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The impact of public smoking bans on well-being externalities: Evidence from a natural experiment

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The impact of public smoking bans on well-being externalities:

Evidence from a natural experiment

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Abstract

Recent studies on the effects of anti-smoking policies on subjective well-being present mixed results and focus mainly on smokers. We contribute to the literature by exploiting the policy experiment provided by the UK public smoking bans and evaluating the impact of smoking bans on the subjective well-being of smokers, non-smokers and couples of different types of smokers. We employ matching techniques combined with flexible difference-in-differences fixed effects panel data models on data from the British Household Panel Survey. We find that the UK public smoking bans appear to have a statistically significant short-term positive impact on the well-being of married individuals, especially among couples with dependent children. These effects appear to be substantial in size, robust to alternative specifications and may be driven by positive externalities due to parental altruism.

JEL: C21; C23; I10; I18

Key words: subjective well-being; smoking bans; policy evaluation; BHPS

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1. INTRODUCTION

Smoking is still the leading cause of avoidable mortality and morbidity in all developed countries and a growing public health concern among developing countries. According to the WHO Report on the Global Tobacco Epidemic (2013), smoking is directly linked to 6 million deaths every year worldwide. The 32rd Surgeon General's Report on Smoking and Health (US Department of Health and Human Services, 2014) finds that smoking increases the risk of cancer (e.g. lung cancer, liver cancer and colorectal cancer), respiratory infections (e.g. chronic obstructive pulmonary disease (COPD) and tuberculosis) and cardiovascular diseases. The 32rd Surgeon General's Report on Smoking and Health (US Department of Health and Human Services, 2014) finds that women's risk of dying from smoking have tripled during the last 50 years and is now equal to men's risk; tobacco smoke causes 8 out of 10 cases of chronic obstructive pulmonary disease (COPD); and that maternal smoking and exposure to second-hand smoke reduces fertility and is linked to pregnancy complications, low birth weight and sudden infant death syndrome (SIDS).

During the last two decades, tobacco-control policies such as smoking bans and increases in excise taxes have been implemented with the aim of reducing the effects of both second-hand smoke (SHS) and cigarette consumption. A large body of empirical research has analysed the impact of anti-tobacco policies. These studies mainly focus on the effects of tobacco-control interventions on passive smoking (e.g. Farrelly et al., 2005; Pearson et al., 2009), specific health conditions such as pulmonary disease (e.g. Menzies et al., 2006; Goodman et al., 2007) and myocardial infarction (e.g. Sargent et al., 2004; Seo and Torabi, 2007) and more recently on active smoking (cigarette consumption) (e.g. Anger et al., 2011; Jones et al., 2015).[1] Overall, these suggest that smoking bans appear to reduce exposure to SHS and improve the health status of those affected by the bans, especially in relation to acute myocardial infarction. However,

[1] For a comprehensive review of studies on the effects of partial and total smoking bans on second-hand smoke (in both public and private places such as cars and private homes), tobacco consumption and a number of health conditions, see Callinan et al. (2010).

their effects on tobacco consumption appear to be limited to specific population sub-groups such as individuals who often go to bars and restaurants or heavy smokers. Whereas these papers focus on the direct consequences of anti-smoking policies on smoking behaviour and physical health, they do not appear to account for the presence of potential externalities on important measures of individual welfare such as subjective well-being (SWB).[2]

SWB and its measurement are now central to public policy as a number of governments worldwide are increasingly concerned with the use of well-being measures to inform and appraise policy interventions (Dolan and Metcalfe, 2012). Expected potential gains and losses of SWB could be employed as an additional tool to rank policy options across different domains or to aid the allocation of resources towards policies with the largest expected improvements in SWB relative to their costs (Dolan and White, 2007; Dolan and Metcalfe, 2008).

An emerging stream of research has started examining the impact of smoking bans on individual well-being. Brodeur (2013) employs US data and finds that only smokers who do not quit smoking after the introduction of smoking bans appear to present higher levels of SWB. Odermatt and Stutzer (2013) also suggest that smokers who have recently failed to quit smoking, report higher levels of SWB after the implementation of smoking bans (and this finding appears to be consistent with cue-triggered models of addiction and the idea of bans as self-control devices). Hinks and Katsaros (2010) employ UK data and find that smokers who reduce their intake of cigarettes after the ban report significantly lower levels of life satisfaction if compared to individuals who did not reduce their amount of tobacco intake (and smoked the same - pre-ban - amount

[2] A related strand of research has focused on the potential unintended consequences of anti-smoking interventions. Adams and Cotti (2008) find that in the U.S. local and state public smoking bans may increase the risk of fatal car accidents due to drunk driving by leading smokers to drive longer distances to reach bars in neighbouring jurisdictions allowing them to smoke. Using biomarkers (cotinine) for tobacco intake, Adda and Cornaglia (2010) show that by displacing smokers from public to private places, public smoking bans may increase the exposure to passive smoking of young children living with smokers. A subsequent study of Carpenter et al. (2011) employing self-reported data on smoking, however, find limited evidence of smoking bans causing displacement from public to private places.

of cigarettes). Leicester and Levell (2013) also exploit UK data and find that while tobacco excise taxes increase smokers' well-being, the impact of smoking bans appear to be weaker. Overall, these papers appear to focus mainly on the effects of anti-smoking interventions on the well-being of smokers and present mixed results. Furthermore, most of these studies do not appear to fully exploit the longitudinal nature of their data and to explicitly account for the presence of individual-level unobserved heterogeneity.

The main objective of this paper is to evaluate the potential well-being externalities of public smoking bans. We employ UK longitudinal data from the British Household Panel Survey (BHPS) and exploit the policy experiment provided by the differential *timing* of the introduction of public smoking bans in Scotland and England. We *combine* matching techniques with a series of flexible difference-in-differences fixed effects panel data models to estimate the impact of public smoking bans on the subjective well-being of smokers, non-smokers and couples of different types of smokers. We find that the UK public smoking bans appear to have a positive short-term effect on the well-being of individuals in couples, especially among couples with dependent children. Differently from the findings of the previous literature, the size of these effects appears to be substantial and robust to alternative specifications and placebo tests. Our findings appear to suggest that public smoking bans may produce short-term positive externalities by increasing the subjective well-being of partners of smokers with dependent children. We interpret and discuss these results also in the light of parental altruism.

This paper provides several contributions to the literature. First, we extend previous analyses on the impact of smoking bans on the subjective well-being of smokers by focusing on the potential well-being externalities among non-smokers and couples. Secondly, we quantify the effects of the bans on subjective well-being by systematically comparing variations in well-being due to the introduction of these policies with the ones driven by other important events such as unemployment,

marriage and widowhood identified by previous studies. This should help establishing the relative size of the impact of smoking bans on well-being. Finally, this paper combines matching methods with panel data difference-in-differences models to build more comparable treatment and control groups, produce less model-dependent results and account for individual-level time-invariant unobservables.

2. DATA

2.1 THE BRITISH HOUSEHOLD PANEL SURVEY

We draw individual-level information on smoking consumption and subjective well-being before and after the introduction of the UK public smoking bans from the British Household Panel Survey (BHPS) (1991–2009). Two identical comprehensive public smoking bans were introduced on 26 March 2006 in Scotland and on 1 July in England. These were the first binding laws (i.e. before these bans no fines could be levied for smoking in public places) in the UK to forbid smoking in *all enclosed public places* such as pubs and restaurants and were enforced immediately after their introduction. In our data, the ban in Scotland was introduced between waves 15 and 16 of the BHPS while the one in England between waves 16 and 17. We exploit the exogenous variation provided by the differential timing of the introduction of these policies in the BHPS to identify the impact of public smoking bans on subjective well-being.

The BHPS is a UK nationally representative panel survey that includes a wide range of variables on demographic and household characteristics, income, job status, health, subjective well-being and smoking behaviour. Wave 1 sample (1991) includes 5,500 households and 10,264 individuals from England, Wales and Scotland at the south of the Caledonian Canal. In wave 9, additional samples of 1,500 households from each of Scotland and Wales were added to the main sample while in wave 11 a sample of sample of 2000 households from Northern Ireland was also added (Buck et al., 2006). Household members are followed through time and interviewed annually together with

individuals that enter the sample as they move into the household after the start of survey. In this paper, we restrict the sample to adult members (aged 18 years or above) from England and Scotland.[3]

2.2 Measures of subjective well-being

We employ the 12-item version of the General Health Questionnaire (GHQ) to define individual SWB (Goldberg and Williams, 1988). The GHQ is a psychometrically-validated and well-established measure of SWB that is often used in the economics literature (e.g. Clark and Oswald, 1994; Clark, 2003; Shields and Price, 2005; Gardner and Oswald, 2006; Gardner and Oswald, 2007; Dolan et al., 2008; Andersen, 2009; Binder and Coad, 2011). More specifically, the GHQ is a summary measure of psychological distress based on 12 questions concerning both positive and negative recent emotional experiences (Gardner and Oswald, 2007). The 12-item version includes questions on: concentration; loss of sleep; playing a useful role; being capable of making decisions; being constantly under strain; having problems overcoming difficulties; enjoying day-to-day activities; ability to face problems, unhappiness/depression; losing confidence; believing in self-worth; and general happiness. For each item/question, respondents are asked to choose between four answers ranging from 1 to 4, with higher scores reflecting lower levels of well-being.[4] In this study, we use the GHQ measured on the Likert scale with values ranging from 0 to 36 (computed by taking the sum of the responses to the 12 questions and assigning values of 0 to the ones corresponding to the highest levels of well-being and 3 to the ones corresponding to lowest levels of well-being). The resulting measure is a

[3] More specifically, in this paper we present results based on a sample of adult individuals from England and Scotland from wave 9 (1999) onwards. This is to exploit the additional sample of Scottish households included in wave 9. However, results based on the full set of waves appear to be similar and are available upon request.

[4] Higher scores of the GHQ reflect lower levels of SWB. An example of the GHQ question is as follows: "Have you recently been able to concentrate on whatever you're doing?" followed by the answers "Better than usual (1)", "same as usual (2)", "less than usual (3)" and "much less than usual (4)".

summary index of well-being that is increasing in psychological distress: higher GHQ values correspond to lower levels of well-being.

2.3 COVARIATES AND DESCRIPTIVE STATISTICS

The BHPS contains rich information on demographic and socioeconomic individual-level characteristics that we include in our panel data models. Our models control for age (age and age squared); employment status (self-employed, unemployed; retired; being in maternity leave or family care; student; long-term sick/disability status; government training or in other jobs; all contrasted against being employed as an employee); marital status (by estimating separate models for individuals married or in a couple vs single/divorced/widowed); health status (self-assessed health status, presence of chest or breathing problems and heart related problems), and household related variables including household size and the number of dependent children living within the household (if present).

In the BHPS, information on smoking prevalence and intensity is based on the questions "Do you smoke cigarettes?" and "Approximately how many cigarettes a day do you usually smoke?", respectively. For the purpose of our analysis, we define two types of individuals: potential smokers and never smokers. Potential smokers are individuals who report being a smoker at least once during the survey period (i.e. individuals who answered "yes" to the question on smoking prevalence at least once). Never smokers are defined as individuals who always reported being non-smokers throughout the 18 waves. Our definition of potential smokers allows us to go beyond current smoking status that might be affected by the introduction of the smoking bans while also including individuals with a propensity to smoke. This is also in line with previous studies that employed similar definitions (see the definition of "likely smokers" in Gruber and Mullainathan, 2005; Odermatt and Stutzer, 2013; Leicester and Levell, 2013), which is often based on an individual's probability to smoke. Table 1 presents summary statistics of all the variables in our analysis. These variables are presented for males and females separately and broken down by smoking status

(overall population and potential versus never smokers). Within the overall population, female individuals appear to present a slightly lower level of individual subjective well-being as defined by the GHQ on the Likert scale if compared to men. Higher levels of psychological distress appear to be also present among female individuals who are potential smokers and never smokers. A higher proportion of men appears to be married or in a couple in both categories of smokers and the overall population. Yet, women seem to show a generally higher average number of children.

[Table 1 about here]

3. ECONOMETRIC METHODS

We estimate the impact of smoking bans on subjective well-being by exploiting the different timing of the introduction of the Scottish and English smoking bans. Since an identical public smoking ban was implemented in England one year later than in Scotland, we can identify our treatment effect by computing differences in well-being between Scottish and English individuals before and after the implementation of the ban in Scotland via difference-in-differences (DD) models (Ashenfelter, 1978; Ashenfelter and Card, 1985; Heckman and Robb, 1985). We first employ standard two-way fixed effects models (*2FE*) using Scotland and England as treated and control groups respectively, and then use a more flexible model with fixed effects and country-specific time trends that allows for different policy effects by region and time. We also combine our DD models with matching techniques to pre-process the data and enhance comparability between treatment and control groups while improving the overall credibility of our identification strategy (Ho et al., 2007).

3.1 MATCHING

We first use matching to pre-process the data before the estimation of our DD models in order to produce more accurate and less model-dependent estimates. The pre-processing approach matches the pre-treatment observable characteristics of individuals in treated and control groups to increase their comparability. The approach was proposed by Ho et al. (2007) and further discussed and applied in a number of recent studies (e.g. Blackwell et al., 2009; Hainmueller and Xu, 2011; Jones and Rice, 2011; Iacus et al., 201; King et al., 2011). In this case, the main goal of matching is to ensure that individuals in treatment (Scotland) and control (England) groups are as similar as possible in terms of covariate distribution. An advantage of this combined approach is that it is "doubly robust" in that under weak conditions (and excluding extreme cases were matching would lead to non-identification even when the subsequent parametric models are correctly specified) if either the matching or parametric models are correct, causal estimates should be consistent (Bickel and Kwon, 2001; Ho et al., et al., 2007) .

In order to pre-process the data, we have applied a series of alternative matching methods such as nearest neighbour, kernel and Mahalanobis distance matching. The DD results presented in our result section are based on kernel matching,[5] however estimates obtained using nearest neighbour and Mahalanobis distance matching techniques appear to be very similar.[6] In this case, kernel matching is preferred as it exploits a wider range of information on the individuals in the control group to achieve a lower variance.

[5] Kernel matching builds the counterfactual outcome using weighted averages of all individuals in the control group, with higher weights being placed on the untreated individuals with scores closer to the treated. We impose common support condition and use a bandwidth of 0.01. We have also tried alternative bandwidth values (e.g. 0.005, 0.0025 and 0.00125), however in our case lower bandwidths lead to a smaller a sample size and do not appear to improve the overall quality of the matching. Hence, we present our results based the 0.01 bandwidth.

[6] Results based on nearest neighbor and Mahalanobis distance matching are available upon request.

3.2 TWO-WAY FIXED EFFECTS MODELS

We estimate the impact of the smoking bans on the GHQ of smokers, non-smokers and couples using two-way fixed effects models (*2FE*). These models exploit differences in reported subjective well-being between England and Scotland between 1999-2007 (waves 9-18) while controlling for observed individual characteristics, time effects and time-invariant individual-level unobserved heterogeneity. Our basic *2FE* model is:

$$y_{it} = \alpha + \tau_s(S_i P_t) + X_{it}\emptyset + v_t + u_i + \varepsilon_{it} \quad (1)$$

where y_{it} is subjective well-being measured by the GHQ of an individual *i* at time *t*. S_i is a dummy variable defining whether an individual resides in Scotland ($S_i = 1$) while P_t is an indicator for the post-ban period (i.e. $P_t = 1$ if the smoking ban is in force at survey time *t*, 0 otherwise). The *treatment effect* is identified by τ_s, an interaction between country of residence and the post-ban period. X_{it} is a vector of individual observed characteristics at time *t* (age and age squared, marital status, household characteristics, income, employment status; self-assessed health status and other health conditions). We use lagged values of the health variables to ease potential endogeneity concerns as an individual's current overall health status might influence subjective well-being. u_i represents individual fixed effects and captures time-invariant unobservables that might be correlated with the outcome and the allocation of the treatment. The time dummies v_t account for time trends common to both the treatment and control groups. ε_{it} is an idiosyncratic error term. This is a DD estimator with one of the differences corresponding to the within-individual difference of a standard fixed effects estimator (Jones and Rice, 2011).

3.3 COUNTRY-SPECIFIC TIME TRENDS MODELS

As an alternative to the basic *2FE* model, we also estimate a more flexible specification with fixed effects and country-specific time trends (*CSTT*). This is a more general specification that nests model (1) as a special case and identifies the impact of the UK

smoking bans by disentangling the treatment effect by countries and different time periods:

$$y_{it} = \alpha + S_i \sum_{t=1}^{T} \tau_{St} v_t + E_i \sum_{t=2}^{T} \tau_{Et} v_t + X_{it}\emptyset + u_i + \varepsilon_{it} \quad (2)$$

The impact of the bans on subjective well-being is captured by the parameters τ_{St} and τ_{Et} on the interactions between being resident in Scotland ($S_i = 1$) or England ($E_i = 1$), and the time dummies v_t. Here, changes in subjective well-being related to the introduction of the smoking bans are derived by comparing country-specific time trends with a baseline country-specific time trend.[7] These models are also estimated using linear fixed effects specifications.

4. RESULTS

4.1 Descriptive statistics

Identification of the average treatment effect on the treated through DD models relies on the parallel trend assumption so that values of our outcome of interest, well-being defined via the GHQ, should follow similar pre-treatment time trends in both Scotland and England. To examine whether this assumption holds, we display GHQ trends by country of residence, gender and types of smokers in Figure 1. For the overall population (which includes both potential smokers and never smokers, upper part of Figure 1), GHQ trends appear to be very similar in Scotland and England before the introduction of the bans. After the implementation of the bans, there appear to be decreases in GHQ levels (i.e. higher levels of well-being), especially among Scottish women, followed by increases one year later in both countries. The graph for male potential smokers (first graph on the left in the middle of Figure 1) appear to show slightly more converging GHQ trends between England and Scotland, becoming stable

[7] In this case we use England in wave 9 as a baseline country-specific time trend as no smoking ban was in place at that time.

approximately two years before the introduction of the ban in Scotland. Yet, we can still observe an apparent decline in GHQ levels in the years of the imposition of the bans in both Scotland and England and increases one year after their introduction. Female potential smokers appear to display stable trends, showing a decrease in the year of the ban for Scotland. Never smokers (lower part of Figure 1) have similar GHQ trends in England and Scotland during the pre-ban period, although smoking bans appear to affect mostly women. Among never smokers, women seem to display a downward trend in GHQ levels in the years of the bans and upward trends one year later, while men's GHQ levels do not appear to be affected (showing a slight upward trend among men in Scotland). Overall, these graphs appear to show relatively stable trends before the bans and short-term positive variations in well-being levels, especially among male potential smokers and female never smokers.

[Figure 1 about here]

4.2 Estimates

Since we focus on the identification of potential well-being externalities caused by public smoking bans, we present estimates broken down by type of smokers (potential smokers versus never smokers) and compare it with the ones for the overall population. To investigate whether there are any intra-couple well-being externalities, we also present these estimates separately by gender and marital status (men versus women and married/living with a partner versus single).

Estimates of both *2FE* and *CSTT* models are produced by combining Kernel matching with linear fixed effects models. All treatments effects should be interpreted as point changes on the GHQ Likert scale. Tables 2 and 3 display estimates of the impact of the Scottish public smoking ban on well-being produced by *2FE* and *CSTT* models, respectively. The treatment effects for married men and women in the overall population appear to be negative and statistically significant in both *2FE* and *CTTS* models. Since higher GHQ scores correspond to lower levels of well-being, this

suggests that the Scottish ban had a positive and statistically significant impact on the SWB of married individuals. For married male individuals (overall population), the ban led to a decrease in the GHQ (increase in well-being) of around 0.4 points on the Likert scale (0.395, 2FE model, and 0.377, CSTT model) while for married females in the overall population the decrease in the GHQ appears to be well-over half a point (between 0.546-0.733). Married male and female never smokers also appear to experience statistically significant increases in well-being (0.44 points and between around 0.54-0.82 points, respectively).

[Tables 2 and 3 about here]

Tables 4 and 5 report treatment effects from *2FE* and *CSTT* models broken down by gender, type of smokers as well "smoking type" of each spouse. Treatment effects appear to be highly statistically significant for married men (*2FE* results in the upper part of Table 4) with spouses from the overall population (either potential smokers or never smokers) with a decrease of nearly 0.8 GHQ points on the Likert scale. The estimate for male individuals who are potential smokers and married/living also with a potential smoker, shows a statistically significant decrease in the GHQ scale of 1.43 points. This implies that the ban appeared to have improved the well-being of married male individuals, especially if living with a potential smoker. Note that although decreases in GHQ values among couples of never smokers appear to be relatively large (0.82 and 1.02 in the *2FE* and *CSTT* models, respectively), these estimates are only statistically significant at 10%.

The SWB of female individuals married/living with a potential smoker appear to be positively affected by the introduction of the Scottish ban: their GHQ decreases by around 1 GHQ point. The largest improvement in well-being is observed among female never smokers married/living with potential smokers (with GHQ decreases between 1.1-1.86 points).

These effects appear to be substantial in size if compared to the ones of important life events on well-being identified in previous studies. Gardner and Oswald (2006) use data from the BHPS and the GHQ on the Likert scale and find that unemployment is associated with an increase of nearly 1.9 GHQ points while marriage is correlated with a decrease of 1.3 points. Further, Clark and Oswald (2002) and Gardner and Oswald (2007) find that widowhood, the life event thought to have the largest negative effect on well-being observable in standard datasets, is associated with a decrease in well-being of around 5 GHQ points. The size of the effects on the GHQ of these rare and important life events appear to suggest that our treatment effects may not just be statistically significant but also economically relevant. For example, the size of our estimated improvement in well-being among couples of potential smokers due to the smoking ban appears to be slightly larger, in absolute value, than the one associated with marriage (1.4 versus 1.3 GHQ points). Moreover, the increase in GHQ points identified by the *CSTT* model among female never smokers married/living with potential smokers driven by the ban (1.86) appears to resemble very closely the quantitative effect of unemployment (1.9).

[Tables 4 and 5 about here]

To further investigate well-being externalities induced by smoking bans, we look at the impact of the Scottish ban among couples with and without dependent children (Tables 6 and 7). Overall, treatment effects appear to show statistically significant and large improvements in well-being mainly among couples with children. The largest improvements in well-being are observed among males (overall population) living with a potential smoker and dependent children (between 1.71-2.39 GHQ points) and non-smoking males living with potential smokers and children (between 4.141-4.744 points). The size of this treatment effect appears to be larger than the impact of unemployment and marriage on well-being and close to the one of widowhood.

Female spouses with children are also found to experience statistically significant improvements in well-being following the introduction of the Scottish ban (lower parts

of Tables 6 and 7). Highly statistically significant, large and consistent effects are found among females potential smokers with dependent children whose spouses/partners are also potential smokers (around 2.5 GHQ points). This effect is around half the size of the impact of widowhood.

[Tables 6 and 7 about here]

Placebo tests

Tables 8 and 9 present results from placebo tests assuming that the Scottish ban was implemented in 2004 and 2005 (i.e. two and one year before its actual implementation, respectively). These should explore the robustness of our results as well as the presence of potential anticipation effects. Results are broken down by gender, type of smokers and marital status. All the estimated treatments effects do not appear to be statistically different from zero (apart from one coefficient for women in Table 9 which is only statistically significant at 10%). Furthermore, the direction of these effects appears to be undetermined with a mixture of positive and negative signs. This also seems to provide some further support to our main results.

[Tables 8 and 9 about here]

5. CONCLUSION AND DISCUSSION

We exploit the natural experiment provided by the timing of the introduction of the UK smoking bans to identify the causal impact of public smoking bans on subjective well-being. We extend the literature by focusing on well-being externalities among non-smokers and couples and contrary to previous studies, we find robust and substantial effects of public smoking bans on well-being, especially among couples with children. The largest effects on well-being are found among non-smoking male spouses of smokers with dependent children, with their GHQ scores decreasing by more than 4 points on the Likert scale. If compared to the previous literature on well-being, the size of this effect is very close to the impact of widowhood, the life

event with the largest negative effect on well-being. Hence, we argue that the changes in subjective well-being that we identify in this study, although short-term, are of non-negligible size.

The particularly large positive well-being externalities among couples with dependent children may indicate the presence of parental altruism. Individuals with altruistic preference towards their children would benefit more from the introduction of public bans than non-altruistic parents, mainly for the expected reduction of their children's exposure to second hand smoke, at least in public places. The importance of within-family altruism was first discussed by Becker (1981). He argued that altruism is likely to dominate intra family behaviours and proposed a model where altruistic individuals derive utility from the well-being of other family members, including children. More recent studies analyse how parents allocate health-protective goods between themselves and their pre-teenage children living at home. These suggest that parents can be altruistic toward their young children, especially concerning health and exposure to environmental risks (e.g. Liu et al., 2000; Dickie and Ulery, 2001; Dickie and Messman, 2004; Dupont, 2004; Dickie and Gerking, 2007). Interestingly, smoking parents are also found to be altruistic and to value their children's health twice as much as their own health (Agee et al., 2001). Further, some studies also use subjective well-being to measure altruism within family and find that children's health and well-being have a positive impact on the their parents' life satisfaction (Schwarze, 2004; Bruhin and Winkelmann, 2009). For all these reasons, we believe that the increase in subjective well-being among couples with children could be partly explained by parental altruism.

Our findings suggest that the welfare impact of public smoking bans should not be limited solely to smokers but could also be extended to partners and family members of smokers, especially those concerned with their children's health and well-being. From a policy perspective, while public smoking bans may have a limited effect on active smoking and some potential adverse effects on passive smoking (Adda and Cornaglia,

2010; Carpenter et al., 2011), they may also produce positive short-term well-being externalities, especially among couples living with young children. This additional information could be exploited by governments concerned with the overall impact evaluation of their anti-smoking policies alongside standard findings on smoking prevalence and intensity.

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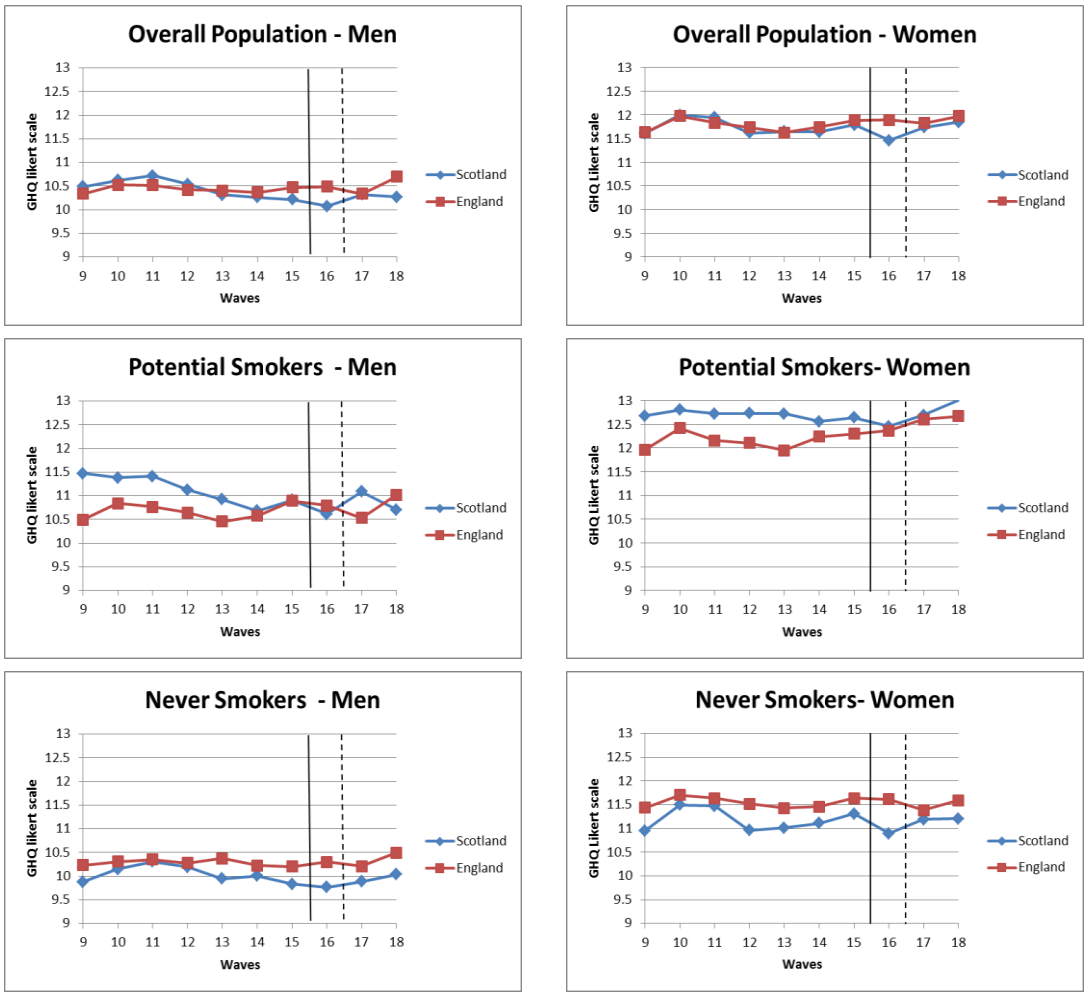
Table 1: Descriptive statistics

	Overall population		Potential smokers		Never smokers	
	Men	Women	Men	Women	Men	Women
GHQ 12 Likert scale	10.417	11.764	10.797	12.329	10.176	11.445
Smoker	0.267	0.256	0.691	0.714	0.000	0.000
Number of cigarettes	15.955	14.294	15.955	14.294	---	---
Age	45.234	46.592	41.612	42.406	47.516	48.929
Married/couple	0.704	0.641	0.677	0.618	0.721	0.654
Household size	2.847	2.756	2.931	2.828	2.794	2.717
Number of children	0.499	0.546	0.564	0.630	0.458	0.499
Unemployed	0.051	0.025	0.085	0.039	0.030	0.017
Self-employed	0.116	0.038	0.111	0.038	0.119	0.037
Retired	0.183	0.216	0.119	0.144	0.223	0.256
Maternity leave/family care	0.041	0.051	0.064	0.070	0.026	0.041
Student	0.006	0.132	0.008	0.145	0.004	0.124
Long-term sickness	0.036	0.036	0.033	0.033	0.039	0.037
Government training	0.002	0.001	0.003	0.001	0.001	0.001
Other jobs	0.004	0.004	0.003	0.005	0.004	0.004
SAH excellent	0.253	0.206	0.205	0.174	0.283	0.224
SAH very good/good	0.480	0.482	0.480	0.470	0.480	0.488
SAH fair	0.192	0.213	0.220	0.230	0.174	0.203
SAH poor/very poor	0.076	0.099	0.096	0.126	0.063	0.084
Chest problems	0.124	0.134	0.138	0.163	0.114	0.118
Heart problems	0.149	0.166	0.121	0.134	0.166	0.185
Household income	1.989	1.823	1.839	1.707	2.083	1.887
Number of observations	81750	94332	31603	33798	50147	60534

Notes: the Table contains mean values for all the main variables computed for waves 1-18 for pooled samples and for males and females separately, broken down by smoking status (i.e. potential smokers and never smokers).

Figure 1: GHQ trends in Scotland and England



Notes: the continuous vertical lines indicate the Scottish smoking ban while the dashed lines represent the English bans

Table 2: The impact of the Scottish ban on the GHQ – 2FE models

ATET Scotland	Overall	Potential smokers	Never smokers
	Men	Men	Men
Married	-0.395***	-0.342	-0.440**
	(0.144)	(0.259)	(0.172)
N	18923	6870	12053
Non-married	0.434	0.384	0.523
	(0.302)	(0.546)	(0.350)
N	6352	2581	3771
	Women	Women	Women
Married	-0.546***	-0.543*	-0.541***
	(0.164)	(0.314)	(0.190)
N	21260	7229	14031
Non-married	-0.0425	0.111	-0.177
	(0.261)	(0.452)	(0.313)
N	9619	3921	5698

Notes: Standard errors in parentheses. Statistical significance: *** 1% level; ** 5% level; * 10% level.

Table 3: The impact of the Scottish ban on the GHQ – CSTT models

ATET Scotland	Overall	Potential smokers	Never smokers
	Men	Men	Men
Married	-0.377**	-0.450	-0.334
	(0.185)	(0.331)	(0.220)
N	34681	12427	22254
Non-married	-0.121	-0.486	0.113
	(0.362)	(0.649)	(0.421)
N	11159	4597	6562
	Women	Women	Women
Married	-0.733***	-0.566	-0.825***
	(0.208)	(0.390)	(0.244)
N	39502	13122	26380
Non-married	-0.184	0.126	-0.382
	(0.332)	(0.577)	(0.396)
N	17027	6933	10094

Notes: Standard errors in parentheses. Statistical significance: *** 1% level; ** 5% level; * 10% level.

Table 4: The impact of the Scottish ban among couples - 2FE models

	Overall	Potential smokers	Never smokers
	Men	Men	Men
Spouse: overall population	-0.760**	-0.906	-0.666*
	(0.327)	(0.571)	(0.395)
N	4902	1880	3022
Spouse: potential smoker	-1.072*	-1.432**	-0.337
	(0.556)	(0.684)	(0.975)
N	1877	1238	639
Spouse: never smoker	-0.518	0.0102	-0.821*
	(0.413)	(1.066)	(0.441)
N	2940	598	2342
	Women	Women	Women
Spouse: overall population	-0.573***	-0.706*	-0.496**
	(0.195)	(0.395)	(0.222)
N	14719	4556	10163
Spouse: potential smokers	-0.904**	-0.658	-1.107**
	(0.374)	(0.551)	(0.496)
N	4734	2616	2118
Spouse: never smoker	-0.395	-0.488	-0.377
	(0.240)	(0.641)	(0.259)
N	9004	1535	7469

Notes: Standard errors in parentheses. Statistical significance: *** 1% level; ** 5% level; * 10% level.

Table 5: The impact of the Scottish ban among couples - CSTT models

	Overall	Potential smokers	Never smokers
	Men	Men	Men
Spouse: overall population	-0.861**	-0.869	-0.852*
	(0.392)	(0.673)	(0.478)
N	8878	3278	5600
Spouse: potential smoker	-1.122*	-1.323	0.537
	(0.655)	(0.809)	(1.123)
N	3238	2110	1128
Spouse: never smoker	-0.678	0.117	-1.021*
	(0.496)	(1.232)	(0.537)
N	5464	1082	4382
	Women	Women	Women
Spouse: overall population	-0.769***	-0.549	-0.890***
	(0.247)	(0.480)	(0.286)
N	27693	8456	19237
Spouse: potential smoker	-1.091**	-0.561	-1.858***
	(0.460)	(0.656)	(0.633)
N	8976	4906	4070
Spouse: never smoker	-0.548*	-0.006	-0.691**
	(0.308)	(0.781)	(0.335)
N	16986	2851	14135

Notes: Standard errors in parentheses. Statistical significance: *** 1% level; ** 5% level; * 10% level.

Table 6: The impact of the Scottish ban among couples with and without dependent children – 2FE models

	Overall		Potential smokers		Never smokers	
	Men		Men		Men	
	Without children	With children	Without children	With children	Without children	With children
Spouse: overall population	-0.607	-1.083*	-0.844	-0.601	-0.481	-1.165
	(0.394)	(0.604)	(0.771)	(0.964)	(0.447)	(0.783)
N	2861	2041	1021	859	1840	1182
Spouse: potential smoker	-0.081	-2.390**	-0.467	-1.629	0.0125	-4.744**
	(0.703)	(0.987)	(0.944)	(1.182)	(1.046)	(1.966)
N	1016	861	652	586	364	275
Spouse: never smoker	-0.569	-0.0849	-1.209	0.510	-0.631	-0.450
	(0.489)	(0.793)	(1.461)	(1.709)	(0.503)	(0.885)
N	1784	1156	339	259	1445	897
	Women		Women		Women	
	Without children	With children	Without children	With children	Without children	With children
Spouse: overall population	-0.106	-1.301***	-0.190	-1.419**	-0.0577	-1.196***
	(0.242)	(0.347)	(0.493)	(0.699)	(0.274)	(0.398)
N	9103	5616	2759	1797	6344	3819
Spouse: potential smoker	-0.0315	-1.894***	0.635	-2.576***	-1.013	-1.127
	(0.506)	(0.586)	(0.734)	(0.901)	(0.678)	(0.766)
N	2675	2059	1489	1127	1186	932
Spouse: never smoker	0.0473	-0.966**	-0.694	-0.282	0.135	-1.192**
	(0.286)	(0.458)	(0.745)	(1.323)	(0.311)	(0.487)
N	5791	3213	997	538	4794	2675

Notes: Standard errors in parentheses. Statistical significance: *** 1% level; ** 5% level; * 10% level.

Table 7: The impact of the Scottish ban among couples with and without dependent children – CSTT models

	Overall		Potential smokers		Never smokers	
	Men		Men		Men	
	Without children	With children	Without children	With children	Without children	With children
Spouse: overall population	-0.820*	-0.781	-0.723	-0.619	-0.931*	-0.813
	(0.481)	(0.666)	(0.895)	(1.070)	(0.559)	(0.853)
N	5176	3702	1785	1493	3391	2209
Spouse: potential smoker	-0.409	-1.714*	-1.193	-0.846	1.035	-4.141**
	(0.860)	(1.039)	(1.097)	(1.262)	(1.389)	(1.958)
N	1735	1503	1102	1008	633	495
Spouse: never smoker	-0.942	-0.193	-0.100	-0.884	-1.437**	-0.272
	(0.591)	(0.876)	(1.619)	(1.961)	(0.621)	(0.976)
N	3311	2153	618	464	2693	1689
	Women		Women		Women	
	Without children	With children	Without children	With children	Without children	With children
Spouse: overall population	-0.334	-1.511***	0.114	-1.677**	-0.593*	-1.409***
	(0.304)	(0.416)	(0.592)	(0.811)	(0.352)	(0.482)
N	16887	10806	4959	3497	11928	7309
Spouse: potential smoker	-0.475	-1.840***	0.719	-2.526**	-2.464***	-1.070
	(0.599)	(0.705)	(0.851)	(1.047)	(0.836)	(0.945)
N	5021	3955	2736	2170	2285	1785
Spouse: never smoker	-0.165	-1.231**	0.145	-0.518	-0.262	-1.477**
	(0.369)	(0.550)	(0.890)	(1.499)	(0.406)	(0.589)
N	10782	6204	1798	1053	8984	5151

Notes: Standard errors in parentheses. Statistical significance: *** 1% level; ** 5% level; * 10% level.

Table 8: Placebo test I: the impact of the Scottish ban on the GHQ in 2004

ATET Scotland	Overall	Potential smokers	Never smokers
	Men	Men	Men
Married	-0.160	-0.260	-0.095
	(0.169)	(0.301)	(0.201)
N	18337	6916	11421
Non-married	0.362	0.351	0.377
	(0.316)	(0.526)	(0.389)
N	7062	3002	4060
	Women	Women	Women
Married	-0.011	-0.218	0.091
	(0.192)	(0.361)	(0.225)
N	19976	7147	12829
Non-married	0.170	0.407	0.023
	(0.285)	(0.498)	(0.343)
N	10396	4127	6269

Notes: Standard errors in parentheses. Statistical significance: *** 1% level; ** 5% level; * 10% level.

Table 9: Placebo test II: the impact of the Scottish ban on the GHQ in 2005

ATET Scotland	Overall	Potential smokers	Never smokers
	Men	Men	Men
Married	-0.051	0.064	-0.135
	(0.168)	(0.302)	(0.201)
N	21162	7962	13200
Non-married	-0.002	-0.309	0.233
	(0.320)	(0.559)	(0.381)
N	8124	3432	4692
	Women	Women	Women
Married	0.279	0.068	0.395*
	(0.192)	(0.362)	(0.223)
N	23046	8203	14843
Non-married	0.184	0.020	0.255
	(0.284)	(0.489)	(0.344)
N	11968	4762	7206

Notes: Standard errors in parentheses. Statistical significance: *** 1% level; ** 5% level; * 10% level.