 65 and the share of population that is aged between 15 and 64. These turn out to be sufficiently strong instruments passing standard partial F test values, are not subject to reverse causality, and there is no reason why they should have a direct influence on the dependent variables. In other words, they are plausibly exogenous.

Domestic economic dependence on tobacco-related industries could also affect smoking bans (Toshkov 2012). Producers are likely to actively lobby against restrictions and bans, while governments may be reluctant to introduce and enforce them owing to the associated economic consequences. Countries' economic dependence on such industries is measured using data from the UN's Food and Agriculture Organization (FAO 2013) on (unmanufactured) tobacco leaf production in thousand metric tons.

A fourth variable which might affect smoking bans are public health expenditures (Gallet 2009; Shipan and Volden 2006). Higher expenditures suggest a larger health lobby with interests in advancing anti-smoking laws (Studlar et al. 2011). The relative amount governments spend on healthcare (as opposed to other items) is also likely to proxy public support for public health interventions, including smoking cessation. In order to capture this potential determinant, we use data from World Bank (2012) on the ratio of health to all government expenditures.

For the compliance analysis, we additionally take into account the possibility that the degree of compliance might be a function of the comprehensiveness of smoking bans, as well as the length of time public officials and other relevant parties have had experience with such bans. To this end, a measure of the comprehensiveness of bans (proxied by the total number of bans in place across all facilities, as reported in WHO 2011) is included in these estimations, together with the number of years since a partial ban was instituted in five respective places: healthcare facilities; educational facilities (other than universities); government facilities; restaurants; and public transport. Evidence suggests that public support towards smoking bans increases over time following their enactment, resulting in more self-enforcement (Minardi et al. 2014). Data on year of adoption were assembled by the authors.

Estimation technique

For bans, we have dichotomous dependent variables, for which we use probit and instrumental variables probit (IV-probit). For compliance, the dependent variable is of the ordered categorical type, for which we use ordered logit. There is no instrumental variables ordered logit (or probit) estimator in Stata, the econometric software package used in our analysis, meaning that we use a linear two-stage least squares estimator. All estimations employ robust standard errors.

Data on smoking ban adoption and compliance are available for 194 and 106 countries, respectively. Our first set of estimations have a smaller sample size due to missing data for some countries for the per capita income, smoking prevalence and public health expenditures variables. In additional estimations, we employ standard multivariate normal regression imputation of missing values of these three variables, using the other variables in the model plus auxiliary variables (demographic variables as well as income group and regional location dummy variables) in the dataset as sources for the imputation. This allows us to run regressions for 184 and 99 countries, respectively.

Results

Table 1 shows the results for the determinants of adoption of smoking bans in restaurants or bars. Columns 1 and 2 report probit and IV-probit estimates based on samples of actually available data, whereas columns 3 and 4 report probit and IV-probit estimates based on 100 imputed samples in which missing values of three explanatory variables have been imputed, as described above. The coefficients represent average marginal effects on the probability of a smoking ban with 95 % confidence intervals sideways next to them in parentheses.

With the exception of per capita income, which has the expected positive effect, the estimated coefficients of all other variables are statistically indistinguishable from zero. Substantively, a one unit increase in the log of per capita income, which represents a 2.7 fold increase in per capita income, is estimated to increase the probability of a ban by between 0.06 and 0.08. An interquartile range (IQR) move

in the log of per capita income would increase the probability of a ban by between 0.12 and 0.17.

Table 2 shows estimation results for the adoption of smoking bans in other facilities. We restrict Table 2 to IV-probit estimations based on imputed samples. Estimations based on probit and on samples with actual data for three of the explanatory variables produce very similar results. None of the explanatory variables have any statistically significant effect on the probability of adopting smoking bans in indoor offices, health-care facilities, education facilities, and public transport.

Turning to the determinants of compliance, Table 3 provides results for the full sample, and Table 4 for a sample of non-OECD countries only. Columns 1 and 3 show ordered logit estimations and columns 2 and 4 two-stage least squares estimations. Columns 1 and 2 are based on samples with actual data whereas columns 3 and 4 are derived from the imputed samples. In column 1, as with the adoption estimations for restaurants and bars, the coefficient for GDP p.c. is significantly positive, indicating that wealthier countries have a better record of complying with smoking bans. Higher levels of tobacco production and higher smoking prevalence are associated with lower levels of compliance, whereas higher health to overall government expenditures predicts better compliance. Finally, neither the time period since partial restrictions have been adopted nor the total number of bans exerts a statistically significant impact on compliance. Ordered logit coefficients have no intuitive substantive meaning, but one can estimate the substantive effect of a one standard deviation (SD) increase in explanatory variables on the odds that a country has a higher compliance score. A one SD increase in per capita income raises the odds of higher compliance by 146 %, whereas the equivalent increase in odds for a one SD increase in governmental expenditures on health is 74 %. The odds of lower compliance are increased by 76 and 38 %, respectively, following a one SD increase in smoking prevalence and tobacco production.

Results are qualitatively similar in the two-stage least squares estimations based on actual data reported in column 2, with one exception. Smoking prevalence no longer has a statistically significant effect. This could either be because once reverse causality is taken into account there is no effect or because the higher variance that comes inevitably with instrumental variable regression renders the estimation inefficient (note the higher confidence interval around the coefficient in column 2 compared to column 1).

Basing the estimations on samples in which data for explanatory variables have been imputed does not change the overall picture. Results from columns 3 and 4 mirror those from columns 1 and 2, respectively. The one exception is that the negative effect of tobacco production on smoking ban compliance becomes very marginally insignificant in column 4.

Repeating the estimations from Table 3 for a sample that only contains non-OECD countries produces very similar results (see Table 4). The only difference is that, in column 1, only per capita income has a statistically significant effect at $P < 0.05$. Coefficients for tobacco production and governmental health expenditures would only be considered statistically significant at $P < 0.1$.

Discussion

There are similarities in the determinants governing countries' adoption of, and compliance with, smoking bans in public places. Richer countries—as measured by GDP p.c.—are both more likely to have smoke-free policies in restaurants and bars and have a better general record of compliance with smoke-free policies. Yet our findings also reveal several differences in the factors influencing adoption and compliance. A possible explanation for these discrepancies is the (potentially) uneven costs, as well as the different motives, for adoption and compliance. The real costs of smoking bans are largely borne when

Table 1 Results on adoption of smoking bans in restaurants or bars

Variables	(1) Coefficient (95 % CI)	(2) Coefficient (95 % CI)	(3) Coefficient (95 % CI)	(4) Coefficient (95 % CI)
Per capita income	0.08* (0.02 to 0.14)	0.08* (0.02 to 0.15)	0.06* (0.01 to 0.10)	0.08** (0.03 to 0.13)
Smoking prevalence	−0.00 (−0.01 to 0.01)	−0.00 (−0.02 to 0.01)	0.00 (−0.01 to 0.01)	−0.01 (−0.02 to 0.00)
Tobacco production	−0.33 (−0.94 to 0.28)	−0.32 (−0.93 to 0.29)	−0.35 (−1.05 to 0.34)	−0.28 (−0.92 to 0.36)
Health to all gov. expend.	0.00 (−0.02 to 0.02)	0.00 (−0.02 to 0.02)	0.01 (−0.01 to 0.02)	0.01 (−0.00 to 0.03)
Missing data for explanatory variables imputed?	No	No	Yes	Yes
Estimation technique	Probit	IV-probit	Probit	IV-probit
Observations	131	131	184	184

Coefficients report average marginal effects on probability of ban with 95 % confidence interval next to them. Coefficient of constant not reported. First-stage results of IV-probit estimations not reported. ** $P < 0.01$, * $P < 0.05$

Table 2 Results on adoption of smoking bans in other facilities

Variables	(1) Health Coefficient (95 % CI)	(2) Education Coefficient (95 % CI)	(3) Government Coefficient (95 % CI)	(4) Offices Coefficient (95 % CI)	(5) Transport Coefficient (95 % CI)
Per capita income	−0.00 (−0.01 to 0.02)	0.03 (−0.04 to 0.11)	0.06 (−0.00 to 0.12)	0.03 (−0.03 to 0.08)	0.00 (−0.07 to 0.08)
Smoking prevalence	0.00 (−0.03 to 0.01)	0.01 (−0.01 to 0.02)	−0.01 (−0.02 to 0.00)	−0.01 (−0.02 to 0.00)	−0.00 (−0.02 to 0.01)
Tobacco production	−0.45 (−1.16 to 0.27)	−0.39 (−1.02 to 0.24)	−0.06 (−0.28 to 0.15)	−0.05 (−0.26 to 0.16)	0.79 (−0.04 to 1.62)
Health to all gov. expend.	−0.01 (−0.03 to 0.01)	−0.01 (−0.02 to 0.01)	0.01 (−0.01 to 0.03)	0.00 (−0.01 to 0.02)	0.01 (−0.01 to 0.03)
Missing data for explanatory variables imputed?	Yes	Yes	Yes	Yes	Yes
Estimation technique	IV-probit	IV-probit	IV-probit	IV-probit	IV-probit
Observations	184	184	184	184	184

Coefficients report average marginal effects on probability of ban with 95 % confidence interval next to them. Coefficient of constant not reported. First-stage results of IV-probit estimations not reported

Table 3 Results on smoking ban compliance (full sample)

Variables	(1) Coefficient (95 % CI)	(2) Coefficient (95 % CI)	(3) Coefficient (95 % CI)	(4) Coefficient (95 % CI)
Per capita income	0.74** (0.33 to 1.15)	0.84** (0.33 to 1.35)	0.68** (0.31 to 1.04)	0.87** (0.37 to 1.37)
Smoking prevalence	−0.05* (−0.10 to −0.00)	−0.02 (−0.10 to 0.06)	−0.04 (−0.08 to 0.01)	−0.03 (−0.11 to 0.05)
Tobacco production	−0.96* (−1.76 to −0.16)	−1.01* (−1.86 to −0.15)	−0.75* (−1.45 to −0.05)	−0.86 (−1.73 to 0.01)
Health to all gov. expend.	0.14* (0.01 to 0.26)	0.15* (0.03 to 0.28)	0.12* (0.03 to 0.21)	0.14** (0.04 to 0.25)
Total number of strict bans	0.07 (−0.15 to 0.28)	0.08 (−0.12 to 0.29)	0.10 (−0.07 to 0.27)	0.14 (−0.05 to 0.32)
Years of partial ban: restaurants	0.09 (−0.01 to 0.19)	0.08 (−0.00 to 0.17)	0.08* (0.01 to 0.16)	0.09* (0.01 to 0.17)
Years of partial ban: government facilities	0.01 (−0.04 to 0.06)	0.01 (−0.05 to 0.06)	−0.00 (−0.06 to 0.05)	−0.01 (−0.08 to 0.05)
Years of partial ban: schools	0.01 (−0.09 to 0.11)	−0.01 (−0.11 to 0.09)	0.01 (−0.07 to 0.09)	0.01 (−0.08 to 0.10)
Years of partial ban: hospitals	0.01 (−0.08 to 0.10)	0.01 (−0.08 to 0.09)	0.01 (−0.06 to 0.08)	0.01 (−0.07 to 0.08)
Years of partial ban: public transport	−0.02 (−0.07 to 0.02)	−0.02 (−0.07 to 0.04)	−0.02 (−0.07 to 0.03)	−0.02 (−0.08 to 0.04)
Missing data for explanatory variables imputed?	No	No	Yes	Yes
Estimation technique	Ordered logit	2-stage least squares	Ordered logit	2-stage least squares
Observations	77	77	99	99

Coefficients of ordered logit and 2-stage least squares regression with 95 % confidence interval next to them. Coefficient of constant not reported. First-stage results of 2-stage least squares estimations not reported. ** $P < 0.01$, * $P < 0.05$

Table 4 Results on smoking ban compliance (sample of non-OECD countries)

Variables	(1) Coefficient (95 % CI)	(2) Coefficient (95 % CI)	(3) Coefficient (95 % CI)	(4) Coefficient (95 % CI)
Per capita income	0.62** (0.21 to 1.03)	0.75** (0.19 to 1.32)	0.57** (0.19 to 0.94)	0.76** (0.24 to 1.29)
Smoking prevalence	−0.04 (−0.10 to 0.02)	0.00 (−0.08 to 0.09)	−0.03 (−0.08 to 0.02)	−0.01 (−0.10 to 0.08)
Tobacco production	−1.13 (−2.38 to 0.12)	−1.12* (−2.18 to −0.05)	−0.80* (−1.60 to −0.00)	−0.94 (−1.92 to 0.04)
Health to all gov. expend.	0.12 (−0.01 to 0.24)	0.14* (0.00 to 0.27)	0.11* (0.01 to 0.21)	0.13* (0.01 to 0.25)
Total number of strict bans	0.02 (−0.25 to 0.30)	0.06 (−0.20 to 0.33)	0.10 (−0.09 to 0.29)	0.14 (−0.08 to 0.36)
Years of partial ban: restaurants	0.11 (−0.06 to 0.27)	0.08 (−0.06 to 0.23)	0.09 (−0.01 to 0.20)	0.10 (−0.01 to 0.22)
Years of partial ban: government facilities	0.01 (−0.05 to 0.06)	0.00 (−0.06 to 0.06)	−0.02 (−0.08 to 0.05)	−0.02 (−0.10 to 0.05)
Years of partial ban: schools	−0.03 (−0.15 to 0.10)	−0.05 (−0.17 to 0.07)	−0.01 (−0.10 to 0.08)	−0.01 (−0.11 to 0.09)
Years of partial ban: hospitals	0.08 (−0.03 to 0.19)	0.09 (−0.02 to 0.20)	0.06 (−0.02 to 0.14)	0.07 (−0.02 to 0.16)
Years of partial ban: public transport	−0.04 (−0.13 to 0.06)	−0.02 (−0.11 to 0.07)	−0.03 (−0.11 to 0.05)	−0.03 (−0.12 to 0.05)
Missing data for explanatory variables imputed?	No	No	Yes	Yes
Estimation technique	Ordered logit	2-stage least squares	Ordered logit	2-stage least squares
Observations	62	62	83	83

Coefficients of ordered logit and 2-stage least squares regression with 95 % confidence interval next to them. Coefficient of constant not reported. First-stage results of 2-stage least squares estimations not reported. ** $P < 0.01$, * $P < 0.05$

governments purposely set out to achieve high levels of compliance, in that doing so requires substantial bureaucratic, technical and legal resources, and carries with it political costs arising from opposition to practical measures to penalize individuals for smoking in public places (Gonzalez and Glantz 2013). Conversely, the adoption of smoking bans, which involves little more than the legal or administrative action of promulgating laws, regulations or directives, is in itself comparatively costless. Furthermore, whereas efforts to ensure high levels of compliance are likely to be predominantly driven by domestic demands to improve public health outcomes, governments may adopt smoking bans for no reason other than to symbolically demonstrate their in-principle commitment to smoking cessation.

These differences could explain why, with the exception of restaurants and bars, GDP p.c. is not a statistically significant predictor of smoke-free policies in public places but is a statistically significant positive predictor of compliance. Whereas high- and low-income countries should both be readily able to promulgate smoking bans on paper, the ability of governments to effectively implement them in practice is likely to be greater in higher income countries because of superior enforcement capacity. Moreover, whilst demand for smoke-free environments should be larger in higher income countries, lower income countries may paradoxically be equally inclined to adopt bans because doing so provides an opportunity to improve their international standing on health-related matters without having to make a significant financial outlay. The result that GDP does seem to matter for restaurants and bars might be explained by heightened popular opposition to smoking laws in these establishments (Gonzalez and Glantz 2013; Hersch et al. 2004). In particular, governments (including those who might adopt for symbolic reasons) may be more reluctant to issue bans in restaurants and bars unless there is significant societal demand for smoking cessation, which should logically be stronger in countries with higher levels of income.

The idea that the true costs of smoking bans—including political costs—arise at the enforcement stage is also consistent with two further discrepancies: that compliance is worse in countries with more smokers and higher tobacco leaf production, whereas these factors make no difference to the propensity of governments to adopt bans in the first place. Interestingly, the statistically insignificant results for smoking prevalence and tobacco production challenge standard accounts which suggest that domestic smoker and tobacco lobbies create disincentives for governments to adopt smoking bans (Studlar et al. 2011; Cohen et al. 2002; Lee et al. 2012). Of course, our findings say nothing about the strength of these lobbies, but do seem to indicate that they only have a material impact on

outcomes when it comes to compliance. A further practical reason as to why smoking prevalence may matter at the compliance stage is that a higher number of smokers also make it more difficult to police non-compliance.

The result that health expenditures matter for compliance but not adoption also calls into question the different motives surrounding anti-smoking measures. Logically, one might expect countries with a larger domestic public health bureaucracy to be more likely to institute bans, not least because of greater interests in public health promotion. Yet the influence of these interests is seemingly only manifest at the compliance stage, possibly because a stronger health lobby is instrumental in monitoring and promoting effective enforcement.

There are a number of limitations of our study. One is that, because compliance scores are not available for all countries, the sample for the compliance stage is smaller than the one for the adoption stage. However, if we restrict to the sample of compliance availability (with or without imputing), the results for the adoption stage are the same. The only exception is that GDP p.c. becomes statistically significant in education facilities.

Another possible limitation of our study concerns data on the adoption of, and compliance with, smoking bans. Starting with the former, it is worth noting that the WHO takes a strict approach to coding absolute bans, consistent with the specific requirements of Article 8 of the FCTC. One consequence is that public places in several countries where smoking is, to all intents and purposes, prohibited are not recorded by the WHO as having smoke-free environments. A case in point is Italy which adopted a comprehensive smoke-free ban in 2005—albeit one which permitted smoking in completely enclosed smoking rooms with special ventilation systems. Whilst the WHO does not record a single public place in Italy as smoke-free, the technical requirements for smoking rooms are extremely difficult and costly to comply with in practice (Minardi et al. 2014), meaning that smoking is effectively not possible in all but a small number of premises. Yet, to the extent that the WHO data are concerned with de jure rather than de facto smoke-free environments, they provide a good measure of governments' commitment to banning smoking in public places outright.

A more important issue concerns the validity of the WHO's subjective expert assessments and whether they accurately capture the underlying reality of compliance. We know of no other alternative measures of smoking ban compliance against which one could cross-validate the WHO data. Evidence from qualitative country studies are broadly consistent with the WHO data (Lazuras et al. 2012; Liu et al. 2014; Ma et al. 2010; Radwan et al. 2012; Reichmann and Sommersguter-Reichmann 2012; Scoggins et al. 2009; Tripathy et al. 2013; Yong et al. 2010). Still, whilst lending credence to the WHO compliance measure, such piecemeal qualitative evidence is by itself unsatisfactory as a systematic test of validity. We therefore additionally analyzed how highly the smoking ban compliance data correlate with two general assessments of compliance with laws and regulations: (1) the International Country Risk Guide (PRS Group 2013) which provides a measure of foreign investors' perception of "law and order" in a country, relating to an assessment of the strength and impartiality of the legal system and an assessment of popular observance of the law; and (2) Kaufmann et al.'s (2010) "rule of law" measure which, produced by aggregating a large number of individual variables, seeks to capture, 'perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence' (pg. 4).

The WHO smoking ban compliance measure correlates at 0.35 ($N = 83$) with the "law and order" measure and at 0.51 ($N = 103$) with the "rule of law" measure. This is no conclusive proof of validity, not least because these widely-used measures are also exclusively perception-based, and furthermore aim to capture aspects of the quality of domestic legal systems which are far broader than compliance with smoking bans. Yet the fact that the WHO compliance score is correlated with two measures which also seek to capture observance with public laws, rules and regulations suggests it has some validity.

The question then is whether the inevitable measurement error in the compliance measure is likely to be random or systematic. If measurement error is random, this would increase standard errors, making it more difficult to find statistically significant results. We see no reason in general why measurement error should be systematic, though it could be that in poorer countries it is more difficult to measure the degree of compliance, e.g. because of the lower availability of trained health professionals, competent non-governmental organizations, etc. For compliance as our dependent variable, we therefore additionally ran separate regressions on a sample of non-OECD countries, which produced consistent results.

Conclusions

Our key contribution in the present paper is to provide new evidence on the determinants of countries' adoption of, and compliance with, smoking bans across a large sample of countries. We find some similarities in the determinants of smoking bans. Yet more notable are the differences, with several political economy factors which have a statistically significant influence on countries' level of compliance with existing smoke-free laws in public places found not to

consistently influence their propensity to adopt bans in the first place. An obvious lesson is that public health analysts should be careful in reading too much from the act of adoption alone. Beyond this, the empirical findings suggest that efforts to address the public health challenge of second-hand smoke should not only focus on encouraging countries to adopt bans in public places, but also ensuring compliance with these bans. It is at this latter stage that income is a constraining factor and pressure from smoker and tobacco lobbies would appear to be influential. Indeed, from the perspective of protecting public health, there is a case for holding governments more accountable to the very anti-smoking policies that they have adopted and to do more to publicize their record of compliance.

References

Christopoulou R, Lillard DR, de la Miyar JRB (2013) Smoking behavior of Mexicans: patterns by birth-cohort, gender, and education. Int J Public Health 58(2):285–293

Clark B (2013) Multilateral, regional, and national determinants of policy adoption: the case of HIV/AIDS legislative action. Int J Public Health 58(2):285–293

Cohen JE, de Guia NA, Ashley MJ, Ferrence R, Northrup DA, Studlar DT (2002) Predictors of Canadian legislators' support for tobacco control policies. Soc Sci Med 55(6):1069–1076

Drope JM (2010) The politics of smoke-free policies in developing countries: lessons from Africa. CVD Prev Control 5(3):65–73

FAO (2013) FAOSTAT CD ROM. Food and Agriculture Organization of the United Nations, Rome

Feldman EA, Bayer R (2011) The triumph and tragedy of tobacco control: a tale of nine nations. Annu Rev Law Soc Sci 7:79–100

Gallet CA (2009) Snuff the puff: international evidence on the determinants of anti-smoking laws. Appl Econ Lett 16(14):1449–1453

Gallet CA, Catlin JR (2009) The determinants of tobacco control in Europe: a research note. Soc Sci J 46(1):143–149

Gonzalez M, Glantz SA (2013) Failure of policy regarding smoke-free bars in the Netherlands. Eur J Public Health 23(1):139–145

Hathaway OA (2002) Do human rights treaties make a difference? Yale Law J 111(8):1935–2042

Hersch J, Rossi AFD, Viscusi WK (2004) Voter preferences and state regulation of smoking. Econ Inq 42(3):455–468

Kaufmann D, Kraay A, Mastruzzi M (2010) The worldwide governance indicators: methodology and analytical issues. World Bank Policy Research Working Paper No 5430

Laumbach R, Kipen H (2014) Mechanistic data support protecting non-smokers from the lethal effects of second-hand smoke. Int J Public Health. doi:10.1007/s00038-014-0550-1

Lazuras L, Zlatev M, Rodafinos A, Eiser JR (2012) Smokers' compliance with smoke-free policies, and non-smokers' assertiveness for smoke-free air in the workplace: a study from the Balkans. Int J Public Health 57(5):769–775

Lee S, Ling P, Glantz S (2012) The vector of the tobacco epidemic: tobacco industry practices in low and middle-income countries. Cancer Causes Control 23(1):117–129

Liu R, Jiang Y, Travers MJ, Li Q, Hammond SK (2014) Evaluating the efficacy of different smoking policies in restaurants and bars in Beijing, China: a four-year follow-up study. Int J Hyg Environ Health 217(1):1–10

Ma J et al (2010) Workplace smoking restrictions in China: results from a six country survey. Tob Control 19:403–409

Minardi V et al (2014) Compliance with the smoking ban in Italy 8 years after its application. Int J Public Health 59(3):549–554

PRS Group (2013) International Country Risk Guide (ICRG), Database. The PRG Group, Montana

Radwan GN, Loffredo CA, Aziz R, Abdel-Aziz N, Labib N (2012) Implementation, barriers and challenges of smoke-free policies in hospitals in Egypt. BMC Res Notes 5:568

Reichmann G, Sommersguter-Reichmann M (2012) The Austrian tobacco act in practice—analysing the effectiveness of partial smoking bans in Austrian restaurants and bars. Health Policy 104(4):304–311

Scoggins A, de Vries H, Conklin A, Hatziandreu E (2009) Analysis to support the impact assessment of the commission's smoke-free initiatives. Technical report. RAND Corporation

Shipan CR, Volden C (2006) Bottom-up federalism: the diffusion of antismoking policies from U.S. cities to states. Am J Polit Sci 50(4):825–843

Simmons B (2010) Treaty compliance and violation. Annu Rev Polit Sci 13(1):273–296

Studlar DT, Christensen K, Sitasari A (2011) Tobacco control in the EU-15: the role of member states and the European Union. J Eur Public Policy 18(5):728–745

Toshkov D (2012) Policy-making beyond political ideology: the adoption of smoking bans in Europe. Public Adm 91(2):448–468

Tripathy JP, Goel S, Patro BK (2013) Compliance monitoring of prohibition of smoking (under section-4 of COTPA) at a tertiary health-care institution in a smoke-free city of India. Lung India 30(4):312–315

Usmanova G, Mokdad A (2013) Results of the Global Youth Tobacco Survey and implementation of WHO Framework Convention on Tobacco Control in former Soviet Union countries. Int J Public Health 58(2):217–226

WHO (2011) WHO report on the global tobacco epidemic, 2011: warning about the dangers of tobacco. World Health Organization, Geneva

World Bank (2012) World Development Indicators. Database, IBRD

Yong HH et al (2010) Support for and reported compliance among smokers with smoke-free policies in air-conditioned hospitality venues in Malaysia and Thailand: findings from the international tobacco control Southeast Asia survey. Asia Pac J Health 22(1):98–109