All in the Family British Style: Does Family Smoking Cause British Youth to Smoke?

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Very preliminary draft, please do not quote

Abstract

Smoking is one of the leading preventable causes of death in every developed economy. In the U.S. smoking is estimated to be a significant cause of more than 400,000 premature deaths annually. Recent policy debates in most countries have tended to focus on how to prevent youth from starting to smoke. Embedded in these debates is a stylized fact that has yet to be established in a systematic way - whether smoking by older family member (parents and/or older siblings) causes youth to be more likely to take up smoking. Many policy experts assume the answer to this question is obvious. In this paper we use data from the British Household Panel Study to try to estimate whether the relationship is causal. We estimate both naive models that ignore the endogeneity of the smoking decisions of family members and models that control for those choices. The results suggest that failing to control for the endogenous choice of parents to smoke leads to incorrect inferences.

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I. Introduction

Smoking is one of the leading preventable cause of death in every economically developed country in the world. The World Health Organization (1999) predicts that worldwide mortality from tobacco is likely to rise from about four million deaths a year in 1998 to about 10 million deaths a year by 2030. Most of this increase stems from tobacco use in low income countries: Murray and Lopez (1996) predict tobacco-related deaths in low income countries will more than quadruple. But the large number of current smokers in the formerly socialist economies and the established market economies mean that tobacco control efforts in these countries remain critical for public health. The European Partnership to Reduce Tobacco Dependence (2001) observes that: "Unless more is done to help the 200 million European adult smokers stop, the result will be 2 million European deaths a year by 2040."

Recent policy debates have tended to focus on how to prevent youth from starting to smoke. When one reads policy debates about factors associated with smoking it is often observed that children are more likely to smoke if their parents or older siblings also smoke. In such debates analysts often slip into language that elevates this correlation into causation. That is, implicitly or explicitly people assert that children of parents are more likely to take up smoking ***because*** their parents smoke. However, the empirical literature has not yet produced evidence to support the hypothesis that the relationship is causal.

Researchers have articulated several plausible mechanisms through which parental smoking could cause children to be more likely to smoke. Researchers have proposed that a parent-child smoking correlation could arise because children inherit a genetic predisposition to nicotine dependence (Sullivan and Kendler, 1999; Batra *et al*. 2003), because they adopt social norms that condone smoking (Palmer,1970; Hunter *et al*. 1982), and because they are inadvertently addicted to nicotine because, when parents smoke, they expose their children to secondhand smoke.

While economists have begun to specify and estimate models of demand for cigarettes that include a role for peer smoking behavior, empirical results are mixed. Some studies model whether peers smoke but fail to control for the peers youth choose. These studies generally estimate implausibly large peer effects (e.g. Powell, Tauras and Ross, 2005). When one accounts for the fact that youth predisposed to smoke are more likely to select peers who also smoke (de Vries, Candel, Engels, and Mercken, 2006) estimated peer effects are generally small. Eisenberg (2004) uses data that track when a (self-nominated) close friend moves away and estimates how the probability of smoking initiation varies between the youth whose friend did or did not smoke. He finds much smaller and often statistically insignificant effects of peer smoking. Krauth (2007) models peer effects accounting for selection using observable characteristics. Krauth replicates the large effects estimated when no account is made for characteristics of peers youths choose. When he accounts for that systematic selection he estimates peer effects that are very small.

Economists have traditionally focused on the role that cigarette prices or cigarette taxes play on youth initiation decisions but find mixed empirical evidence on whether youth respond to higher cigarette prices. Models of smoking participation find that youth are less likely to smoke when cigarette prices or taxes are high (Chaloupka and Warner, 2000; Gruber, 2000; Harris and Chan 1999). However, using models of smoking onset other studies show that cigarette prices appear to be uncorrelated with the decision to start smoking (DeCicca, Kenkel, and Mathios, 2001, 2002; Glied, 2002; Douglas, 1998, Wasserman et al. 1991, Douglas and Hariharan 1994). More recent research shows that the association between youth smoking participation and prices found in the earlier studies disappears when one controls for average anti-smoking attitudes within a state (DeCicca *et al*. 2006; Liu 2006). Their approach is notable because the earlier studies rely mostly on cross-state differences in prices or taxes. However, a recent working paper by Lillard and Sfekas (2009) also uses longitudinal data but finds that youth are less likely to smoke when they face higher cigarette prices. They show that the failure of the earlier studies to find any price effect arises because of measurement error induced-attenuation bias and specification bias arising from the failure to properly measure price.

None of the economic studies include a role either for family factors related to genetic transmission, the transmission of social norms, or the possibility that youth living with parents or siblings who smoke face a lower price of cigarettes because they can steal them. Most studies that investigate the role of parental smoking are poorly designed, lack the requisite data, or fail to account for the endogenous choice of parents to smoke.

In this paper we contribute to two literatures - one narrow and one broad. We contribute to the narrow literature on the determinants of youth smoking, specifically with respect to the question of whether smoking by other family members plays a causal role. We sketch a heuristic model of smoking behavior that includes a role for the mechanisms described above. We also model the endogenous choice of parents and siblings to smoke. In doing so, we provide evidence to test whether there is a causal link between the smoking behavior of family members and youth initiation. To test for causality we use the method of instrumental variables and develop a new set of instruments. These instruments, and the general logic of their use, contributes to a broader literature on methods one might use to investigate whether and how family behavior causes or fails to cause similar behavior of younger family members. Our approach, applied here to smoking behavior, applies more generally to a set of behaviors that share similar characteristics we discuss below. Basically we exploit exogenously assigned differences between younger children, their older siblings, and parents. We use data from the UK to test the predictions the model yields.

II. Background

Empirical evidence on whether parental smoking affects adolescent smoking is mixed. Reviews of empirical studies find no consistent relationship between parental smoking or family across many studies (Conrad *et al*. 1992; Tyas and Pederson, 1998; Mayhew *et al*. 2000; Avenevoli and Ries Merikangas, 2003). A recent comprehensive review by Shelli Avenevoli and Kathleen Ries Merikangas (2003) concludes that "findings across (87) studies show weak and inconsistent associations between parent and adolescent smoking"[1] When estimated correlations are statistically significant, they are small. There is also no evidence that the correlation varies when both parents smoke compared to when only one parent smokes. Avenevoli and Ries Merikangas (2003) review some studies that find a parent-child smoking correlation only for Caucasians and Asians but, because most of the studies use small school-based samples, the

[1]They review only 87 of 121 published studies because they exclude papers that use the same data used in another paper. They also exclude studies published before 1980.

studies often lack power to identify differences across demographic groups. Some of the studies reviewed reported that children were more likely to smoke if their parents currently smoke than if their parents were ex-smokers. At least one study (Jackson and Henrisken 1997) found that children of former smokers were more likely to smoke compared to children with two parents who both currently smoke. Overall, empirical evidence is mixed.

It is difficult to compare results across published studies because of differences in methods, data, or study design. Avenevoli and Ries Merikangas (2003) note that the 87 studies they review differ substantially in the survey instruments used to collect data, sample design (cross-sectional versus longitudinal), representativeness and comparability of the samples, the way data were generated (self or proxy reports), and analytical methods used. They conclude that most of the studies suffer from omitted variable bias because they fail to control for important covariates such as education, race, or other family background characteristics. In some cases these data were unavailable. In others, the covariates were omitted from estimated models.

The much smaller economics literature on youth smoking initiation has ignored the role that might be played by parental smoking. Most cigarette demand studies only estimate smoking participation models and fail to distinguish initiation and cessation. Among the fourteen studies reviewed by Chaloupka and Warner (2000, p.1550-1555) that use micro data, eleven studies estimate models of smoking participation. Chaloupka and Warner (2000) review two studies that estimate models of initiation and only one study estimates models of both initiation and cessation. More recent studies focus on initiation and cessation (DeCicca *et al* 2002; Nicolas 2002; Cawley et al 2004; Lillard and Sfekas 2006, 2009) but all fail to control for whether or not parents smoke because they lack the requisite data.

The broader empirical literature on the parent-child smoking correlation suffers several shortcomings. First, a majority of studies either rely on cross-sectional data or use longitudinal panel studies that cover a short time period. Second, measures of smoking status of parent and child are often not generated in the same way. For example, many studies of youth smoking onset use school-based samples in which adolescents report their own smoking status and, as proxies, the smoking status of their parent(s) and siblings. The proxy reports raise doubts about whether children reliably know their parents' smoking histories. Most studies are often quite limited in the measures of smoking status of other family members. Some studies characterize sibling smoking by the percentage of a respondent's siblings who smoked (McCaul *et al*. 1982) - a specification that treats as equal a youth with 10 siblings (of whom five smoke) and a youth with two siblings (of whom one smokes). Moreover, samples in most studies are small and unrepresentative of the youth population. Sample sizes in the 116 studies reviewed by Avenevoli and Ries Merikangas (2003) range from a minimum of 39 to a maximum of 16,996. More than half of the samples include fewer than 1,100 persons and more than 75 percent include fewer than 3,000 persons.

Even where all of the above were not present, the extant empirical literature suffers from a more substantive shortcoming - the failure to account for unobserved factors that lead both parents (siblings) and a child to smoke. Although most studies of parent-child smoking correlations are careful to discuss findings in terms of associations rather than in the language of causality, there is a glaring failure to discuss how inferences and policy prescriptions must be qualified in the face of unobserved heterogeneity. This failure has serious implications for the design, implementation, and spending on interventions that aim to discourage youth from starting to smoke. Absent credible evidence that parental (or sibling) smoking causes youth to be more likely to start smoking, it is not possible to evaluate the costs and potential benefits ongoing or proposed interventions to prevent youth initiation.[2]

III. Contribution

We use longitudinal data, instrumental variables, and a different modeling strategy to try to overcome several of the above problems. The longitudinal data are from the British Household Panel Study (BHPS) which makes it possible to rely on a relative large sample for the analysis and to link contemporaneous smoking behavior of up to three generations over a time period that spans more than fifty years. Moreover, since the data identify (in varying degrees) how household members are related to one another, we can test whether a youth is more likely to smoke if a biological parent smokes than if a non biological parent smokes. We can also examine the separate influence of smoking by older siblings, including controls for whether an older sibling resides in the same house as the youth.[1] BHPS data also include background information on a wider range of demographic characteristics that are typically available in the literature on smoking. Finally, thanks to the presence of retrospective questions, the BHPS allows us to construct a measure of each person's smoking behavior over his whole lifetime. To do so, we use data on the age a person began and the age he stopped smoking regularly.

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[2]Overall spending by States to try to limit the use of tobacco was roughly $541.7 million dollars in fiscal year 2004 (CDC 2007). This figure is far below the $1 billion dollars per year the Centers for Disease Control and Prevention "Best Practices" recommends be spent annually for just smoking cessation counseling and services (CDC 1999)

[1] This information is not fully exploited in this version of the paper, but it will be used extensively in a later version, which is currently in preparation.

This full history allows us to develop instruments that identify smoking participation independently of unobservable factors that might lead related family members to smoke. In fact, in order to instrument the smoking status of parents and older siblings, we exploit temporal variation in the factors affecting smoking initiation that each generation faced as youth. In particular, we rely on temporal variation in cigarette prices, smoking bans and taxes on tobacco products.[2] Unfortunately, unlike the USA, Britain does not permit to exploit also geographical variation due to differences across states. However, we exploit some geographical variation by using the distance between the place where the respondent lives and the main ports for smuggling in the country. In the case of siblings, we use information on birth order and the sex composition of a person's older siblings to identify whether an older sibling (of the same sex) also smokes. All these factors predict the probability that each of them ever smoked and whether each of them currently smokes. We use the predicted smoking status variables to investigate whether a youth is more likely to start smoking if his parents or siblings also smoke.[3]

The method of instrumental variable demands much. It requires an instrument to predict parental smoking behavior that does not also predict the smoking behavior of children and that is uncorrelated with the error term. It is standard and proper to question the validity of the instruments. While below we use the richness of the data to make the best case we can, the results must be interpreted cautiously with a keen eye to the shortcomings of the exclusion restrictions.

With this caveat in mind, the rest of the paper sketches a theoretical framework that

[2] In this version of the paper we mainly use the time variation in prices.
[3] This version of the paper focuses on a much narrower set of instruments, but a complete version of the analysis will be available very soon.

guides the specification and empirical strategy in section IV, discusses the specification and empirical strategy in section V, describes the data in section VI, explores identification issues in section VII, presents results in section VIII, discusses results and concludes in section IX.

IV. Theoretical framework

To frame the empirical analysis we incorporate the above mechanisms into an economic model of utility maximization. An individual chooses to smoke or not when the (perceived) utility of smoking exceeds the (perceived) utility from not smoking. we include a mechanism in the model to allow smoking by one or both parents through the transmission of parental norms, transmission of a genetic predisposition to nicotine dependence, and a lower effective price of cigarettes.

In this model, parental norms enter directly into the utility function as a good (parental approval) that has real economic value to the youth. Parental approval is produced by a youth's actions so that, a youth whose parents disapprove of smoking suffers a real (utility) cost if his parents discovers he smokes. In this sense, parental norms enter a youth's decision framework as one of the determinants of the shadow price of smoking. It is possible to similarly allow a role to be played by the social norms of other members of a person's network (e.g. siblings, peers, teachers, etc). We do not do so here in part because the data do not include measures of peer smoking behavior or attitudes.

A person's genetic predisposition to nicotine dependence is included here as a shifter of the utility function in a similar way that labor economists include unmeasured ability as a shifter of schooling or wage functions. Although a model could, in principle, accommodate a richer role for genetic predisposition to nicotine dependence, scientists have not yet identified a single or even a combination of genes that one can use to categorize degrees of nicotine dependence across individuals. Even with such knowledge, no social science data set yet combines all the pieces one would need to empirically test a model that included a measure of genetic predisposition.[3]

Parental and sibling smoking also alters the effective price a youth pays to smoke because he can (within limits) steal cigarettes from packs of cigarettes his mother or father leave lying around the house.

Note that we also allow for individuals to be less than fully informed about the health risks associated with smoking by including general health as one of the arguments of the utility function. When individuals are less than fully informed, they decide whether or not to smoke based on the expected health effects of smoking.

Individuals choose whether or not to smoke to maximize:

$$u_t = \sum_{t=0}^{T} \frac{1}{\beta^t} U(H_t(S_t, Z_t), S_t, A_t(FN, S_t^M, S_t^F), X_t | g, I_t) \tag{1}$$

where u_t is the discounted present value of lifetime utility in period t. β is the discount factor. Each individual gets utility from his own health (H_t), by smoking (S_t), parental approval (A_t), and other consumption (X_t). The health production function (H_t) is embedded in the utility function.

[3]Several efforts are underway to collect and make available biomarker data combined with longitudinal demographic and behavioral data. For example, the new UK Longitudinal Household Study plans to collect biomarker data (see http://www.esrcsocietytoday.ac.uk/ESRCInfoCentre/index.aspx). Saliva swabs are being collected as part of the Adolescent Health study. The English Longitudinal Study of Aeging collects and stores biomarker data. Other studies have various pieces one needs (e.g. National Health Examination and Nutrition Studies III, see also Ding *et al*. 2006).

(Negative) health is produced by smoking (S_t) and with other purchased and non purchased goods that I've represented here by a vector (Z_t). As mentioned before, family norms (FN) enter the utility function through the parental approval function. Notice that I've assumed that parental approval is also a function of the smoking status of both the mother (S) and father (S). Utility is conditioned here on each person's genetic predisposition to nicotine dependence (g) and on his knowledge of the health risks of smoking (I_t). Family norms, genetic predisposition, and knowledge are all unobserved.

An individual choose (how much) to smoke, produce health, and consume to maximize lifetime utility subject to his (lifetime) budget constraint:

$$W_t = \sum_{t=0}^{T} \frac{1}{(1+r)^t} (P_{st}(S_t^f, R_t^f, P_{st}^*) S_t + P_{zt} Z_t + P_{xt} X_t) \qquad \underline{(2)}$$

where the present discounted value of lifetime wealth at time t is given by (W_t) and the price (P) of each good or input in time t are denoted by the respective subscript. The price of smoking (cigarettes) we specify here, P_{st} is the "shadow" price or the "full" price a person pays for his cigarettes. The shadow price of cigarettes is a function of the market price (P), a vector of variables that measure the whether a person's mother, father, or older sibling(s) smoke and the number of cigarettes they smoke(d) on average (S), and whether a vector of variables that indicate if a youth currently resides with each family member (R). This specification incorporates the idea that a youth has more opportunities to steal cigarettes if he lives with more people who smoke and if those people smoke more.

The specification also allows us to specify indirect tests of the influence of family norms that might affect his propensity to steal. A youth is constrained in the amount he is able to steal because the probability his theft gets detected rises as he steals more and because he will be punished if he is caught. Youth will steal as long as the expected punishment is lower than the price he would pay on the open market. To try to capture systematic variation in the probability or severity of punishment, we assume that family norms are correlated with the value systems of different religions. In one of our extended specifications we test the hypothesis that a youth's propensity to smoke is systematically different if his family professes to be religious (holding the amount smoked constant).

The maximization of (1) subject to (2) yields a utility value for two states of the world; one in which a person smokes (S=1) and one in which he does not smoke (S=0). Denoting these two utility values by $\nu_{s=1}$ and $\nu_{s=0}$, a person will choose to start smoking in the period that the utility of smoking exceeds the utility from not smoking $(\nu_{s=1} - \nu_{s=0}) > 0$.

The above model predicts two testable implications about how parental smoking might affect a youth's decision to start smoking. First, if it is the case that parents who smoke disapprove less if a child smokes than do parents who do not smoke, then a youth will be more likely to smoke if his parent(s) smoke. If former smokers disapprove of smoking even more than never smokers then children of former smokers should be even less likely to smoke than children of current and never smokers.

Similarly, a youth will be able to steal cigarettes more easily if his parents smoke than if his parents do not smoke. Everything else equal, the cigarette price should have less effect on the probability that a youth starts to smoke than it does on the probability of initiation for a youth whose parents never smoked or who are former smokers.

To move from the above theoretical model to a statistical model we invoke the usual assumption that the difference in utility in the two states of the world is a latent variable whose value is a linear function of the underlying factors. In the latent variable approach the analyst will see a person start to smoke only when the value of the latent variable crosses a critical threshold. Under the usual assumptions about the distribution of the error term, the probability that a youth starts to smoke is given as:

$$\Pr(Smoke_{ist}) = F(\beta_0 + \beta_1 S^f_{it} + \beta_2 P_{St} + \beta_3 I_{tt} + D_{it}\beta_4 + \varepsilon_{it}) \tag{3}$$

where i represents the individual and t represents the year. Here S is a vector of smoking status of family members (mother, father, siblings) that includes indicators for whether a family member ever smoked, and whether he (she) currently smokes. The vector D_{it} includes time varying and time invariant demographic characteristics.

V. Specification and empirical strategy

We estimate the above model using GMM. A youth is at risk to start smoking if he has not yet smoked. The dependent variable $Smoke_{it}$=0 until the year he starts. In that year $Smoke_{it}$=1. That individual drops out of the at-risk population in every subsequent year.[4] We estimate several versions of the above models. The first includes only the current smoking status of a youth's father and mother. The second specification adds indicators to identify fathers and mothers who currently do not smoke but who did smoke in the past. We also estimate models where we ignore the smoking behavior of fathers (labeled below as "mother only models") and a second set of models where we ignore the smoking behavior of mothers (labeled below as "father only models"). We estimate these models to allow for the possibility that the smoking decisions of parents are highly correlated.

In the baseline models we ignore the endogeneity of the relative's decisions to smoke. We then estimate, by the general method of moments, models that use instrumental variable estimation to estimate the probability that a parent ever smokes and the probability that a parent currently smokes.

In a second specification, we consider the hypothesis that the effect of parental smoking may operate by inducing the eldest children to smoke and that their smoking, in turn, raises the probability a youth smokes. To test this proposition, we re-estimate the above models (OLS and IV) on the sample of youths who are the eldest child (or singletons). Here again we instrument the smoking behavior of parents.[4]

[4] We have also estimated models controlling for measures of smoking behaviour of older siblings. Our results

Before we discuss issues of identification, we describe the structure of the data.

VI. Data

We use data from first 16 waves of the British Household Panel Survey (1991-2005). The BHPS is an annual survey of households that was launched in 1991. It follows all individuals in the original households as they form their own households. From 1991 to 1993 all individuals age 16 and older in the new households were surveyed. Starting in 1994 youth ages 11 to 15 were also interviewed with a separate questionnaire.

Data on smoking behavior

The BHPS contains data on smoking that reflect both contemporaneous and past behavior. In each year of the survey all interviewed household members age 16 and older are asked if they currently smoke. Starting in 1994, parents were also asked to report whether their youngest children (up to three) ever smoked and starting in 1995 whether they currently smoke. In the youth surveys that started in 1994, youth ages 11 to 15 were asked to report whether they had ever smoked a whole cigarette, whether they currently smoke, how often they currently smoke and the number of cigarettes they had smoked in the previous week. In 1999 all adults were asked if they had ever smoked and, if they had, the age they began to smoke and, for former smokers, how long ago they had quit. The 1999 question on quitting had predefined response categories that grew broader for more temporally distant quits. Because this wording of the

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generally show that smoking status of solder siblings is strongly correlated with the probability a youth starts to smoke so that the correlation between parental smoking and initiation disappears. These results are not discussed in this version of the paper, but they will be available very soon.

question potentially masked important variation, the quit question was asked again in the 2002 survey. On that survey former smokers were asked to report the age they were when they last smoked regularly. Finally, each year current smokers are asked to report the number of cigarettes they smoke on average per day. In both 1999 former smokers were asked to report the number of cigarettes they smoked on average when they did smoke.

We use all available data to impute the smoking status of every person in the BHPS in every year of his life up to the last year he is interviewed. For the time span in which the respondents are in the panel, this is straightforward and we use the standard BHPS question on current smoking. In addition to that, in order to get information on the smoking behavior prior to the point in time in which the respondents joined the panel, we use the retrospective questions asked in 1999 and 2002, which enable us to construct the lifetime smoking behavior of everyone who responded to at least one of these waves. For the years preceding the first wave of BHPS, for which we do not have self reported information on current smoking status, we construct a smoking status variable that takes on the value of 1 if the calendar year includes or falls between the calendar years in which a person turned the age he reported having smoked his first cigarette and the age he reported he last smoked (or the year of the survey if the respondent is a current smoker). The smoking status variable takes on the value of 0 in all other years the person was alive up to and including the survey year. We use these data to code indicators for starting and stopping smoking. In the case of starting, we drop any observation who reported he started smoking before age 6 and people who have not yet started by age 30. The smoking initiation indicator is zero at each age from age 6 until the year the person started to smoke when it takes on the value "1" and is set to missing in every subsequent year.

The smoking cessation variable is almost a mirror image of the smoking initiation variable. It is set as missing for all people who never smoked and for smokers until the year a person starts to smoke. It is set at “0" from the year a person starts to smoke until either the last year the person is observed in the panel (the year of the retrospective report). The smoking cessation variable equals “1" in the year a person reports he quit.

In the BHPS we supplement the data on those who started to smoke by using data collected in each wave of the panel (from 1991 to 2006) on whether a person currently smokes, data collected from youth ages 11 to 15 in each wave since 1994 on whether they had ever tried a cigarette and on how much they smoke, and data reported by parents from 1995-1998 on the smoking behavior of up to three children per parent. We use the retrospective histories to code the dependent variable - whether a person started smoking. We exclude any individual who started smoking before age 12 and who has not yet started smoking by age 30. The dependent variable is coded as a “0" for all individuals in this age range who have not yet started to smoke. We stack observations, retaining an individual in the “at-risk” population until the year he turns the age he first smoked. In that year, the dependent variable equals “1" and he is subsequently dropped from the sample.

Research suggests that lifetime smoking histories built from retrospectively reported data are likely to be reasonably accurate. Kenkel, Lillard, and Mathios (2003b) show that retrospectively reported smoking behavior provides reliable indicators of smoking behavior. They find that smoking prevalence rates calculated using retrospectively reported data matches closely with smoking prevalence rates calculated with contemporaneous survey data even up to twenty years in the past. Machlin, Kleinman, and Madans (1989) find, using retrospective and contemporaneous data from the National Health and Nutrition Examination Studies, that contemporaneous and retrospective measures of smoking status agreed for more than 90 percent of the sample.

The above results apply to all but the end point of a person's smoking history. That is, people tend to report accurately the age they started smoking (Kenkel, Lillard, and Mathios, 2003b) but the year they quit is reported with error. Lillard, Bar, and Wang (2008) document that former smokers tend to round the age they reported they last smoked regularly to ages that are evenly divisible by 5. This tendency is higher for ex-smokers who are older when they report on their quit age and those who quit in the more distant past. Lillard, Bar, and Wang (2008) show that this type of reporting error biases coefficients on cigarette prices downwards and they develop a method to mitigate bias from this source. We adopt their specification in our model to instrument parent's current smoking status.

The sample: exclusion rules and links with cohabiting sample members

The sample available for analysis is limited not only to individuals who answered the retrospective smoking questions, but also to individual for whom both the biological mother and biological father also answered the retrospective smoking questions. That restriction means that we exclude individuals whose biological parents did not participate in one of the waves that collected retrospective smoking data - either because they were never in the BHPS, because they had dropped out the sample (e.g. because they died), or refused to participate.[7]

[7]In a later version of this paper we will relax this rather restrictive sample selection rule to include children who

Figures 1-2 plot these data to show the prevalence of smoking at each age in the sample of current and former smokers. Figures 1-2 show a stylized fact that informs the choice of instruments below, i.e. that almost all smokers start to smoke between the ages of 14 and 18

Because of the intergenerational nature of the BHPS, we can link members of the same family across generations. In particular, it is possible to get information on all the cohabitations which took place in the time span covered by the dataset. In addition, using the "British Household Panel Survey Consolidated Marital, Cohabitation and Fertility Histories, 1991-2006 dataset" (Pronzato, 2007) we were able to reconstruct retrospectively for each respondent his full history of cohabitations previous to the years in which he entered the panel. Therefore, having constructed similar information for each BHPS respondent, we were able to observe all whether and for how long each respondent has been leaving with smokers in the time span in which he was "at risk of initiation into smoking".

It is worth noting that the BHPS relationship file does not only permit to match persons who co-resided in a particular year, but also identifies what that person's relationship was to the respondent whose decision is being studied. The data structure also allows us to separately estimate the effect on a person's initiation decision when a family member smokes but does not live in the same household and the effect when a family member smokes and shares the same household. In the models estimated here, we include only measures of the smoking status of biological mothers and biological fathers. However, in future work, as sample sizes permit, we will estimate models that include a richer description of who smokes in the family.

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grew up with a non biological parent.

After matching building the retrospective smoking history of each respondent and after matching any individual with anyone he has ever cohabited, we completed our sample by adding the cigarette price anyone had faced in each year of his life. In order to do so, we use the real price of the British brand Capstan (in 2008 British pounds from 1904 to 2002.[5]

Other demographic control variables

After restricting the sample to respondents who answered the relevant smoking questions, we are left with 2009 persons and 39,470 person-age year observations. In addition to the smoking variables and the cigarette prices, we can rely on a rich set of data on demographic personal characteristics of all individuals. Some of these data can be used to construct covariates that change over time. In this first specification, we use information on the highest qualification achieved by the respondent and his religious affiliation. Moreover, we control for life events (such as births of a child, starts or ends of a partnership) which might affect people's propensity to smoke. Finally, we control for linear time trends.

Table 1 reports descriptive statistics for time-varying data, where the sample consists of 39,470 person-year observations. In particular, the table reports a variable which is crucial for our identification strategy i.e. the average cigarette price faced when each parent was 14-18 years old. Table 2 shows descriptive statistics for time-invariant data in a sample of 2009 persons.

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[5] Due to unavailability of data on capstan prices for the years 1980-1997, we had to impute those values by using price of 20 Benson & Hedges Gold 1998-2006

We observe that about 27 percent started to smoke in the average year after age 12. On average thirty-nine percent of mothers and thirty-five percent of fathers were current smokers each year we observe. Finally, the average price of pack of cigarettes was 4.44 pounds (in real 2008 pounds)

VII. Identification issues and econometric specification

As briefly discussed above, it is an ambitious goal to find instruments that satisfy all of the conditions a valid instrument must meet. Stated again, to be valid, an instrument must predict the behavior of interest (the probability that a parent smokes), be orthogonal to the ultimate object of interest (the probability that a youth starts to smoke), and be uncorrelated with the error term of the initiation equation.

These conditions are difficult to meet in the best of situations. Particular characteristics of smoking behavior complicate matters further. The key complicating factor is that the decision to smoke today is correlated with decisions in past periods about whether or not to smoke. Consider the probability a person smokes in a given period (t). That probability is given by:

$$\Pr(Smk_t) = \Pr(Start_{18}) \prod_{k=0}^{k=t+1} \Pr(Smk_{18+t-k}) = \Pr(Start_{18}) \prod_{k=0}^{k=t+1} (1 - \Pr(Quit_{18+t-k})) \tag{4}$$

where we represent the probability a person starts to smoke as the probability that he starts by age 18 - denoted here by $\Pr(\text{Start}_{18})$. The structure in (4) assumes away temporary quit behavior, that is once a person starts, he continues to smoke until he permanently quits. The structure also highlights the challenge one faces in trying to find an instrument that predicts whether a person smokes at a given age and is independent of another person's decision to start to smoke that is taken in the same period.

The choice of instrument is guided principally by two factors: the characteristics of stylized patterns in life-cycle smoking trajectories and the generational gap between parents and children.

The first factor is clearly explained by figures 1 and 2. Using data from the BHPS sub sample of those for which we have retrospective information on smoking, the graphs in figures 1 and 2 plot the lifetime smoking trajectories for men and women and for birth cohort in the UK. It can be easily noticed that the probability of starting smoking is not constant over time, but it reaches a peak when people are teenagers and then decreases later on. In fact, both figures show that most people start smoking between the age of 14 and 20. This pattern holds on average for each cohort we consider both for men (Figure 1) and for women (Figure 2).[6] The second stylized fact on which our identification strategy is built is the generational gap between parents and their children, i.e. the fact that the decision by parents to start smoking precedes the decision of their child to start smoking by at least six years (see figure 3 for a graphical explanation).[7]

In line with the timing of initiation into smoking, we use as an instrument for parents' smoking an average of the cigarette prices they faced when they were 14-18. In order for this instrument to be valid, the cigarette price must display at least a form of random variation. Figure 4 plots

[6] The data are we use here are only a subset of the full sample we use - consisting only of respondents to the 1999 and 2002 retrospective smoking questions. However, the pattern in the full sample is the same and it also holds in Germany,, Russia (Kenkel, Lillard, and Mathios 2003a, 2004) and China (Kenkel, Lillard, and Liu 2005)

[7] This assumes nobody starts smoking before age 12 or after age 20 and nobody produces a child before age 14. In the limiting case - when a person becomes a parent at age 14, starts smoking at age 20, and his child starts smoking at age 12 - the parent's decision to start occurs six years before the child's decision to start.

cigarette prices for the time span we are interested in (1904 -2008). It is crucial to notice that the graph does not describe a simple increasing pattern, but it suggests that the prices were affected by a source of random variation. This is important for our identification strategy, given that it suggests that we are not picking up a general time trend in prices, but a variation in prices which is specific to cigarettes. Moreover, such a time variation[8] permits to lower the correlation between the price faced by parents and prices faced by children which helps supporting our identification strategy. In fact, in our sample, the raw correlation between the average cigarette price faced by the at-risk population and the cigarette tax faced by mothers and fathers at age 14-18 is 0.59 and 0.51 respectively, while the correlation between prices faced by mothers where they were 14-18 and prices faced by father in the same age span is 0.7

Being able to restrict the relevant information on prices within reasonably narrow and overlapping time windows has a few advantages. First of all, even after averaging the level of prices over the 5 years time span, we are still left with some random variation we can exploit for the identification. Second, being our time window overlapping for people born in different years, we are able to use an average of relevant prices which varies yearly. Relying on 5 years time windows, together with the generational gap mentioned above, implies also that there are no cases in which parents and children are affected by the same set of prices and this limits the scope for confounding factors. In fact, in general, the prices parents face when they are 14-18 and the prices their children face in the same age gap are well distant in time: in particular, in our BHPS sample such a distance in time is equal to 27.2 years for mothers and 30 years for fathers.

[8] We are also exploiting additional variation in the taxes on tobacco and other variables predicting smuggling. Results will be available very soon.

Obviously, it is still possible that we are picking up some unobserved time effect or some time trend, but the apparent randomness of the values of the relevant prices seems to suggest that this is not the case. However, to overcome completely such a potential problem, in a later specification we will exploit also some geographical variation in the suitability of the British costs for smuggling. As additional instruments, following and Lillard, Bar, and Wang (2008), we will also use indicators of particular ages at which a smoker is more likely to (erroneously) report he (she) quit.

The above model is estimated by both Ordinary Least Squares and by a generalized method of moments instrumental variables estimator (GMM-IV) that allows for heteroskedasticity of unknown form.

VIII. Results

Table 3 reports selected OLS and IV coefficients from discrete time hazard models based on the equation shown in (3). Here we present three models studying the effect of parental smoking on children's initiation. The three models differ because the first one considers the effects of mother's smoking only, the second one focuses on the effects of father's smoking only and the third one includes both parents' smoking status. Each model is estimated separately for males and females.

The "naïve" estimates considering parental smoking status as an exogenous variable (see columns 1 and 3) suggest that there exists a positive relationship between parental smoking and initiation into smoking for children. In fact, for each of the models we consider, the coefficient for parental smoking is both positive and strongly significant. Moreover, such an effect seems to be stronger when mother's smoking behavior is considered and when the sub sample of female respondents is used for the analysis. The latter result seems to rule out all those hypotheses claiming that the transmission of smoking behavior takes place via role models that should be stronger in the case of family members of the same sex.

Quite surprisingly, when we look at the IV models with only one exogenous variable, the correlation is reverted. In fact, not only is the new coefficient negative for each of the models we consider, but it is always significant (in the case of the sub sample of males it is always significant at the 1 per cent of significance). In addition, the F tests on the excluded restrictions in the first stage seem to rule out the hypothesis of week instrument, thus giving some evidence in support of our identification strategy.

The results for the model with two endogenous variables (both parents' smoking status) point in the same direction as the results we got when we considered mothers or fathers only. In fact, the OLS results still display a positive correlation between parents' and children's smoking status, while in the IV models such a correlation disappears and the coefficients for parents' smoking status becomes generally insignificant apart from the cases of fathers' smoking status in the sub sample of female respondents. However, the values of the F test on the excluded restrictions at the first stage are in general low and this signals that instrumenting two endogenous variables by using the average prices faced by the parents is probably not a viable option. We suspect that such a result is due to the high correlation between the two instruments and we conclude that temporal variation alone is not probably enough to solve the problem of endogeneity in this particular model. Results using also geographic variation will be presented later.

Incidentally, it is interesting to notice that the cigarette price is always significant in determining the probability of smoking initiation and its coefficient has always the expected negative sign. This, again, supports our identification strategy, which relies on prices as drivers of smoking behavior.

Table 4 shows the results we got when we run the model presented above on a sub sample of singletons and eldest children. The estimates of the coefficients in the naïve models are very similar to those we derived when we used the full sample and they show a strong and positive correlation between parents' and children's smoking behavior. Again, instrumenting the smoking behavior of the parents makes the positive correlation to disappear and the coefficient for parental smoking becomes strongly negative.

The change in the sign of the coefficient for parental smoking that we found after carrying out the instrumental variable analysis deserves further explanation. In fact, this suggests that the perceived intergenerational transmission of smoking behavior between parents and children is not due to causality, but it is likely to be due to unobserved personal characteristics shared by individual belonging to the same family. Once controlled for the endogeneity of smoking behavior, our results seem to show that the cohabitation with a parent who smokes does decreases the probability of initiation into smoking for young people. It is not clear what the cause of such an effect is but some conjectures can me made. We can assume, for example, that children leaving with smoking parents are in general more aware of the negative consequences smoking can have on people's health. Alternatively, the results can be driven by the negative externalities of smoking (like bad smell) or by the detrimental effects of second-hand smoking.

IX. Discussion and conclusions

The evidence seems to suggest that a youth's decision to start smoking is not caused by the smoking behavior (past or present) of his father or mother. When one does not account for the choice parents make to start or quit smoking, it appears that young people are more likely to start smoking if their parents smoke. However, these results are reverted when one accounts for endogeneity in initiation into smoking. On the contrary, there seems to be evidence that living with a smoking parent decreases the probability for the children to start smoking, perhaps because it leads to a higher awareness on the negative consequences of smoking.

The results presented here help answer the question, do parents who smoke induce youth to take up smoking? Based on these results, the answer is "No." If this is true, then our findings could have an important policy implication i.e. that anti-smoking interventions should not necessarily target the children of adult smokers. It appears that youth start to smoke independently of their parents' smoking habits.

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Tables and figures

Table 1 Sample statistics: person level observations

Variable	Mean	Std. Dev.
demographics		
female	0,48	0,50
white	0,96	0,20
white	0,96	0,20
black	0,01	0,10
asian	1,00	0,00
other	0,00	0,05
education		
higher degree	0,01	0,11
first degree	0,08	0,27
HND/HNC/teaching	0,04	0,18
A level	0,20	0,40
O level	0,25	0,44
CSE	0,08	0,26
none of these	0,10	0,29
missings/non in education	0,25	0,43
religion		
switch religion	0,05	0,21
no religion	0,45	0,50
church of england	0,20	0,40
other christians	0,10	0,29
eastern churces	0,03	0,17
famiy		
cigarette price when mother was 14-18	3,19	0,39
cigarette price when father was 14-18	3,26	0,38
N (persons)	2009	

Table 2: sample statistics (person-year observations)

Variable	Mean	Std. Dev.
Mother smokes now	0,39	0,49
Father smokes now	0,35	0,48
Cigarette Price	4,44	0,98
Familiar shocks	<0.01	0,06
Child Born	<0.01	0,05
age	16,43	2,52
year	1994,89	8,65
N (Person year)	39470	

Table 3 Selected results: model os smoking initiation on parental smoking (full sample)

	Females				Males			
	(1)		(2)		(3)		(4)	
Mother only model	OLS		IV		OLS		IV	
Mother smokes	0.1313	***	-0.2602	*	0.0934	***	-0.9606	***
F test Mo capstan price at age 14-18			**[40.7]**				**[59.2]**	
Price Capstan's (real 2008)	-0.0371	***	-0.0609	***	-0.0509	***	-0.1032	***
N	18884				20589			
	(1)		(2)		(3)		(4)	
Father only model	OLS		IV		OLS		IV	
Father smokes	0.0831	***	-0.4417	**	0.0696	***	-0.3380	***
F test Fa capstan price at age 14-18			**[28.2]**				**[107.0]**	
Price Capstan's (real 2008)	-0.0580	***	-0.0798	***	-0.0364	***	-0.0671	***
N	12502				13699			
	(1)		(2)		(3)		(4)	
Mother & Father model	OLS		IV		OLS		IV	
Mother smokes	0.1037	***	0.5356		0.0560	***	-1.0762	
F test Mo capstan price at age 14-18			**[0.9]**				**[29.2]**	
F test Fa capstan price at age 14-18			**[13.5]**				**[4.5]**	
Father smokes	0.0420	***	-0.9005	**	0.0390	***	0.1909	
F test Mo capstan price at age 14-18			**[5.6]**				**[36.4]**	
F test Fa capstan price at age 14-18			**[5.5]**				**[19.8]**	
Price Capstan's (real 2008)	-0.0676	***	-0.0392		-0.0298	***	-0.0591	***
N	11031				11985			

Notes: *, **, and *** denote coefficients that differ from zero with p-values<.10, <.05, and <.01 respectively. Addition controls: marital events (marriage, separation), child birth, highest educational qualification attained, religious affiliation, linear time trend

Table 4 Selected results: model of smoking initiation on parental smoking (full sample)

	Females				Males			
Mother only model	OLS		IV		OLS		IV	
Mother smokes	0.1168	***	-1.0355	**	0.0950	***	-2.0682	***
F test Mo capstan price at age 14-18			**[11.4]**				**[12.8]**	
Price Capstan's (real 2008)	-0.0548	***	-0.1400	***	-0.0444	***	-0.1630	***
N	11637				13277			
Father only model	OLS		IV		OLS		IV	
Father smokes	0.0886	***	-4.4430		0.0694	***	-0.6137	***
F test Fa capstan price at age 14-18			**[.9]**				**[37.8]**	
Price Capstan's (real 2008)	-0.0768	***	-0.3678		-0.0286	***	-0.0882	***
N	7364				8564			
Mother & Father model	OLS		IV		OLS		IV	
Mother smokes	0.1066	***	2.5030		0.0564	***	1.2997	
F test Mo capstan price at age 14-18			**[1.0]**				**[5.2]**	
F test Fa capstan price at age 14-18			**[.11]**				**[0.0]**	
Father smokes	0.0365	***	-0.9748	**	0.0325	***	-1.6136	
F test Mo capstan price at age 14-18			**[6.0]**				**[26.6]**	
F test Fa capstan price at age 14-18			**[2.8]**				**[4.3]**	
Price Capstan's (real 2008)	-0.0878	***	0.0637		-0.0177		-0.0678	*
N	6363				7256			

Figure 1: UK men's life-course smoking trajectories, by birth cohort

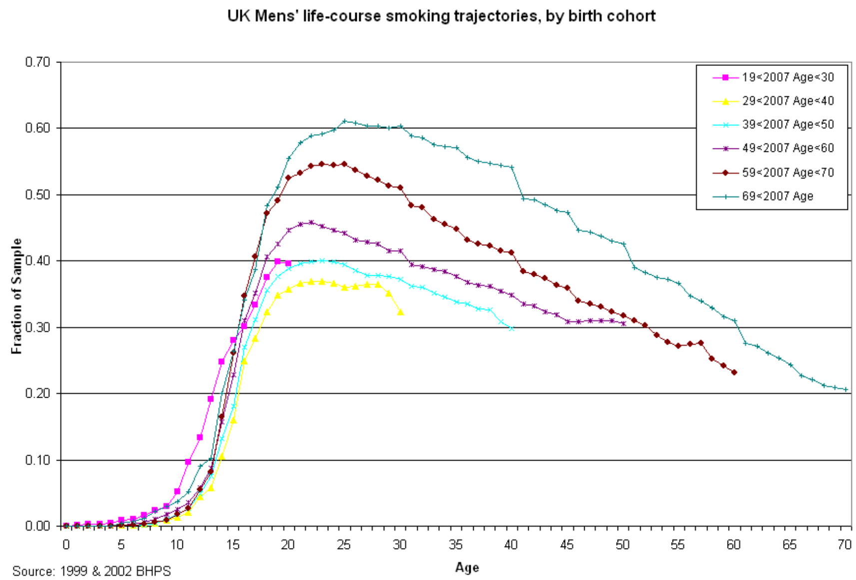

Figure 2: UK women's life-course smoking trajectories, by birth cohort

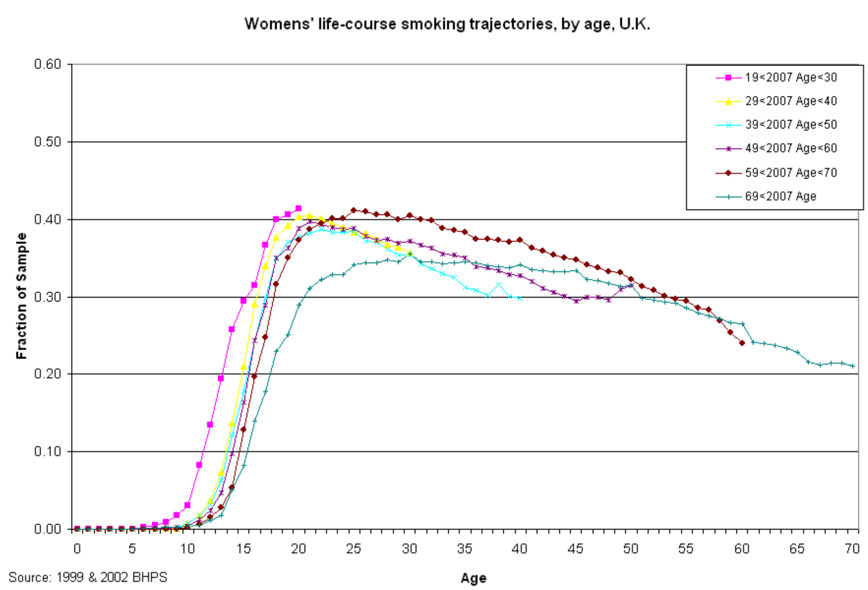

Figure 3: the generational gap.

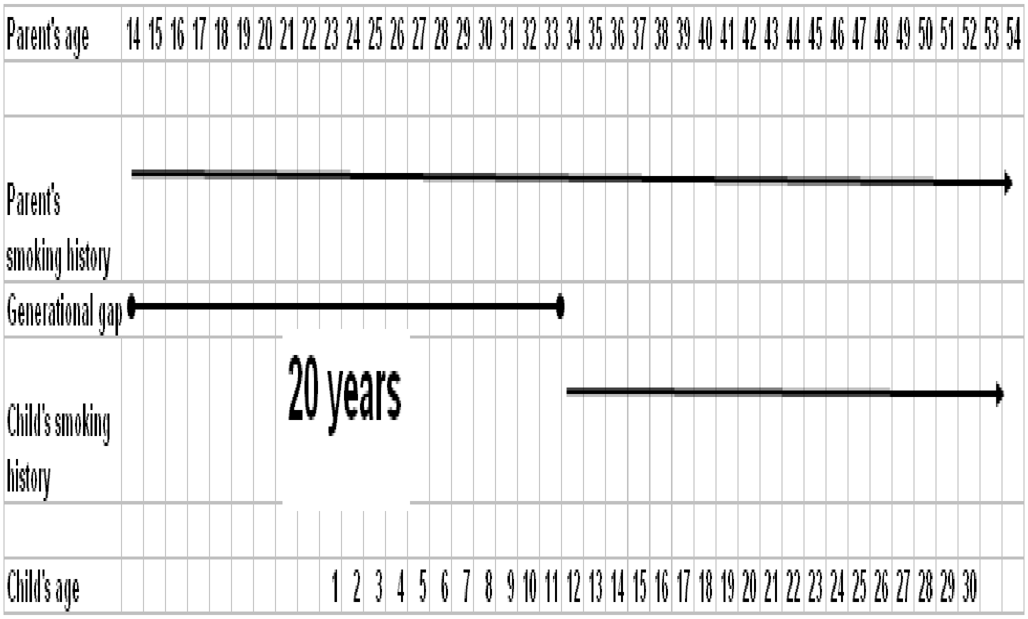

Figure 4. cigarette prices years 1920-2008