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Parents can influence the effect of public policy. Evidence from smoking ban in the UK.

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Parents can influence the effect of public policy. Evidence from smoking ban in the UK

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Abstract

The smoking ban policy was introduced in the UK to prohibit smoking in outdoor public places, such as bars and restaurants, and also in private workplaces. The aim of this smoking ban policy is twofold: firstly, to avoid the effects of passive smoking on non-smokers individuals and secondly, to reduce consumption of cigarette. Using the British Household Panel Survey, after an initial evaluation of the impact of smoking ban on active smoking in the UK, this work aims at using a casual empirical design to investigate whether the impact of the smoking ban policy changes due to the impact of parental smoking behaviour on the smoking habits of adults offspring (i.e. smoking prevalence and cigarette consumption).

The findings confirm the positive and limited impact of the smoking ban policy in the UK on the smoking prevalence, with a higher probability of smoking after the policy implementation for women than for men.

Furthermore, considering the cigarette consumption of young adults, the findings show that there is a relation between the intensity of smoking of the parents and that of the offspring after the policy implementation. In particular, if the parents are light/moderate smokers, the probability of their offspring being heavy smokers after the introduction of a smoking ban policy is reduced by 19%. However, our analysis has some limitations related to the availability of number of observations when considering the cigarette consumption of offspring and parents.

Keywords: smoking ban, policy intervention, parental smoking behaviour, young adults, cigarette consumption.

JEL codes: I12, I14, I18, J6.

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1 Introduction

The *ASH Action on smoking and health (2015)* report on the effect of the smoking-free legislation shows that attitudes towards smoking are a major public health issue in the United Kingdom, as in almost all parts of the world. Smoking-related health issues are among the leading causes of death. Our research question aims at addressing if parental smoking habits can influence the effect of the smoking ban policy through an impact on offspring's smoking behaviour. To the best of our knowledge, this is the first work to examine the intergenerational effect of smoking among adults' offspring and their parents, using a causal empirical design that takes into account the implementation of a smoking ban policy. Because of the intergenerational transmission of smoking, in the presence of higher smoking rates, young people are more exposed to smoking behaviour and are more likely to try smoking, resulting in increased smoking prevalence and inequalities due to parental smoking behaviour. Before the implementation of the smoke-free law, the *Action on smoking and health (2015)* report declares that exposure to second-hand smoke in the workplace caused around 617 premature deaths per year in the UK. The degree of risk considers the extent and duration of exposure. In Scotland, for instance, more than 13,000 people die every year from tobacco-related health problems. Furthermore, 9 out of 10 lung cancer deaths are caused by smoking, killing more people than other types of cancer. In Scotland, about 1,000 people who have never smoked die each year due to passive smoking.

Table A1 in the Appendix shows a brief summary of the tobacco regulation implemented in the time period used in the analysis sample (i.e. 2000-2009) to better understand what might drive the results (Action on smoking and health (2022)). The introduction of an initial partial ban aimed to protect the health of non-smokers without affecting the personal freedoms of smokers by allowing them to exercise their legal right to smoke in other places. However, a comprehensive legislation could induce individuals to smoke more at home, leading to greater exposure of children to second-hand smoke. For this reason, the government initially has proposed a partial ban that exempts private clubs and public places that do not serve food. However, this exemption may increase health inequalities, as pubs that do not offer food are mainly located in poorer communities.

On 26 March 2006, the *Smoking Health and Social Care Act 2005* implemented a smoking ban policy in Scotland to reduce smoking in all virtually or substantially[1] enclosed workplaces and public places[2]. *The Health Act 2006* implemented the same policy in

[1] Enclosed area means permanent walls and doors without any gaps and different from windows and doors (i.e. a building). Substantially enclosed refers to structures with a ceiling or roof and there are permanent openings (other than windows or doors), that represent less than half of the area of the walls. The law also refers to workplace vehicles used by more than one person at any time.

[2] The main places are restaurants, bars, cafes, hotels, theatres, bingo halls, church halls, sports centres, shopping centres, public transport, schools, hospitals and clubs.

England on 1 July 2007. In Scotland, a smoking ban policy is estimated to prevent 219 deaths per year from lung cancer and coronary heart disease and 187 deaths per year from respiratory disease. Furthermore, 30 minutes of exposure to second-hand smoke could be enough to reduce coronary blood flow in a healthy adult individual, causing health issues. Moreover, the risk of lung cancer increases by around 24% due to long-term exposure to passive smoking. In Scotland and England, individuals who smoke in no-smoking premises can incur a fixed penalty fine of £50. Refusal to pay or failure to pay can result in prosecution and a fine of up to £1,000. Managers of no-smoking premises could be fined a fixed penalty of £200 for allowing people to smoke on their premises or for failing to display warning notices. Refusal to pay or failure to pay could result in prosecution and a fine of up to £2,500.
There are some exceptions to the smoking ban law applied to "designed rooms", such as:

- guest bedrooms in hotels, guest houses, care homes, hospices and prisons;
- private homes in which there is no space designed as a workplace (i.e. music lessons);
- open-air sports stadiums;
- bus stops, if the bus shelter is not "substantially enclosed";
- actors may smoke for the artistic performance integrity (this is possible only in England);
- Offshore installations, such as oil rigs;
- specialist tobacco shops.

The introduction of a total smoking ban in England lagged behind public opinion, while in other countries, such as Scotland, government action anticipated public opinion. In summary, the most effective actions against smoking occurred in countries where there was collaboration between the medical community and the political community, creating a favourable public climate for action involving committed officials and ministers and civil society[3].
Considering the economic impact reported by the Department of Health (2008), 81% of businesses agreed that the smoking ban policy was a "good idea", 40% of them reported a positive impact on the company and only 3% declared a negative impact, 38% of licensed premises declared a positive impact on the company, and finally 59% and 62% of businesses and licensed premises respectively declared a positive reaction from the staff.

[3] For a detailed analysis of events in tobacco regulation over the last 30 years, we recommend reading the report `https://www.instituteforgovernment.org.uk/sites/default/files/smoking_in_public_places.pdf`

Regarding the health impact, according to the *Action on smoking and health (2015)* report, the smoking ban policy in England reduced emergency admission to hospitals for heart attacks by 2.4 % in the 12 months following the implementation of the policy. On the other hand, other countries experienced reductions from 8% to 40% in hospital admissions for heart attacks. Moreover, the smoke-free law has helped to reduce the asthma issue in childhood and to reduce the number of people who smoke.
Concerning the price of cigarettes, it has increased every year since 2000, when the average retail price of a pack of 20 cigarettes was 3.91 British pounds. In 2005, the average retail price of a pack of 20 cigarettes was 4.57£, in 2006 it was 4.76£, and in 2007 it was 5.02£. The UK also has the highest level of taxation for hand-rolling tobacco, mainly due to the high levels of control on advertising, the ban on displaying tobacco products at retail and graphic warnings on cigarette packs[4].
Existing studies (i.e., Black and Devereux (2010), Björklund and Salvanes (2011)) have focused on the direct effects of family background on children's outcomes such as health, education, income, mobility, employment status and cognitive skills, declaring that genetic transmission, parents' preferences, tastes, habits, or/and environment can affect the behaviour and decisions pursued by their children. Learning the processes by which parental characteristics can affect children's choices is more difficult than determining the existence of an effect. For instance, using the concept of the production function, Chevalier et al. (2013) state that parental education could be considered as a direct input into the production function on which the quality of children's endowments depends. Furthermore, parental education may also have an indirect impact on children's choice of other inputs through its effect on household income. Our study aims at investigating whether this transmission mechanism can alter the effects of a policy intervention to reduce active smoking.
To date, no empirical work has attempted to simultaneously account for the heterogeneous effects of public policies by looking at the moderating relevance of parental traits, preferences and features on the effect of public policies on offspring outcomes. The work begins with an analysis of the impact of the smoking ban policy in Scotland and England, following recent literature. As a contribution to the literature, the work uses individual data from the British Household Panel Survey (BHPS), a household survey that allows us to associate parents with their adult offspring, to analyse the impact of parental smoking behaviour on young adults offspring who smoke during the implementation of the smoking ban policy.
The empirical technique used for the smoking prevalence analysis between UK regions and by gender is the difference-in-difference approach with a linear probability model.

[4] Detailed average retail price of a typical pack of 20 cigarettes in the UK over time on the website `https://www.statista.com/statistics/414973/cigarette-prices-in-the-united-kingdom/`

To better understand the evolution of smoking prevalence between UK regions and by gender, a country-specific time trend approach was also implemented. Finally, a linear probability model taking into account the number of cigarettes consumed by adult offspring and parental cigarette consumption was adopted to test robustness.
The findings confirm a small and positive impact of the smoking ban policy, on average. Furthermore, considering parental cigarette consumption, the impact of parental smoking behaviour on offspring's smoking habits changes significantly depending on the intensity of the cigarette consumed by parents.
The remainder of the work is organized as follows. Section 2 describes a literature review. Section 3 reports the data used in the paper, Section 4 describes the empirical strategies adopted, following the ones already existing in the literature, and a new econometric approach in which the effect of parental smoking behaviour effect is considered. Section 5 shows the results of the empirical specification models. Finally, section 6 offers some conclusions and further extensions.

2 Literature review

The US literature is rich in empirical evaluations of several types of smoking policies and the effect of parental health shocks on adult smoking behaviour. In the UK, otherwise, evidence on the effects of smoking bans on tobacco consumption is limited. The literature on the effects of public bans on smoking presents conflicting results. For instance, through a review of 50 studies in 13 countries, Callinan et al. (2010) find that the evidence on the impact of smoking bans on active smoking is limited, while there is a reduction in passive smoking. A study by De Chaisemartin et al. (2011) finds that the demand for smoking cessation services and smoking consumption by people who habitually visit enclosed places are reduced by the smoking ban policy. Irvine and Nguyen (2011) highlight how workplace bans have a significant impact on heavy smokers and higher-income smokers because the ban leads to higher consumption of cigarettes. Anger et al. (2011) conduct a one-year analysis in 2007-2008 in Germany to see if the smoking ban changes smoking behaviour in the whole population. They found that this policy only affects selected groups, such as men, young and unmarried people who lived in urban areas. In the USA, Adda and Cornaglia (2006), considering the level of cotinine as a measure of passive smoke, find that the tobacco taxes lead adults to greater health problems due to higher nicotine extraction per cigarette. However, Adda and Cornaglia (2010) did not find evidence of the impact of the smoking ban policy on smoking behaviour, neither in terms of consumption nor prevalence. Some studies have been conducted on the impact of smoking ban policies in Italy introduced by the *Sirchia Law* of 10 January 2005. Gualano et al. (2014) describe smoking habits in Italy through a time series analysis, estimating smoking prevalence and tobacco consumption. They find that over eight years, the percentage of Italian smokers shows a constant and statistically significant reduction

in smoking prevalence from 2001 to 2013, particularly among men. Concerning smoking consumption, there is a downward trend in Italy, with no point of connection related to the introduction of the smoking ban policy. In this regard, the authors suggest that the smoking ban policy could focus on different interventions (e.g. increasing the price of cigarettes). The main reference used as a starting point for our analysis is that of Jones et al. (2015), which assesses the short-term impact of the smoking bans in Scotland and England. Their analysis was conducted through a series of flexible difference-in-difference fixed effects panel data models using data from the British Household Panel Survey, the same data we used in our analysis. Their findings show a limited short-run effect of the public smoking ban policy on both smoking prevalence and total level of smoking, although they identify significant differences in smoking trends by population sub-groups. Furthermore, their results challenge those of the health literature because they find a positive impact of the smoking ban, but follow the most recent economic literature that highlights that there is no certainty about the effect of smoking bans on smoking prevalence. Jones et al. (2015) use robust econometric methods of policy evaluation for the first time to identify the causal impact of the smoking ban on smoking behaviour.

Looking at the intergenerational association between parents' smoking behaviour and their children's cigarette use, Vuolo and Staff (2013) analyse in the United States how parents' long-term smoking trajectories are related to adolescent children's likelihood of smoking. They used data from parents when they were young (aged 14 to 38) to compare their smoking behaviour with that of their children. The authors find that, although in an era of declining rates of cigarette use by teenagers, there is a high smoking risk for children in current and former smokers. Moreover, parental smoking behaviour may encourage children to smoke to cope with stress factors such as failure at school, psychological distress, low parental education or older sibling cigarette use. The findings highlight that children's cigarette use is strongly related to parents who started smoking heavily in adolescence and remained heavy smokers in adulthood. In addition, older siblings play an important role in intergenerational transmission. Among the limitations of Vuolo and Staff (2013)'s study, the main one is related to the fact that the smoking information came from only one parent, undermining the possibility of analysing the possible relationship between parents' and children's gender.

In this regard, Loureiro et al. (2010) investigate the casual effect of parental smoking behaviour on their children's attitudes towards smoking. Using data from the British Household Panel Survey to analyse the relationship between parents' and children's gender, they conduct two types of analysis: the first using two-parent households and the second using single-mother households. They find evidence of same-sex role models only in two-parent households, where daughters' smoking behaviour is affected by their mothers' decisions, while sons tend to imitate fathers' smoking decisions. Considering the latter study, which looks at the correlation between children's sex (11-15 years old) and their parents' sex, our work aims at analysing if the smoking ban policy changes its ef-

fect on the smoking habits of young adults (15+) due to cigarette consumption habits of parents. The findings of Vuolo and Staff (2013) are in line with those of Mays et al. (2014) related to the impact of parental smoking and nicotine dependence on adolescent offspring's smoking attitude. A relevant study was conducted by Frijters et al. (2011) who quantify the effect of the children's exposure to passive smoking on child health using the Health Survey for England (HSE) data from 1997 to 2006. They find that the main risk factors that determine the children's exposure to passive smoking, measured through the level of saliva cotinine, are both parental and child carer smoking behaviour. Following the results obtained by Frijters et al. (2011), a more recent analysis regarding the use of new nicotine delivery products (NDP) has been conducted by Carrieri and Jones (2018). Using the Health Survey for England (HSE) data from 2002 to 2014, Carrieri and Jones (2018) find evidence of a strong influence by parents' use on the nicotine transmission through passive smoking to children (aged 4-14) with a higher impact of mothers than fathers. Further, the authors find a reduction of the transmission's level of cotinine after the diffusion in the use of e-cigarettes in England from 2010.

Smoking is very harmful and differences in the probability of smoking across populations lead to differences in death rates and illness. For this reason, smoking is the main driver of health inequalities in England, as stated by the Action on smoking and health (2019) report. Attitudes to smoking are related to socio-economic status, with disadvantaged people smoking more and consequently suffering from smoking-related illnesses and premature death. Moreover, smoking is related to geographical distribution. Indeed, in the north of England, health conditions are worse among people with higher rates of smoking compared to those living in the south of the country.

Reducing health inequalities through policy intervention on smoking behaviour requires population-level interventions that prioritise disadvantaged smokers. Smoking behaviour is most common among people with a mental health condition, with lower incomes, who are unemployed, in contact with the criminal justice system, who live in social housing, without qualifications and lone parents. Marmot (2013) defines six goals that can be achieved through the contribution of tobacco control. For instance, through the smoking ban regulations, it is feasible to create fair employment and good works for all, ensure a healthy standard of living for all and create healthy and sustainable places and communities. Anyanwu et al. (2020) analyse the long-term impacts of smoke-free public places legislation and legal age change for tobacco purchase in the UK on young people's smoking uptake and inequalities due to parental education. They used the British Household Panel Survey dataset and its follow-up Understanding Society between 1994 and 2016 to examine if there is an association between policy implementation and youth smoking transitions or inequalities related to parental education. The authors found that the long-term impacts of the smoking ban law on adult smoking cessation are inconsistent, while there is a reduction in adolescents quitting smoking as a result of the law. Further, the authors found that these policies may be effective in preventing and reducing socio-

economic inequalities in youth smoking initiation.
Our work aims at contributing to the literature analysing the impact of parental smoking behaviour after the policy implementation, to find out if the probability of smoking in young adults changes due to the combination of parental circumstances and the smoking ban policy.

3 Data

3.1 Smoking prevalence analysis using household-level data

Following the results of Jones et al. (2015), this first part of the analysis aims at replicating part of the authors' analysis to confirm the limited impact of the smoking ban policy on reducing smoking prevalence. In particular, in this work we did not only consider the heterogeneous effect by gender as the authors did, but also the smoking prevalence of all respondents. The British Household Panel Survey (University of Essex, Institute for Social and Economic Research (2018)) is an annual survey that follows the same representative sample of young adult (15+) household members sampled (more than 5,000) from 1991 to 2009 (i.e. from wave 1 to 18)(Taylor et al. (1993)). The data used in this work are from waves 10 to 18 of the BHPS, covering the period 2000-2009, to account for the additional samples that were added to the main sample in 1999 in Scotland to make the panel suitable for UK-wide research. The smoking ban policy in Scotland was introduced between waves 15 and 16, whereas the same policy in England was introduced between waves 16 and 17. Wave 1 (1991) consists of 5,500 households and 10,264 individuals from Wales, England and Scotland. Additional samples of 1,500 households in Scotland and Wales were added to the main sample in 1999 and a sample of 2,000 households in Northern Ireland was added in 2001. Our analysis considers only the England and Scotland observations from waves 10 to 18, focusing on the policy experiment through the introduction of an identical policy in these two countries, but at different times. The survey contains demographic variables (such as gender, ethnicity and age), information on household features (such as household income, number of children and household size), lifestyle variables (such as smoking attitudes, health status, health problems and subjective well-being) and job information.

3.1.1 Sample of interest and descriptive statistics

In this first analysis, the aim is to measure the smoking prevalence, the information which was obtained through the question "*Do you smoke cigarette?*". Using the variable "smoker", a dummy variable is generated with a value of 1 if the individual is a smoker, and 0 otherwise. The panel data analysis excludes individuals who never smoked throughout the 9 waves of the BHPS, thus capturing the effects of the policy on current smokers, ex-smokers and future smokers (i.e. potential smokers). Furthermore, the panel

data is balanced and takes into account individuals who answered in all nine waves. A fixed effects control is made for unobserved time-invariant individual heterogeneity, i.e. for unobservable variables that do not change over time for each individual, such as many individual traits or attitudes. Following the variables choices done by Jones et al. (2015), as covariates the models are conditioned on age and its squared value, a series of household information (marital status, household size, number of children in the household and annual household income), labour market status and current economic activity (self-employed, unemployed, retired, being in maternity leave or family care, student, long-term sick status, government training or other) and health variables (self-assessed general health, chest problem, heart problem, GHQ subjective well-being measure of distress and anxiety or depression problem). These covariates were broken down by gender and country of residence for the sample of potential smokers, as reported in Table A2 in the Appendix. Looking at the household variables, it is expected that families with higher income may reduce the probability of smoking because members can attain a high level of education, confirming the negative correlation between the level of education and smoking prevalence. In addition, it is expected that households with a higher number of children and household size may reduce the probability of smoking to ensure better health conditions for their children. Concerning the labour force status, retired, maternity leave status, family care status and long-term sick conditions may lead to a reduction in smoking prevalence, whereas unemployed and employed status may increase the probability of smoking. Looking at marital status, married people tend to smoke less compared to people who live in a couple, are separated, or have never been married or divorced, because married status leads to access to increased social, economic and psychological resources through spousal support that promotes overall well-being. As regards the health-related variables, having health problems could predict a reduction in the probability of smoking. Looking at the mean of the smoking prevalence, it is expected that there is a higher smoking attitude in Scotland than in England. Analysing the differences by gender, women tend to smoke more than men in both Scotland and England. Considering the number of cigarettes consumed, the highest quantity per day is in Scotland than in England and man tends to smoke more cigarettes than women in both Scotland and England.

3.2 Smoking prevalence analysis using parental smoking behaviour information

Smoking bans in public places are useful to avoid the effects of second-hand smoke on non-smokers individuals, to reduce the consumption of cigarettes and may increase smoking cessation rates among adult smokers. As described in the previous section, the smoking ban policy has a limited impact because, for instance, smokers can change locations if smoking is not allowed. For this reason, this regulation may lead to a perverse displace-

ment effect of smoking. Adda and Cornaglia (2010) have shown the negative effect of taxes and prices on the demand for cigarettes, but this does not mean that regular smokers uniformly reduce smoking. Moreover, they explain that if people tend to smoke as a social activity, a smoker may reduce the number of cigarettes consumed when alone or at home, and not those consumed in the company of other adults.
The analyses done by Jones et al. (2015) did not consider the impact of parental smoking behaviour on the offspring's attitudes towards smoking, thus this second analysis aims at contributing to the literature by finding out if parental smoking behaviour can affect the smoking attitude of young adults in the same period of the smoking ban policy implementation. The parents' smoking habit is identified through cigarette consumption. The policy, without considering the smoking behaviour of parents, is not statistically significant for young adults and has a positive impact on the probability of smoking. However, considering this second type of analysis, the policy may change its effect on the treatment group due to circumstances beyond the children's control.

3.2.1 Sample of interest and descriptive statistics

This analysis is conducted using the British Household Panel Survey, as done previously. The survey is at household-level, thus each respondent is matched with his or her relative (i.e. sibling, father, mother, partner). By combining the responses of offspring and parents, a new dataset was generated in which each young adult (15+) has a unique identification number and he/she is matched to their parents. The analysis is conducted by parents' attitudes towards cigarette consumption. Due to the limited number of observations, unbalanced panel data is used. Following the variables choices done by Jones et al. (2015), but with some adjustment of the number of categories for some variables, as covariates the models are conditioned on age and its squared value, on a series of household information (marital status, household size, number of children in the household and annual household income), on labour market status and current economic activity (self-employed and employed, unemployed, student and other) and especially the cigarettes consumed by the parents, whose question was *"Approximately how many cigarettes a day do you usually smoke?"*. In this respect, the question is only asked to smokers, however, as a possible answer there is also "0" for occasional or social smokers, namely people who declared to be a smoker but with an average daily consumption of 0 cigarettes per day. The continuous variable of cigarette consumption, both for offspring and parents, is re-coded to obtain a dummy variable that assumes a value equal to 0 up to 17 cigarettes a day (light/moderate smokers), 1 over 18 cigarettes a day (heavy smokers). For a robustness check, the continuous variable of cigarette consumption is transformed into three different dummy variables, namely:

1. a dummy variable that assumes a value equal to 0 up to 16 cigarettes per day, 1

over 17;

2. a dummy variable that assumes a value equal to 0 up to 18 cigarettes per day, 1 over 19;

3. a dummy variable that assumes a value equal to 0 up to 19 cigarettes per day, 1 over 20.

Table A3 in the Appendix reports a descriptive statistic with information about parents. Looking at the average probability of smoking in young adults, young adults in Scotland are expected to smoke less than young adults in England.
Looking at the mean probability of parental smoking, mothers are expected to smoke more than fathers in both Scotland and England. Considering the number of observations of each parent, it is expected that the mother's circumstances may have a higher impact than the fathers.
Considering the average cigarette consumption, both young adults and parents are expected to smoke more in Scotland than in England.
Further, Table 1 shows the mean of cigarettes consumed by sons and daughters, conditioned first on the number of cigarettes smoked by fathers and then on the number of cigarettes smoked by mothers. The results show that the mean of cigarettes smoked by young adults in the UK increases if the number of cigarettes consumed by parents increases. In addition, we find that the mean number of cigarettes consumed by young adults is statistically different for sons and daughters when the father smokes up to 17 cigarettes per day and the mother smokes over 18 cigarettes per day. Finally, Table A4 in the Appendix shows several transition matrices between the categories of the number of cigarettes consumed by parents and young adults.
In summary, there is a greater likelihood that both young adults and parents maintain the same cigarette consumption in the following year. In particular, comparing offspring and parents, the probability of consuming the same number of cigarettes is higher for parents than offspring, mainly for those who smoke over 18 cigarettes per day. Among offspring, daughters have a higher probability of remaining light/moderate smokers compared to sons. Among parents, mothers have a greater probability of remaining light/moderate smokers compared to fathers. In addition, in all transition matrices, all respondents are more likely to remain light/moderate smokers in the following year.

4 Empirical Strategy

4.1 Smoking prevalence and cigarette consumption analyses

To analyse the impact of the smoking ban policy, the empirical strategy adopted is a difference-in-difference model with a two-way fixed effect specification (TWFE), as suggested by Jones et al. (2009) for evaluating health policies in a panel data setting.

Tab. 1. Descriptive statistics on cigarettes smoked by young adults conditioned on cigarettes smoked by their parents

	Father		**Mother**	
Cigarettes consumption	*mean*	*Contrast*	*mean*	*Contrast*
up_to_17#Sons	0.3853	-0.2693****	0.1948	0.0087
up_to_17#Daughters	0.1160		0.2036	
over_18#Sons	0.5307	-0.0391	0.3427	-0.1017**
over_18#Daughters	0.4916		0.2410	
	N=288		N=770	

Notes: *$p < 0.10$ **$p < 0.05$,*** $p < 0.01$, ****$p < 0.001$.

This technique allows estimating treatment effects by comparing treatment and control groups to identify the differences in outcomes observed in the pre- and post-treatment periods, also considering the within-individual difference of a standard fixed effects estimator but without exploiting variation across individuals. However, the weighted sums of the average treatment effects in each group and period could be obtained through a linear regression whose weights may be mostly negative, leading to obtain a negative regression estimator while all the average treatment effects are positive. In this situation, a recent contribution was proposed by De Chaisemartin and d'Haultfoeuille (2020) who define an estimator that corrects this problem in the case of heterogeneous treatment effects and which could be considered in the future to test the robustness of our analysis.
The smoking ban law in Scotland was implemented one year earlier compared to the ban in England, thus the former was used as the treatment group and the latter as the control group. The use of a regression framework is more advantageous because regression provides standard errors for hypothesis testing, can be easily extended to multiple groups and periods, covariates can be included and aggregate data can be used. The analysis was conducted using the mean weights of each respondent between the first wave 10 and the last wave 18 to use a more representative longitudinal weight[5]. This work uses information on smoking behaviour from 2000 (wave 10) to 2007 (wave 16) to evaluate the

[5] The analysis was also conducted without taking into account the longitudinal weights of the last wave and the results are very similar.

impact of the policy in Scotland. Moreover, between waves 16 and 17, the same policy was introduced also in England, which can therefore no longer be considered as a control group after wave 16.
Considering as the main variables the enactment of the smoking ban and the probability of smoking in the UK, reverse causality is not an issue in our analysis because the enactment of the smoking ban law, whose aim is to change social norms and behaviour, is a result of beliefs and preferences. However, does not mean that the changes in smoking behaviour following the enactment of the smoking ban cause the enactment of the law.
Following Jones et al. (2015), a two-way fixed effects (2FE) estimator is used for the smoking prevalence analysis from 2000 to 2007, considering England as the control group. Further, a more flexible model with country-specific time trends is used, allowing the policy effect to vary by country and for the entire survey period (2000-2009). Concerning offspring smoking behaviour, the empirical strategy adopted is a difference-in-difference model with a two-way fixed effects (2FE) estimator and a triple interaction term that takes into account the information on parental smoking behaviour (i.e. cigarette consumption of parents).
In particular, a linear probability model with fixed effects is used, which considers firstly the offspring's smoking prevalence and secondly their cigarette consumption as dependent outcomes. In the latter case, a robustness check is performed by considering different transformations of the cigarette consumption variable of both parents and their offspring.

4.1.1 Model 1 -Difference-in-difference analysis: two-way fixed effects models

The two-way fixed effects model is conditioned on observed characteristics, time effects and time-invariant individual unobserved heterogeneity. The panel data estimator has the following form:

$$y_{it} = \alpha + \beta_i T_i + \beta_t P_t + \beta_T (T_i P_t) + \gamma X_{it} + v_t + \mu_i + \epsilon_{it} \tag{1}$$

where:

- y_{it} is the smoking prevalence of individual i at time t;
- T_i is the treatment dummy variable with a value equal to 1 if people residing in Scotland, 0 otherwise;
- P_t is the period dummy variable[6] with a value equal to 1 for the post-treatment period, 0 for the pre-treatment period;

[6] The post-treatment period is equal to wave 16 (2006-2007) because England can no longer be considered as a control group after wave 16 due to the application of the same policy between wave 16 and 17.

- β_T is the treatment effect of interest as the difference-in-difference estimator;
- all other β coefficients relate to the singular impact of the independent variables on Y when all other independent variables are equal to zero;
- X_{it} is a vector of individual observed features in period t, namely age, marital status, household variables, labour market status and health variables[7];
- μ_i captures the individual unobserved attributes effect that may be correlated with the outcome;
- v_t is the year dummies common to both treatment and control groups;
- ϵ_{it} is the error term.

Smoking prevalence is determined using a linear probability model with fixed effects, taking into account the differences by gender.
As an alternative to this model, the panel event study can be used as a further extension of this work, following the approach adopted by Clarke and Schythe (2020).

4.1.2 Model 2 - A country-specific time trend model

To identify the impact of smoking bans in each country, a more flexible fixed effects model is used following Jones et al. (2015), namely the country-specific time trends model. This model requires a decomposition of the treatment effect for Scotland and England, taking into account the different periods in which the policy was implemented. In empirical terms we have:

$$y_{it} = \alpha + S_i \sum_{t=1}^{T} \beta_{St} v_t + E_i \sum_{t=2}^{T} \beta_{Et} v_t + \gamma X_{it} + \mu_i + \epsilon_{it} \tag{2}$$

In this model, we have the interaction term between being resident in Scotland, β_{St}, and a set of time dummies, v_t, and the interaction term between being resident in England, β_{Et}, and a set of time dummies, v_t. To know how smoking behaviour changes across countries and over time is required a comparison between the country-specific time trends and the

[7] An important OLS assumption requires that the error term is uncorrelated with the dependent variable, otherwise an endogeneity problem may arise leading to biased and inconsistent estimations of parameters. If a variable is considered potentially endogenous, the common approach used is to lag the variable by one or more periods. In our data, the health variables can be potentially endogenous, so we lagged these variables by one period to account for endogeneity issues and the dynamism between changes in an individual's health and their current smoking decisions. By using lagged values, past values of health variables are unlikely to be subject to the same problem as current values that might be endogenous. An alternative way to solve the endogeneity problem is through approaches based on instrumental variables, whose main difficulty is related to the selection of appropriate instruments. Following the approach adopted by Jones et al. (2015), we used the lagged values.

baseline country-specific time trend (England in wave 10 without the ban on smoking). As with the two-way fixed effects model, the estimation is done through a linear probability model by gender.

4.1.3 Model 3 - Difference-in-difference model with parental smoking behaviour information

The number of observations in this unbalanced panel data is equal to 9.816. To better understand if the parents' cigarette consumption has an impact on the smoking behaviour of their offspring during the period of the smoking ban policy, a difference-in-difference analysis with a triple interaction term was performed. This model is used to investigate, initially, the smoking prevalence of offspring and, secondly, the intensity of offspring's smoking to analyse whether the type of smoker the parent is (i.e., light/moderate or heavy smokers) influences the type of smoker the offspring is (i.e., light/moderate or heavy smokers).
The analysis is conducted using two-way fixed effects model conditioned on observed characteristics, time effects and time-invariant individual unobserved heterogeneity. The panel data estimator has the following form:

$$y_{it} = \alpha+\beta_i T_i+\beta_t P_t+\beta_t N_i+\beta_{it} T_i P_t+\beta_{tt} P_t N_i+\beta_{it} T_i N_i+\beta_T (T_i P_t N_i)+\gamma X_{it}+\upsilon_t+\mu_i+\epsilon_{it} \quad (3)$$

where:

- y_{it} is the smoking prevalence or the cigarette consumption of offspring i at time t;
- T_i is the treatment dummy variable with a value equal to 1 if people residing in Scotland, 0 otherwise;
- P_t is the period dummy variable[8] with a value equal to 1 for the post-treatment period, 0 for the pre-treatment period;
- N_i is a dummy variable that looks at the number of cigarettes that the parents consume per day. This variable captures the impact of parental smoking behaviour on young adults' smoking habits during the same period of the policy implementation.
- β_T is the treatment effect of interest as the difference-in-difference estimator taking into account the parental smoking behaviour and describes the impact of a join increase of T_i, P_t, N_i on Y;

[8] The post-treatment period is equal to wave 16 (2006-2007) because England can no longer be considered as a control group after wave 16 due to the application of the same policy between waves 16 and 17.

- all other β coefficients relate to the singular or join impact of the independent variables on Y when all other independent variables are equal to zero;
- X_{it} is a vector of individual observed features in period t, namely age, marital status, household variables, and labour market status;
- μ_i captures the individual unobserved attributes effect that may be correlated with the outcome;
- v_t is the year dummies common to both treatment and control groups;
- ϵ_{it} is the error term.

The probability of young adult smoking behaviour (i.e. smoking prevalence and cigarette consumption) is determined using a linear probability model with fixed effects. Furthermore, the model is used also to check the robustness of the cigarette consumption analysis using the three dummy variable transformations described in section 3.2.1.

5 Results

5.1 Smoking prevalence analysis using household-level data - Model 1

By estimating 2FE models using equation 1, we analyse the impact of the smoking ban in Scotland on smoking prevalence over the period 2000-2007[9].

To assess any casual effect and to assure the internal validity of difference-in-difference models, the most challenging assumption to implement is the parallel trend one. This last key identifying assumption requires that the treatment group has similar trends to the control group in the absence of treatment. To the best of our knowledge, there is no statistical test to assess this assumption, however, a visual inspection is feasible, in fact Figures 1, 2 and 3 show the trends for each country. As can be seen from the graphs, considering the pooled model without heterogeneous effect by gender, the parallel trend assumption holds. Looking at the heterogeneous effect by gender, the hypothesis of the parallel trend may not be respected for men, but this could happen in the case of health policy interventions. Additional reasons may be linked to factors, such as race, correlated to pre-treatment periods. Controlling for differential times trends by an area's racial composition, for instance, could lead to solving this, but we did not do that. On the contrary, for women the assumption of the parallel trend holds.

[9] The tetrachoric correlations test between the probability of smoking and the impact of smoking bans displays that there is no a strong correlation between the two variables (r(Rho)=-0.0317 with a p-value=0.23).

Fig. 1. Graph of DiD analysis pooled model

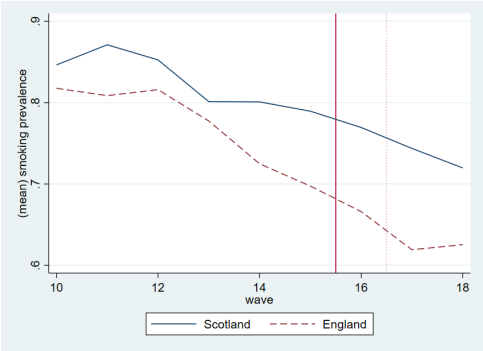


Fig. 2. Graph of DiD analysis with men respondents answers

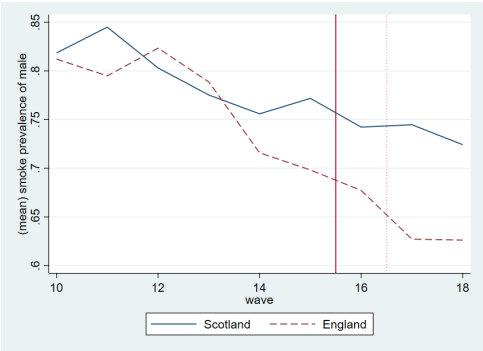


Fig. 3. Graph of DiD analysis with women respondents answers

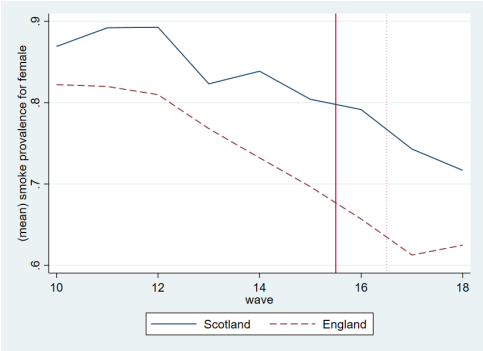


Table 2 shows the difference-in- difference results of a pooled model without heterogeneous effect by gender to display the average effect of the policy[10]. The treatment effect is small and statistically significant showing that the smoking ban policy increases the probability of smoking by 4.9% in Scotland. Looking at the time trend, wave 16 is statistically significant with a decrease in the probability of smoking starting from wave 15. Adding the age variables, these are statistically significant in all the models; specifically, the age squared allows us to model more accurately the effect of age, which may have a non-linear

[10] A multicollinearity test was performed and among all the covariates introduced into the models there is no or very small correlation ($0.01 < |r| < 0.3$).

relationship with the independent variable. In this model, the effect of age is positive up to a certain point (i.e. 54 years old) and then becomes negative. This happens in all the analyses, assuming that the effect is non-linear for age. As regards marital status, the coefficients of people who lived as a couple, separated and never married are statistically significant with a positive effect on the probability of smoking. Concerning the household variables, all coefficients are not statistically significant. Moreover, household size and the number of children decrease the probability of smoking, whereas the log of household income increases it. Looking at the labour force status, most of the coefficients have a negative impact on the probability of smoking, but are not statistically significant, except for the student coefficient. Finally, as regards the health-related variables, all coefficients are not statistically significant, with the exception of the indicator of subjective well-being and the very poor health status coefficients. Looking at the heterogeneous effect of the

Tab. 2. DiD results of the average effect of the policy

	1	2	3	4	5
DD estimator					
1.period	-0.144****	-0.173**	-0.175**	-0.181**	-0.174**
	(0.014)	(0.085)	(0.085)	(0.085)	(0.085)
1.treated# 1.period	0.045**	0.050**	0.048**	0.050**	0.049**
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Controls variables					
Time trends	Yes	Yes	Yes	Yes	Yes
Demographic variables		Yes	Yes	Yes	Yes
Marital status			Yes	Yes	Yes
Household variables			Yes	Yes	Yes
Labour force status				Yes	Yes
Health variables					Yes
N	10289	10289	10289	10289	10289

Notes: Cluster standard error in parentheses,*$p < 0.10$ **$p < 0.05$,*** $p < 0.01$, ****$p < 0.001$. The panel data is balanced without taking into account individuals that had never smoked across all the waves.

policy by gender[11], in Table 3 the difference-in- difference results for men are shown. The DID estimator is not statistically significant, confirming the low impact of the smoking ban policy for men. Considering the time trend, there is a decrease in the smoking probability in wave 16 which is also statistically significant at a 10% significance level. The age variables are statistically significant. Among marital status categories, all coefficients

[11] Similar results are obtained using a triple interaction term that takes into account the gender effect after the policy implementation.

tend to increase the probability of smoking, but the effect is not statistically significant, except for people who have never married. Concerning the household variables, the coefficients are not statistically significant. As regards the labour force status, all coefficients are not statistically significant, except for student status which reduces the probability of smoking for men. Considering the health variables, the coefficient of anxiety problems is statistically significant and increases the probability of smoking. Very poor health status is also statistically significant and reduces the probability of smoking for men.

Tab. 3. DiD results for men respondents

	1	2	3	4	5
DD estimator					
1.period	-0.126****	-0.159*	-0.157*	-0.178*	-0.165*
	(0.022)	(0.091)	(0.090)	(0.091)	(0.091)
1.treated#1.period	0.037	0.040	0.042	0.043	0.042
	(0.029)	(0.029)	(0.029)	(0.030)	(0.030)
Controls variables					
Time trends	Yes	Yes	Yes	Yes	Yes
Demographic variables		Yes	Yes	Yes	Yes
Marital status			Yes	Yes	Yes
Household variables			Yes	Yes	Yes
Labour force status				Yes	Yes
Health variables					Yes
N	4590	4590	4590	4590	4590

Notes: Cluster standard error in parentheses,*$p < 0.10$ **$p < 0.05$,*** $p < 0.01$, ****$p < 0.001$. The panel data is balanced without taking into account individuals that had never smoked across all the waves.

Table 4 shows the difference-in-difference results for women. The DiD estimator related to the difference-in-difference results for women is positive and statistically significant showing an increase in the probability of smoking by 5.7% for women in Scotland after the smoking ban policy. Looking at the time trend, there is a reduction in smoking prevalence over time, but it is not statistically significant. The age-squared variable is statistically significant, confirming the non-linear effect of age. As regards marital status, living as a couple, separated or never married status are statistically significant coefficients and all increase the probability of smoking. Looking at the household variables, all coefficients are not statistically significant. Furthermore, household size and the number of children have a negative impact on smoking prevalence. Looking at the labour force status and health status variables, the coefficients are not statistically significant, except for the GHQ coefficient which is a zero-coefficient but statistically significant. Table A5 in the Appendix displays all the coefficients of the controls variables used in the Model 1 in order to check the possible contextual differences.

Tab. 4. DiD results for women respondents

	1	2	3	4	5
DD estimator					
period=1	-0.159****	-0.187	-0.185	-0.185	-0.188
	(0.019)	(0.144)	(0.142)	(0.142)	(0.141)
1.treated#1.period	0.051*	0.059**	0.052*	0.056**	0.057**
	(0.027)	(0.027)	(0.027)	(0.026)	(0.027)
Controls variables					
Time trends	Yes	Yes	Yes	Yes	Yes
Demographic variables		Yes	Yes	Yes	Yes
Marital status			Yes	Yes	Yes
Household variables			Yes	Yes	Yes
Labour force status				Yes	Yes
Health variables					Yes
N	5699	5699	5699	5699	5699

Notes: Cluster standard error in parentheses,*$p < 0.10$ **$p < 0.05$,*** $p < 0.01$, ****$p < 0.001$. The panel data is balanced without taking into account individuals that had never smoked across all the waves.

To sum up, the interaction effects display an increase in the probability of smoking of all respondents and of women after the introduction of smoking ban in Scotland. These results are not surprising considering that the ban was partial due to some exemptions for its implementation, as we mentioned in Section 1. As analysed by Catalano and Gilleskie (2021), the distinction between partial and full ban is essential because if the smoking is prohibited in the main room of the bars and restaurants but there is a dedicated room for smokers, thus there is less probability of a smoking reduction than if there is no public place to smoke. In addition, the peer effect is relevant because people smoke more by grouping them together in the dedicated smoking area or private place, considering the smoking action more socially acceptable.

Alternative tests based on the placebo test were used to test the hypothesis of parallel trends. In particular, in Table A6 in the Appendix we confirmed the assumption of equal trends by performing difference-in-difference models using a "fake" treatment group (in the first part of Table A6), namely a group that is not affected by the smoking ban and therefore should have zero impact on smoking prevalence (i.e., Scotland in wave 13 is considered as treated group and England as control group). In addition, we also performed a placebo test with a "fake" outcome (in the second part of Table A6), namely the number of people in the household. Considering that the smoking ban policy did not affect this outcome variable, the difference-in-difference estimation should find a zero impact on this outcome variable.

5.2 Smoking prevalence analysis using household-level data - Model 2

Using equation 2, Table 5 reports the average marginal effects, computed after the linear regression, which show a reduction in the probability of being a smoker in both countries and by gender, but the corresponding average marginal effects are not statistically significant.

Regarding the control variables added to the model, for both men and women the age

Tab. 5. Results of country-specific time trend analysis by gender for smoking prevalence, in term of average marginal effects. Cluster standard error in parentheses

		Average marginal effects	
Period (wave 11 as base outcome)	**Country**	**Men**	**Women**
wave 12: 2002-2003	England	0.0325	0.0029
		(0.0259)	(0.0282)
	Scotland	-0.0369	0.0178
		(0.0286)	(0.0349)
wave 13: 2003-2004	England	0.0009	-0.0341
		(0.0411)	(0.0512)
	Scotland	-0.0261	-0.0311
		(0.0461)	(0.0626)
wave 14: 2004-2005	England	-0.0576	-0.0568
		(0.0587)	(0.0757)
	Scotland	-0.0363	-0.0035
		(0.0669)	(0.0838)
wave 15: 2005-2006	England	-0.0925	-0.0989
		(0.0758)	(0.0992)
	Scotland	-0.0373	-0.0444
		(0.0817)	(0.1072)
wave 16: 2006-2007	England	-0.1158	-0.1321
		(0.0939)	(0.1241)
	Scotland	-0.0751	-0.0543
		(0.0974)	(0.1319)
wave 17: 2007-2008	England	-0.1600	-0.1691
		(0.1131)	(0.1487)
	Scotland	-0.0836	-0.0961
		(0.1167)	(0.1530)
wave 18: 2008-2009	England	-0.1617	-0.1433
		(0.1287)	(0.1731)
	Scotland	-0.0831	-0.1012
		(0.1339)	(0.1761)
Observations		6,081	7,545

squared is statistically significant confirming the non-linear effect for age. For men, the coefficients of the marital status are not statistically significant with a positive impact on the probability of smoking. For women, on the other hand, marital status coefficients are statistically significant, except those widowed, and increase the probability of smoking with the highest impact for never married females. Looking at the household variables, for both men and women the coefficients are not statistically significant, except the log household income whose increment leads to a higher probability of smoking of women.

Regarding labour force status, student status (for both genders) and retired status (only for men) are statistically significant with a negative impact on smoking prevalence. Finally, regards to health variables, for men, a state of anxiety and depression increases the probability of smoking, while a very poor health status decreases it and both statuses are statistically significant. For women, on the other hand, the only statistically significant health variable is GHQ, the increase in which has a positive impact on smoking prevalence. To sum up, there are declining trends in smoking prevalence across countries and by gender. However, the probability of being a smoker does not decrease more rapidly in wave 16 for Scotland and wave 17 for England after the implementation of the policy, confirming the small impact of the policy also found by Jones et al. (2015)[12].
In Figures 4 and 5 the graphical representation of the average marginal effects for males and females are shown, respectively.

Fig. 4. Graph of country-specific time trend model-Men

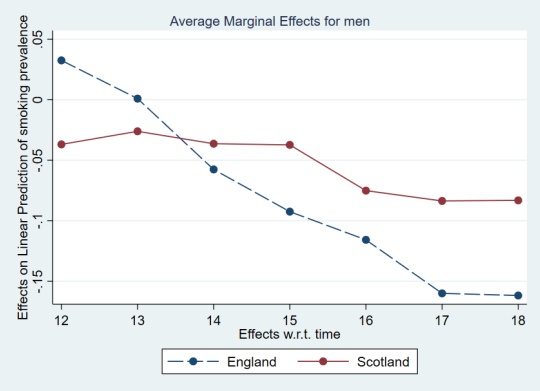
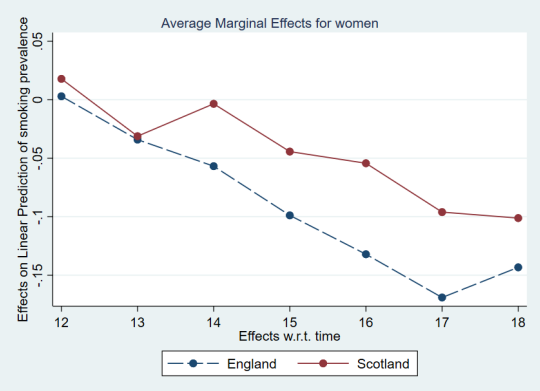


Fig. 5. Graph of country-specific time trend model-Women



[12] This statement is demonstrated through a test in order to see if the probability of smoking changes significantly across waves, taking as starting point the wave 15. The p-value is > 0.05, thus we cannot reject the null hypothesis stating that the difference between the coefficients is equal to zero.

5.3 Smoking prevalence analysis using parental smoking behaviour information - Model 3

Using equation 1, Table A7 in the Appendix displays the smoking ban policy impacts on the smoking prevalence of offspring without considering parental smoking behaviour[13]. The results confirm the lack of impact of the smoking ban policy.
Using equation 3, Table 6 shows the synthetic results of the difference-in differences approach considering as the dependent variable the smoking prevalence of offspring, while Table A9 in the Appendix shows also the coefficients of each control variables introduced in the Model 3[14]. Looking at the triple interaction terms that take into account whether or not the parents are heavy smokers, the coefficients are positive, but not statistically significant in Scotland. This means that when considering the effect of the policy, combined with the cigarette consumption of parents, it does not have a significant effect on smoking prevalence in young adults, confirming the limited impact of the smoking ban policy to achieve one of its objectives. This may be because the policy was only implemented in public places and not in private homes, so if parents smoke at home, where it is allowed, their children may follow their parents' behaviour (smoking displacement effect).
Considering the effect of the control variables, no control variable is statistically significant, except for unemployed status, which is statistically significant at a 10% level and increases the probability of being a moderate/heavy smoker offspring.

Figures 6 displays that the key identifying assumption of parallel trend in the DiD models is respected.

5.4 Cigarette consumption analysis using parental smoking behaviour information - Model 3

Using equation 1, Table A8 in the appendix shows a limited and negative impact of the smoking ban policy on cigarette consumption of offspring without considering parental smoking behaviour. Using equation 3, Table 7 shows the results of the difference-in differences approach considering as dependent variable the cigarette consumption of offspring as a dummy variable, while Table A10 in the Appendix displays the coefficients of each control variables considered in the Model 3[15]. Looking at the triple interaction

[13] The tetrachoric correlations test between the probability of smoking of offspring and the impact of smoking bans displays that there is no a strong correlation between the two variables (r(Rho)=-0.066 with a p-value=0.09).

[14] A multicollinearity test was performed and among all the covariates introduced in the model there is no or small correlation ($0.01 < |r| < 0.3$).

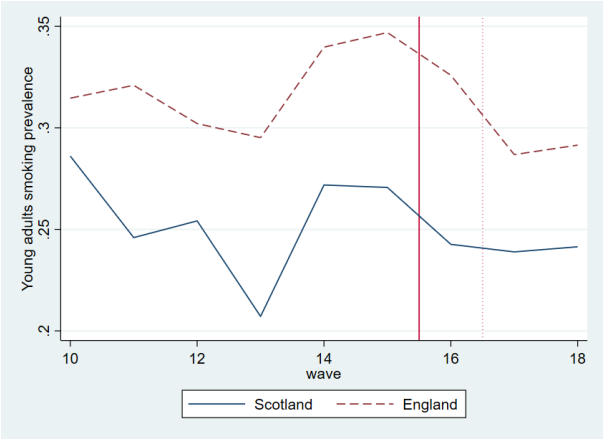
[15] A multicollinearity test was performed and among all the covariates introduced in the model there is no or small correlation ($0.01 < |r| < 0.3$).

Tab. 6. DiD smoking prevalence analysis considering the smoking behaviour of parents

Smoking prevalence	1	2	3	4
DD estimator				
period=1	-0.001	0.170	0.191	0.195
	(0.057)	(0.143)	(0.140)	(0.146)
1.heavy smokers parents	-0.012	-0.008	-0.009	-0.009
	(0.027)	(0.026)	(0.026)	(0.026)
1.period# 1.heavy smokers parents	0.037	0.031	0.033	0.027
	(0.059)	(0.059)	(0.059)	(0.059)
1.treated # 1.heavy smokers parents	0.031	0.024	0.024	0.025
	(0.073)	(0.072)	(0.071)	(0.072)
1.treated # 1.period#0.light/mod. smokers parents	0.110	0.101	0.101	0.104
	(0.084)	(0.094)	(0.095)	(0.096)
1.treated #1.period#1.heavy smokers parents	-0.085	-0.079	-0.075	-0.076
	(0.112)	(0.119)	(0.118)	(0.118)
Control variables				
Time trends	Yes	Yes	Yes	Yes
Demographic variables		Yes	Yes	Yes
Marital status			Yes	Yes
Household variables			Yes	Yes
Labour force status				Yes
N	1606	1606	1606	1606

Notes: Cluster standard error in brackets,*$p < 0.10$ **$p < 0.05$,*** $p < 0.01$, ****$p < 0.001$. The panel data is unbalanced without considering individuals who never smoked in all waves.

Fig. 6. Graph of DiD results, considering the smoking prevalence of young adults



terms that take into account parental cigarette consumption, the coefficient of parents being light/moderate smokers after the policy implementation is negative and statistically significant at the 5% level in Scotland. This means that if parents are light/moderate smokers, the probability of their offspring being heavy smokers decreases after the introduction of the smoking ban policy.

Considering the effect of the control variables, household income is the only coefficient statistically significant at a 5% level and increases the probability of being heavy smokers offspring.

Alternative tests based on the placebo test were used to test the hypothesis of parallel

Tab. 7. DiD cigarette consumption analysis considering the smoking behaviour of parents

Cigarette consumption	1	2	3	4
DD estimator				
period=1	0.102	0.848	0.678	0.698
	(0.091)	(0.521)	(0.503)	(0.501)
1.heavy smokers parents	0.003	0.005	-0.007	-0.013
	(0.062)	(0.065)	(0.065)	(0.066)
1.period# 1.heavy smokers parents	-0.132	-0.127	-0.116	-0.140
	(0.107)	(0.104)	(0.097)	(0.096)
1.treated # 1.heavy smokers parents	0.037	0.046	0.065	0.070
	(0.076)	(0.075)	(0.074)	(0.076)
1.treated # 1.period#0.light/mod. smokers parents	**-0.173****	**-0.167****	**-0.175****	**-0.197****
	(0.085)	(0.085)	(0.080)	(0.083)
1.treated #1.period#1.heavy smokers parents	0.138	0.126	0.147	0.146
	(0.125)	(0.124)	(0.119)	(0.117)
Control variables				
Time trends	Yes	Yes	Yes	Yes
Demographic variables		Yes	Yes	Yes
Marital status			Yes	Yes
Household variables			Yes	Yes
Labour force status				Yes
N	722	722	722	722

Notes: Cluster standard error in brackets,*$p < 0.10$ **$p < 0.05$,*** $p < 0.01$, ****$p < 0.001$. The panel data is unbalanced without considering individuals who never smoked in all waves.

trends. As in the previous analysis for smoking prevalence of all respondents, in Table A11 in the Appendix we confirmed the assumption of equal trends by performing difference-in-difference models using a "fake" treatment group (in the first part of Table A11), i.e. Scotland in wave 14 is considered as treated group and England as control group. In addition, we also performed a placebo test with a "fake" outcome (in the second part of Table A11), namely the number of people in the household.
Further, when we use cigarette consumption of both offspring and parents, we see that estimates are rather unstable if we define light/moderate smokers as those who smoke less than 15 cigarettes. However, when the group of light/moderate smokers includes individuals who smoke over 16, 17 18, or 19, estimates are stable and similar. As a robustness check, Table A12 in the Appendix displays the results of the three dummy variable transformations for the cigarette consumption analysis that confirm the findings display in Table 7.

6 Conclusions

This work confirms the results of Jones et al. (2015), namely that the smoking ban had a small and positive impact on the probability of smoking. Considering the heterogeneous effect by gender, the probability of smoking after the policy implementation is higher for women than for men. Jones et al. (2015) show that the effectiveness of a smoking ban may depend on the type of smokers, looking at the age and pre-ban levels of smoking

consumption. Furthermore, the small impact of this policy on smoking prevalence is not a surprising result considering the specific aims of the policy (i.e. to reduce the effects of second-hand smoke, which also has a positive impact on the environment, and the consumption of cigarettes). In this regard, the analysis conducted assessed the short-term impact of the smoking ban, thus a log-term analysis is required to better understand its impact. As an extension of the previous results, an analysis of the impact of parental smoking behaviour during the implementation of the smoking ban was conducted. In this regard, this is the first work to examine the effect of parental behaviour towards smoking using a causal empirical design, as there are no other studies that have considered the possible effect of parental smoking behaviour after the implementation of the smoking ban.

The findings and the robustness check show that, if parents are light/moderate smokers, the probability of their offspring being heavy smokers decreases after the policy implementation.

However, some authors find that smokers can change locations if smoking is not allowed as well as the period within a day during which cigarettes are smoked. For this reason, this regulation may lead to a perverse displacement of smoking. Whether this latter effect happens, it could lead to a deleterious effect on health especially for young with smoking parents at home. Further, young people living with a parent who smokes are more likely to smoke themselves. However, some evidence (i.e. Frazer et al. (2016), Monson and Arsenault (2017)) reject the displacement theory against the alternative hypothesis that smoking bans lead to an increase in voluntary smoking bans in the home. In this regard, evidences (i.e. Hyland et al. (2009)) show that after the policy implementation, smoking behaviour at home did not change. Moreover, Nanninga et al. (2018) review the overall impact of public smoking bans on children's second-hand smoke exposure at home. Through a meta-analysis, it was found that the smoking ban policy has so far not led to a shift in smoking, but further studies are needed to better understand this phenomenon. Finally, additional findings could be achieved by considering other tobacco control measures (such as changes in the price of cigarettes) and their effects on young people's exposure to second-hand smoke at home, also considering parental smoking behaviour. As further extensions of this work, it is feasible to investigate what might happen if a smoking ban rule in private places was implemented in the UK by parents, how the parental smoking behaviour would change after the policy implementation and whether this circumstance is relevant in other countries (such as Germany). As a methodological analysis, a panel event study analysis and an ordered logit model with fixed-effects can be applied. Finally, due to a large number of missing values for the cigarette consumption analysis, the results have to be interpreted with caution and as further extension is feasible to work with the original continuous variable instead of with the dummy transformation.

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Appendix

Tab. A1. Tobacco regulation from 1990-2009 in the UK

Period	Description of the main event
1990s	Introduction of a smoking ban in many workplaces and enclosed public places such as cinemas, transport and in a few pubs, bars and restaurants with spontaneous adherence.
1998	The first "Smoking Kills" white paper on tobacco was published by the Labour government, with a focus on education, spontaneous adherence on the smoking ban and nicotine replacement therapy, with the aim of inducing people to stop smoking and reducing consumption among children and young people.
1999	A code of conduct on passive smoking in the workplace was proposed but never approved to avoid a reduction in profits and job losses in hospitality industry and tobacco manufacturers.
2000s	There has been little support for the spontaneous ban, which has led to increased pressure within and outside government for a mandatory ban, with relevant opposition in parliament and beyond. The UK government publishes its Tobacco Advertising and Promotion Bill which aims to ban all forms of tobacco advertising across the UK.
2002	The British Medical Association asked a smoking ban in public places to preserve the health of non-smokers due to the higher rate of lung cancer and coronary health disease recorded in 1998 and caused by passive smoking.
2003	The Tobacco Advertising and Promotion Act is implemented, ending tobacco advertising on billboards and in the print media and banning direct mail, internet advertising and new promotions. In the annual report for 2002 was introduced the recommendation of adopting a compulsory smoking ban in public places in the UK to reduce the health risk from passive smoking.
29 March 2004	The Republic of Ireland has introduced a full smoking ban in workplaces and public places.
21 December 2004	The tobacco advertising point of sale regulations are confirmed and enter into force. One third of the surface area of a single A5-sized advertisement must include a health warning. The Scottish First Minister announces that Scotland will introduce a total ban on smoking in workplaces and public places.
March 2005	A British Medical Journal report showed how the passive smoking killed 11,000 a year in the UK.
April 2005	The Labour Party's 2005 manifesto introduced a partial smoking ban with the exemption of private members' clubs and non-food pubs imposed by John Reid.
19 December 2005	Fears are growing that some pubs will stop serving food to avoid the ban. Committee's members signed up to get rid of the exemptions for private member clubs and non-food pubs.
2006	Introduction of a smoking ban in public places in Scotland on 26 March. The Government launches a consultation on proposals to include picture warnings on tobacco products and to raise the minimum age for the purchase of tobacco from 16 to 18.
2007	Introduction of a smoking ban in enclosed workplaces and public places in England on 1 July. Introduction of the law raising the legal age for purchase of tobacco from 16 to 18. Cigarette manufacturers must include picture warnings on the packs of cigarettes from October 2008. The VAT on stop smoking aids will be reduced to the lowest level (5% instead of 17.5%) from 1 July, coinciding with the implementation of the indoor smoking ban. Introduction of the smoke-free legislation in Wales (2nd April) and in Northern Ireland (30th April).
2008	The smoking ban is extended to Mental Health Units. Cigarette sales in England reduced by 6.3% following the smoking ban.
2009	Small shops have until 2015 to comply with the display ban. Tobacco tax increases above inflation are announced in the annual budget. New tobacco control measures in Scotland to restrict sales of tobacco products to young people (i.e., banning cigarette vending machines and point of sale displays of tobacco products).

Tab. A2. Descriptive statistics for all respondents

Descriptive statistics												
	Scotland						**England**					
	Pooled		**Men**		**Women**		**Pooled**		**Men**		**Women**	
Variables	*Obs*	*Mean*	*Obs*	*Mean*	*Obs*	*Mean*	*Obs*	*Mean*	*Obs*	*Mean*	*Obs*	*Mean*
Smoker	4509	0.7942	1989	0.7622	2520	0.8195	11583	0.7287	5238	0.7268	6345	0.7302
n. Cigarette consumption	3560	16.558	1503	17.923	2057	15.561	8357	14.460	3771	15.183	4586	13.865
Age	4509	46.812	1989	45.680	2520	47.706	11583	43.501	5238	42.986	6345	43.926
Household variables												
Number of own children in household	4509	0.5280	1989	0.4786	2520	0.5670	11583	0.6005	5238	0.5954	6345	0.6047
Annual household income	4420	26389.7	1955	28884.2	2465	24411.3	11364	31181.4	5141	32514.8	6223	30079.8
Real equivalised hh ann. income	4417	21760.6	1952	23212.3	2465	20611	11362	24160.1	5139	25000	6223	23466.6
Household size	4509	2.63473	1989	2.67521	2520	2.60278	11583	2.8705	5238	2.93795	6345	2.81481
Log household income	4410	9.9472	1950	10.030	2460	9.880	11337	10.1317	5123	10.192	6214	10.082
Labour market status												
Self employed	237	0.0526	167	0.084	70	0.0278	767	0.0662	549	0.1048	218	0.0344
Employed	2352	0.5217	1121	0.5639	1231	0.4885	6459	0.5576	3196	0.6102	3263	0.5143
Unemployed	249	0.0552	162	0.0815	87	0.0345	546	0.0471	302	0.0577	244	0.0385
Retired	768	0.1704	255	0.1283	513	0.2036	1564	0.135	625	0.1193	939	0.148
Maternity leave	8	0.0018	0	0	8	0.0032	36	0.0031	0	0	36	0.0057
Family care	287	0.0637	20	0.0101	267	0.106	1069	0.0923	38	0.0073	1031	0.1625
Student	74	0.0164	25	0.0126	49	0.0194	330	0.0285	139	0.0265	191	0.0301
Long-term sick	473	0.1049	219	0.1102	254	0.1008	670	0.0578	337	0.0643	333	0.0525
Government training	3	0.0007	3	0.0015	0	0	25	0.0022	6	0.0011	19	0.003
Other jobs	57	0.0126	16	0.008	41	0.0163	117	0.0101	46	0.0088	71	0.0112
Marital status												
Married	2107	0.4674	991	0.4982	1116	0.443	5884	0.5081	2837	0.5416	3047	0.4804
Living as couple	671	0.1488	334	0.1679	337	0.1338	1846	0.1594	851	0.1625	995	0.1569
Widowed	313	0.0694	66	0.0332	247	0.0981	488	0.0421	103	0.0197	385	0.0607
Divorced	498	0.1105	155	0.0779	343	0.1362	992	0.0857	300	0.0573	692	0.1091
Separated	171	0.0379	73	0.0367	98	0.0389	252	0.0218	95	0.0181	157	0.0248
Never married	748	0.1659	370	0.186	378	0.1501	2115	0.1826	1050	0.2005	1065	0.1679
Health variables												
Anxiety or depression	4442	0.1535	1961	0.0943	2481	0.2003	11411	0.1132	5153	0.0692	6258	0.1494
SAH Excellent	694	0.154	313	0.1574	381	0.1513	2013	0.1739	987	0.1885	1026	0.1618
SAH Good	2017	0.4475	893	0.449	1124	0.4464	5557	0.48	2510	0.4794	3047	0.4805
SAH Fair	1146	0.2543	538	0.2705	608	0.2415	2778	0.24	1258	0.2403	1520	0.2397
SAH Poor	507	0.1125	184	0.0925	323	0.1283	949	0.082	361	0.0689	588	0.0927
SAH Very Poor	143	0.0317	61	0.0307	82	0.0326	280	0.0242	120	0.0229	160	0.0252
Chest problems	4442	0.1771	1961	0.1846	2481	0.1713	11411	0.1468	5153	0.1385	6258	0.1537
Heart problems	4442	0.1913	1961	0.1738	2481	0.2051	11411	0.1389	5153	0.1434	6258	0.1353
Subjective wellbeing (GHQ)	4304	12.0867	1892	11.1369	2412	12.8317	11158	11.6672	5008	10.5811	6150	12.5517

Notes: This table shows the number of observations and mean values of all variables required for the analysis of the smoking ban policy, from waves 10 to 18. In this descriptive statistics, individuals who are not listed in all the nine waves and who never smoked in all waves have been removed. This descriptive analysis is presented for the pooled sample (men and women), as well as for men and women separately for each region.

Tab. A3. Descriptive statistics of young adults and their parents

	Scotland						England					
	Pooled		***Men***		***Women***		***Pooled***		***Men***		***Women***	
Variables	*Obs*	*Mean*	*Obs*	*Mean*	*Obs*	*Mean*	*Obs*	*Mean*	*Obs*	*Mean*	*Obs*	*Mean*
Household variables												
Number of own children in household	2489	0.0594	1359	0.0206	1120	0.1071	7255	0.0607	3947	0.0268	3278	0.1021
Annual household income	2384	39557.4	1316	41278.7	1068	37436.4	7048	42464.8	3848	42800.2	3200	42061.4
Log household income	2381	10.4	1315	10.4263	1066	10.3676	7047	10.5043	3848	10.5064	3199	10.5019
Real equivalised hh ann. income	2384	22212.5	1316	23194.5	1068	21002.4	7048	23869.8	3848	24368	3200	23270.7
Household size	2489	3.7963	1359	3.75202	1120	3.85	7255	3.94707	3947	3.85432	3278	4.06071
Young adult variables												
Smoker	2489	0.2679	1359	0.2788	1120	0.2553	7255	0.3019	3947	0.3242	3278	0.2766
N.cigarette consumption	667	12.0630	379	11.6517	286	12.5874	2191	11.8712	1280	13.0766	907	10.1786
Age	2489	21.593	1359	21.8874	1120	21.3277	7255	22.5150	3947	22.8882	3278	22.11592
Labour force status												
Self employed and employed	1270	0.5287	722	0.5507	543	0.50	3936	0.5628	2287	0.6006	1639	0.5161
Unemployed	210	0.0874	143	0.1091	67	0.0617	553	0.0791	328	0.0861	225	0.0708
Student	789	0.3285	388	0.2960	401	0.3692	2152	0.3077	1061	0.2786	1091	0.3435
Other jobs	133	0.0554	58	0.0442	75	0.0691	353	0.0505	132	0.0347	221	0.0696
Marital status												
Child under 16	45	0.0181	26	0.0191	19	0.0170	145	0.0200	71	0.0180	74	0.0226
Married and living as couple	75	0.0302	26	0.0191	49	0.0438	409	0.0564	158	0.0401	251	0.0766
Widowed, Divorced, Separated	48	0.0193	24	0.0177	24	0.0214	187	0.0258	118	0.0299	69	0.0211
Never married	2319	0.9324	1282	0.9440	1027	0.9178	6508	0.8978	3597	0.9120	2881	0.8797
Parents variables												
	Scotland						England					
	Father		***Mother***				***Father***		***Mother***			
	Obs	*Mean*	*Obs*	*Mean*			*Obs*	*Mean*	*Obs*	*Mean*		
Smoker	2489	0.1297	2489	0.2920			7255	0.1075	7255	0.2281		
N.cigarette consumption	323	21.3467	727	17.06878			780	16.3192	1655	15.4060		
Age	1433	51.52477	2309	48.5366			4330	52.798	6693	49.5084		
Labour force status												
Self employed and employed	1111	0.7930	1572	0.6974			3365	0.8020	4590	0.7019		
Unemployed	52	0.0371	48	0.0213			91	0.0217	104	0.0159		
Student	4	0.029	22	0.098			-	-	30	0.046		
Other jobs	7	0.1670	612	0.2715			740	0.1764	1815	0.2776		
Marital status												
Child under 16	-	-	-	-			-		-	-		
Married and living as couple	1280	0.8932	1669	0.7228			3890	0.8984	5155	0.7702		
Widowed, Divorced, Separated	20	0.014	579	0.2508			22	0.0051	1434	0.2143		
Never married	8	0.0056	61	0.0264			1	0.0002	104	0.0155		

Notes: This table displays the descriptive statistics for the variables of young adults and their parents. The household variables are the same for all. The panel data is unbalanced and young adults who never smoked in waves 10 to 18 and 14 to 18 have been removed.

Tab. A4. Transition matrices between categories of the number of cigarettes smoked by parents and offspring

OFFSPRING

Cigarettes consumption	*up_to_17*	*over_18*	*Total*
up_to_17	89.45	10.55	100.00
over_18	28.65	71.35	100.00
Total	73.92	26.08	100.00

SONS

Cigarettes consumption	*up_to_17*	*over_18*	*Total*
up_to_17	88.42	11.58	100.00
over_18	26.94	73.06	100.00
Total	70.62	29.38	100.00

DAUGHTERS

Cigarettes consumption	*up_to_17*	*over_18*	*Total*
up_to_17	90.93	9.07	100.00
over_18	32.74	67.26	100.00
Total	79.29	20.71	100.00

FATHERS

Cigarettes consumption	*up_to_17*	*over_18*	Total
up_to_17	82.58	17.42	100.00
over_18	15.94	84.06	100.00
Total	46.06	53.94	100.00

MOTHERS

Cigarettes consumption	*up_to_17*	*over_18*	Total
up_to_17	87.56	12.44	100.00
over_18	15.48	84.52	100.00
Total	55.02	44.98	100.00

PARENTS

Cigarettes consumption	*up_to_17*	*over_18*	Total
up_to_17	84.77	15.23	100.00
over_18	16.24	83.76	100.00
Total	49.84	50.16	100.00

Tab. A5. Model 1: Coefficients estimate for pooled, male and female models for the smoking prevalence analysis of all respondents (Continue to next page)

Smoking prevalence	Pooled	Men	Women
DiD estimator			
1.period	-0.174**	-0.165*	-0.188
	(0.085)	(0.091)	(0.141)
1.treated × 1.period	**0.049****	0.042	**0.057****
	(0.020)	(0.030)	(0.027)
Time trend (wave=11 as reference)			
wave=12	0.001	0.004	-0.005
	(0.019)	(0.023)	(0.030)
wave=13	-0.042	-0.027	-0.057
	(0.036)	(0.039)	(0.059)
wave=14	-0.078	-0.082	-0.080
	(0.052)	(0.057)	(0.086)
wave=15	-0.124*	-0.117	-0.134
	(0.069)	(0.074)	(0.113)
Demographic variables			
Age	0.037**	0.033*	0.040
	(0.018)	(0.020)	(0.030)
Age squared	-0.000****	-0.000**	-0.000***
	(0.000)	(0.000)	(0.000)
Marital status (married as reference)			
Living as couple	0.105***	0.065	0.137***
	(0.037)	(0.049)	(0.053)
Widowed	0.033	0.104	0.036
	(0.044)	(0.121)	(0.049)
Divorced	0.021	-0.040	0.067
	(0.038)	(0.062)	(0.049)
Separated	0.097***	0.041	0.139****
	(0.034)	(0.060)	(0.040)
Never married	0.184****	0.114*	0.236****
	(0.042)	(0.060)	(0.057)
Household variables			
Household size	-0.006	0.006	-0.019
	(0.008)	(0.011)	(0.012)
Number of own children in household	-0.003	-0.007	-0.008
	(0.014)	(0.022)	(0.019)
Log household income	0.000	-0.014	0.013
	(0.009)	(0.016)	(0.010)

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Labour force status (Self-employed as reference)			
Employed	0.022	0.002	0.061
	(0.032)	(0.042)	(0.053)
Unemployed	0.001	-0.004	0.022
	(0.034)	(0.046)	(0.056)
Retired	-0.031	-0.062	0.018
	(0.038)	(0.055)	(0.057)
Maternity leave	-0.053		0.011
	(0.086)		(0.094)
Family care	-0.010	-0.123	0.037
	(0.038)	(0.095)	(0.056)
Student	-0.127**	-0.181**	-0.064
	(0.058)	(0.090)	(0.081)
Long-term sick	-0.024	-0.037	0.014
	(0.035)	(0.047)	(0.057)
Government training scheme	0.058	0.067	0.080
	(0.092)	(0.063)	(0.147)
Others	0.005	-0.078	0.076
	(0.043)	(0.066)	(0.061)
Health variables			
GHQ	0.002**	0.001	0.002**
	(0.001)	(0.001)	(0.001)
Chest problems	0.007	0.009	0.005
	(0.016)	(0.025)	(0.021)
Anxiety and depression	0.023	0.078***	-0.000
	(0.014)	(0.027)	(0.017)
Heart problems	0.002	0.021	-0.011
	(0.019)	(0.029)	(0.026)
SAH good	0.007	-0.005	0.018
	(0.013)	(0.020)	(0.017)
SAH fair	0.015	0.006	0.021
	(0.015)	(0.024)	(0.020)
SAH poor	-0.026	-0.019	-0.025
	(0.020)	(0.031)	(0.027)
SAH very poor	-0.061*	-0.115**	-0.019
	(0.035)	(0.055)	(0.045)
Constant	-0.112	0.085	-0.313
	(0.709)	(0.732)	(1.200)
Observations	10289	4590	5699

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Tab. A6. Placebo test for smoking prevalence analysis of all respondents and by gender. Cluster standard error in parentheses,*$p < 0.10$ **$p < 0.05$,*** $p < 0.01$, ****$p < 0.001$

Smoking prevalence (fake treatment group)	Pooled	Men	Women
DD estimator			
1.period	-0.015	-0.040	0.007
	(0.043)	(0.048)	(0.069)
1.treated# 1.period	0.002	0.011	-0.000
	(0.020)	(0.028)	(0.029)
Controls variables			
Time trends	Yes	Yes	Yes
Demographic variables	Yes	Yes	Yes
Marital status	Yes	Yes	Yes
Household variables	Yes	Yes	Yes
Labour force status	Yes	Yes	Yes
Health variables	Yes	Yes	Yes
N	5191	2321	2870

Household size (fake outcome)	Pooled	Men	Women
DD estimator			
1.period	-0.238	-0.339	-0.150
	(0.168)	(0.233)	(0.228)
1.treated# 1.period	0.005	0.007	-0.016
	(0.16)	(0.051)	(0.035)
Controls variables			
Time trends	Yes	Yes	Yes
Demographic variables	Yes	Yes	Yes
Marital status	Yes	Yes	Yes
Household variables	Yes	Yes	Yes
Labour force status	Yes	Yes	Yes
Health variables	Yes	Yes	Yes
N	10289	4590	5699

Tab. A7. Smoking prevalence of offspring: Difference-in-difference results without considering the parental smoking behaviour

Smoking prevalence	1	2	3	4
DD estimator				
period=1	0.020	0.181	0.205	0.205
	(0.039)	(0.133)	(0.129)	(0.135)
1.treated#1.period	0.059	0.052	0.055	0.057
	(0.065)	(0.066)	(0.065)	(0.065)
Control variables				
Time trends	Yes	Yes	Yes	Yes
Demographic variables		Yes	Yes	Yes
Marital status			Yes	Yes
Household variables			Yes	Yes
Labour force status				Yes
N	1606	1606	1606	1606

Tab. A8. Cigarette consumption of offspring: Difference-in-difference results without considering the parental smoking behaviour

Cigarette consumption	1	2	3	4
DD estimator				
period=1	0.023	0.779	0.615	0.628
	(0.072)	(0.511)	(0.493)	(0.492)
1.treated#1.period	-0.092	-0.093	-0.088	-0.110*
	(0.061)	(0.059)	(0.060)	(0.061)
Control variables				
Time trends	Yes	Yes	Yes	Yes
Demographic variables		Yes	Yes	Yes
Marital status			Yes	Yes
Household variables			Yes	Yes
Labour force status				Yes
N	722	722	722	722

Tab. A9. Model 3: Coefficients estimate for the smoking prevalence analysis of young adults

Smoking prevalence	(1)	(2)	(3)	(4)
DiD estimator				
1.period	-0.001	0.170	0.191	0.195
	(0.057)	(0.143)	(0.140)	(0.146)
1.heavy smokers parents	-0.012	-0.008	-0.009	-0.009
	(0.027)	(0.026)	(0.026)	(0.026)
1.treated × 1.heavy smokers parents	0.031	0.024	0.024	0.025
	(0.073)	(0.072)	(0.071)	(0.072)
1.period × 1.heavy smokers parents	0.037	0.031	0.033	0.027
	(0.059)	(0.059)	(0.059)	(0.059)
1.treated × 1.period × 0.light/mod. smokers parents	0.110	0.101	0.101	0.104
	(0.084)	(0.094)	(0.095)	(0.096)
1.treated × 1.period × 1.heavy smokers parents	-0.085	-0.079	-0.075	-0.076
	(0.112)	(0.119)	(0.118)	(0.118)
Time trends (wave 10 as reference)				
wave=11	-0.010	0.018	0.023	0.025
	(0.018)	(0.033)	(0.032)	(0.033)
wave=12	-0.010	0.046	0.055	0.057
	(0.021)	(0.052)	(0.050)	(0.052)
wave=13	-0.006	0.079	0.091	0.093
	(0.024)	(0.076)	(0.074)	(0.077)
wave=14	0.009	0.120	0.137	0.140
	(0.028)	(0.094)	(0.091)	(0.096)
wave=15	0.021	0.161	0.182	0.183
	(0.035)	(0.119)	(0.117)	(0.122)
Demographic variables				
Age		0.012	0.013	0.011
		(0.035)	(0.035)	(0.036)
Age squared		-0.001	-0.001	-0.001
		(0.001)	(0.001)	(0.001)
Marital status (Child under 16 as reference)				
Married and living as couple			0.023	0.023
			(0.089)	(0.086)
Widowed, Divorced, Separated			0.022	0.048
			(0.071)	(0.069)
Never married			0.028	0.020
			(0.061)	(0.059)
Household variables				
Household size			0.019	0.017
			(0.026)	(0.025)
Number of own children in household			-0.000	0.001
			(0.154)	(0.154)
Log household income			-0.020	-0.019
			(0.020)	(0.019)
Labour force status (Self employed and employed as reference)				
Unemployed				0.057*
				(0.033)
Student				-0.013
				(0.031)
Other jobs				-0.024
				(0.035)
Constant	0.436****	0.552	0.661	0.692
	(0.024)	(0.504)	(0.547)	(0.557)
Observations	1606	1606	1606	1606

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Tab. A10. Model 3: Coefficients estimate for the cigarette consumption analysis of young adults

Cigarette consumption	(1)	(2)	(3)	(4)
DiD estimator				
1.period	0.102	0.848	0.678	0.698
	(0.091)	(0.521)	(0.503)	(0.501)
1.heavy smokers parents	0.003	0.005	-0.007	-0.013
	(0.062)	(0.065)	(0.065)	(0.066)
1.treated × 1.heavy smokers parents	0.037	0.046	0.065	0.070
	(0.076)	(0.075)	(0.074)	(0.076)
1.period × 1.heavy smokers parents	-0.132	-0.127	-0.116	-0.140
	(0.107)	(0.104)	(0.097)	(0.096)
1.treated × 1.period × 0.light/mod. smokers parents	**-0.173****	**-0.167****	**-0.175****	**-0.197****
	(0.085)	(0.085)	(0.080)	(0.083)
1.treated × 1.period × 1.heavy smokers parents	0.138	0.126	0.147	0.146
	(0.125)	(0.124)	(0.119)	(0.117)
Time trends (wave 10 as reference)				
wave=11	-0.040	0.093	0.055	0.055
	(0.048)	(0.099)	(0.096)	(0.096)
wave=12	-0.082*	0.177	0.115	0.113
	(0.048)	(0.184)	(0.177)	(0.176)
wave=13	-0.089*	0.293	0.213	0.203
	(0.053)	(0.265)	(0.260)	(0.260)
wave=14	-0.073	0.436	0.328	0.328
	(0.060)	(0.350)	(0.345)	(0.346)
wave=15	-0.073	0.557	0.423	0.421
	(0.060)	(0.441)	(0.430)	(0.430)
Demographic variables				
Age		-0.136	-0.131	-0.130
		(0.093)	(0.087)	(0.086)
Age squared		0.000	0.001	0.001
		(0.001)	(0.001)	(0.001)
Marital status (Child under 16 as reference)				
Married and living as couple			0.142	0.152
			(0.389)	(0.386)
Widowed, Divorced, Separated			0.146	0.203
			(0.346)	(0.349)
Never married			0.129	0.115
			(0.347)	(0.353)
Household variables				
Household size			0.011	0.018
			(0.031)	(0.030)
Number of own children in household			-0.129	-0.160
			(0.150)	(0.147)
Log household income			0.128**	0.117**
			(0.055)	(0.053)
Labour force status (Self employed and employed as reference)				
Unemployed				0.020
				(0.050)
Student				-0.010
				(0.058)
Other jobs				-0.164
				(0.100)
Constant	0.337****	3.015	1.313	1.390
	(0.041)	(1.834)	(1.824)	(1.796)
Observations	722	722	722	722

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Tab. A11. Placebo test for the cigarette consumption analysis of young adults. Cluster standard error in parentheses,*$p < 0.10$ **$p < 0.05$,*** $p < 0.01$, ****$p < 0.001$

Cigarette consumption of young adults (fake treatment group)	1	2	3	4
DD estimator				
period=1	-0.122	0.115	0.064	0.051
	(0.088)	(0.381)	(0.377)	(0.387)
1.heavy smokers parents	-0.051	-0.048	-0.062	-0.069
	(0.066)	(0.069)	(0.070)	(0.070)
1.period# 1.heavy smokers parents	-0.053	-0.057	-0.082	-0.070
	(0.109)	(0.106)	(0.100)	(0.104)
1.treated # 1.heavy smokers parents	0.087	0.092	0.099	0.101
	(0.078)	(0.080)	(0.085)	(0.084)
1.treated # 1.period#0.light/mod. smokers parents	-0.060	-0.043	-0.027	-0.041
	(0.111)	(0.108)	(0.117)	(0.119)
1.treated #1.period#1.heavy smokers parents	0.201	0.179	0.185	0.184
	(0.142)	(0.134)	(0.137)	(0.143)
Control variables				
Time trends	Yes	Yes	Yes	Yes
Demographic variables		Yes	Yes	Yes
Marital status			Yes	Yes
Household variables			Yes	Yes
Labour force status				Yes
N	552	552	552	552

Household size (fake outcome)	1	2	3	4
DD estimator				
period=1	-0.343**	1.001	0.104	0.043
	(0.168)	(1.013)	(0.716)	(0.662)
1.heavy smokers parents	0.069	0.070	0.022	0.035
	(0.074)	(0.076)	(0.062)	(0.062)
1.period# 1.heavy smokers parents	-0.274	-0.265	-0.213	-0.193
	(0.224)	(0.213)	(0.180)	(0.176)
1.treated # 1.heavy smokers parents	0.066	0.087	0.194	0.189
	(0.307)	(0.323)	(0.300)	(0.309)
1.treated # 1.period#0.light/mod. smokers parents	0.042	0.030	-0.035	0.045
	(0.127)	(0.136)	(0.138)	(0.142)
1.treated #1.period#1.heavy smokers parents	0.061	0.057	-0.012	-0.017
	(0.438)	(0.407)	(0.361)	(0.324)
Control variables				
Time trends	Yes	Yes	Yes	Yes
Demographic variables		Yes	Yes	Yes
Marital status			Yes	Yes
Household variables			Yes	Yes
Labour force status				Yes
N	722	722	722	722

Tab. A12. Robustness check for the cigarette consumption analysis

Scenario 1 (=0 up to 16, =1 over 17)				
Cigarette consumption	1	2	3	4
DD estimator				
period=1	0.112	0.868*	0.739	0.764
	(0.090)	(0.521)	(0.510)	(0.509)
1.heavy smokers parents	0.042	0.044	0.033	0.025
	(0.071)	(0.073)	(0.075)	(0.078)
1.period# 1.heavy smokers parents	-0.148	-0.142	-0.136	-0.158
	(0.107)	(0.105)	(0.100)	(0.100)
1.treated # 1.heavy smokers parents	-0.011	-0.000	0.019	0.025
	(0.085)	(0.084)	(0.086)	(0.088)
1.treated # 1.period#0.light/mod. smokers parents	-0.160*	-0.152*	-0.158**	-0.179**
	(0.082)	(0.082)	(0.079)	(0.082)
1.treated #1.period#1.heavy smokers parents	0.140	0.127	0.146	0.145
	(0.123)	(0.122)	(0.118)	(0.117)
Control variables				
Time trends	Yes	Yes	Yes	Yes
Demographic variables		Yes	Yes	Yes
Marital status			Yes	Yes
Household variables			Yes	Yes
Labour force status				Yes
N	722	722	722	722

Scenario 2 (=0 up to 18, =1 over 19) **and 3** (=0 up to 19, =1 over 20)				
Cigarette consumption	1	2	3	4
DD estimator				
period=1	0.104	0.773	0.601	0.619
	(0.092)	(0.536)	(0.515)	(0.514)
1.heavy smokers parents	-0.013	-0.016	-0.028	-0.034
	(0.061)	(0.062)	(0.062)	(0.063)
1.period# 1.heavy smokers parents	-0.127	-0.122	-0.120	-0.140
	(0.108)	(0.106)	(0.098)	(0.097)
1.treated # 1.heavy smokers parents	-0.019	0.002	0.035	0.036
	(0.072)	(0.071)	(0.072)	(0.072)
1.treated # 1.period#0.light/mod. smokers parents	-0.173**	-0.170**	-0.182**	-0.201**
	(0.084)	(0.084)	(0.079)	(0.081)
1.treated #1.period#1.heavy smokers parents	0.138	0.129	0.158	0.154
	(0.126)	(0.126)	(0.121)	(0.118)
Control variables				
Time trends	Yes	Yes	Yes	Yes
Demographic variables		Yes	Yes	Yes
Marital status			Yes	Yes
Household variables			Yes	Yes
Labour force status				Yes
N	722	722	722	722