Topics

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Smoking within the Household: Spousal Peer Effects and Children's Health Implications

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Abstract: We study spousal peer effects on smoking and their implication for the health of children. Smoking decisions are modeled as equilibrium strategies of an incomplete information game within the couple. Using French data, we identify two peer effects: a smoking enhancing effect of smoking partners and a smoking deterring effect of non-smoking partners. An implication of these findings is that the smoking behavior may differ qualitatively in couples where both partners smoke and where only one partner smokes. This interpretation is supported by our finding that, controlling for total tobacco consumption of parents, the respiratory health of children is negatively affected only if both parents smoke.

Keywords: smoking, social interaction, simultaneous game model, health
JEL Classification: C31, D10, I12

1 Introduction

This paper estimates spousal peer effects on smoking behavior. Its main contribution is to model the smoking decision within the couple explicitly, so that the empirical results can be interpreted in terms of intra-household interactions. We develop a theoretical model where the partner's smoking behaviors directly affect the individual utility from smoking. Our estimates, using French data, show that having a smoking partner reduces the probability of giving up smoking; the opposite is true for a non-smoking partner, conversely (with respect to no partner at all). This suggests that non-smoking partners might have a control role on smokers within the household. In support of this idea, we find that

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parents' smoking behavior affects children's respiratory health only when both parents smoke. All in all, our findings suggest that the impact of policies aimed at curbing smoking consumption might be enhanced by social interactions within couples.

We model smoking decisions as the equilibrium strategies of an incomplete information game within the couple, while singles take smoking decisions individually. The assumptions that the smoking game is non-cooperative and that information is incomplete within the couple can be justified by the fact that smoking is addictive and results from an instantaneous decision. In addition to that, succeeding in giving up smoking is not perfectly predictable *ex ante* and might depend on random individual shocks that the partner cannot observe or predict (for instance, health, taste or psychological shocks).[1] In a couple, we allow the utility from smoking to be positively affected if the partner smokes, and negatively affected if the partner does not smoke.

We use data from the French Health Survey 2002–2003. To the best of our knowledge, there is no study of intra-couple peer effects on smoking using French data. Despite the fact that smoking decisions might be subject to different social norms in different countries, our results are in line with the existing literature on the determinants of smoking that focuses mainly on US and UK data. We use the methodology proposed by Bajari et al. (2010) to estimate reaction functions in incomplete information games. We include in the sample both individuals in couple and singles. This allows us to identify both the smoking enhancing effect of a smoking partner and the smoking deterring effect of a non-smoking partner.

The main problem in estimating household decision-making models is potential assortative mating (Becker 1974), leading to correlated effects (Manski 1995). To tackle endogenous mating, we control for a number of partners' characteristics influencing the beliefs about the partners' smoking behavior. In our model, each individual takes an instantaneous smoking decision in order to maximize her expected utility, knowing the characteristics of the partner. In addition to that, we control for past smoking behaviors. Thus, our model does not predict the probability of smoking of an individual, but the probability of smoking given her past smoking behavior and the partner she lives with. Identification is based mostly on the decision to give up smoking, which, for adults, are much more prevalent than the decisions to start smoking. Controlling for the past smoking decision of both partners allows us to take into

1 Alternative models have been developed in the context of peer-effects estimation, involving complete information games. For instance, Krauth (2006) and Soetevent and Kooreman (2007) consider complete information games with possibly multiple equilibria. In this context, they propose simulation methods to estimate peer effect.

account the correlation across partners' unobservables that could affect both mating and smoking decisions, as long as this correlation is constant over time. The main identification assumption is that couples do not form based on future propensity to quit or start smoking, given the current smoking status. This is admittedly strong, but might be reasonable if the propensity to smoke is not a very salient characteristic in couple formation. The large size of our sample can mitigate the concerns about the validity of the assumption, since the number of couples formed according to the propensity to smoke may not be too high.

By identifying significant spousal peer effects on smoking behavior, our results are markedly different from the ones of Clark and Etilé (2006). They consider a complete information framework and find that the correlation between spouses smoking decisions is entirely due to the correlation between individual random effects, not to peer effects. However, they do not consider the role of beliefs about the partner's probability to smoke in each period. More specifically, they rule out the possibility that individual effects include beliefs about the partner's instantaneous decision. We explicitly model and structurally estimate these beliefs in order to study their effect on smoking behavior, and we find that beliefs matter. Jones (1994) finds a significant impact of the presence of other smokers in the household on individuals' probability of succeeding in giving up. Cutler and Glaeser (2007) study spousal peer effects on smoking decisions, as well as the impact of other kinds of social interactions. Using instruments in order to tackle selection problems, they show the existence of such effects. Estimating a health capital model, Khwaja et al. (2006) and McGeary (2015) also find that spousal health affects the individuals probability of smoking. A number of studies also provides evidence of peer effects on teenagers' tobacco consumption (Powell et al., 2005; Lundborg, 2006; Harris and González López-Valcárcel, 2008). Harris and González López-Valcárcel (2008) separately identify the impacts of peer-group smoking prevalence and peer-group nonsmoking prevalence using a cross-section of US young people. The authors interpret these effects in terms of learning: the peer-group smoking and non-smoking behavior do not convey the same kind of information about how "cool" smoking is. We apply a similar approach to adult couples. Our results, however, are subject to different interpretations.

As highlighted in Khwaja et al. (2006) spousal peer effects might be due to consumption externalities within the household, to learning, or to altruism. In adult couples, where consumption externalities or altruism are likely to prevail, individuals may consume cigarettes in a different way, depending on the partner's smoking status. For instance, smokers could be forbidden to smoke at home by non-smoking partners, or get continual complaints from them, suffering thus a consumption externality. Alternatively, smokers might refrain from smoking at home or smoke less than they would like to out of altruism toward non-smoking partners. In both cases, this should have an impact on the exposure to passive smoking of other family members, and ultimately on their health status. Using data on the non-chronic respiratory diseases of children, we find evidence supporting the presence of consumption externalities or altruism.[2] We show that the respiratory health of children is affected negatively only if both parents smoke, while the effect of one smoking parent is non-significant. Non-smoking parents seem to play a control role on their smoking spouses, possibly reducing the utility of smokers by imposing less smoke at home.

A relatively large literature has studied the effect of passive smoking on the health of children. Cook and Strachan (1999) review evidence from different sources and find a positive relationship between children respiratory illnesses and parental smoking. Mannino et al. (2001) showed that a high level of exposure to tobacco smoke (measured by the cotinine levels in body fluids) increases the numbers of sick days in school for U.S. children. Adda and Cornaglia (2010) showed that smoking bans in public places increase the exposure of children with smoking parents. However, these studies do not look at the interaction of smoking and non-smoking parents. There also exists a public health literature focusing on the impact of parental tobacco consumption and chronic respiratory diseases. For instance, Jaakkola and Gissler (2004) establish a positive relationship between mother's smoking and asthma in children. Our results cannot be directly compared with those, since we cannot observe the long-term effects of smoking on children, and this would make it difficult to establish causal relationships. Thus, we only focus on non-chronic respiratory diseases.

The paper is structured as follows: in Section 2 we describe the theoretical model and in Section 3 we discuss the estimation strategy. In Section 4 we present the data and we describe the results concerning both the equilibrium smoking behavior and the effect of smoking on the respiratory diseases of children. Section 5 concludes.

2 Explaining Smoking Behavior: A Theoretical Model

As Khwaja et al. (2006), we assume that partners behave strategically with respect to smoking behavior. The assumption that the game is non-cooperative

2 Diseases are self-reported by respondents, who are also asked whether the disease is chronic or not.

can be justified by the fact that commitment to a smoking behavior might be impossible, due to addiction, for instance.[3] We consider a model in which individuals living in a couple choose their smoking behavior simultaneously, taking into account the expected decision of the partner. Simultaneity captures the fact than none of the partners would like to move first and commit to a given choice. Singles take their decision individually.

Let us first consider the utility of an individual i living with a partner j. The benefit that this individual obtains from smoking depends on her taste for smoking f_i and on the smoking behavior of her partner. Let $a_i \in \{0, 1\}$ be the smoking decision of individual i, where $a_i = 1$ means that the individual smokes. The partner makes the same dichotomous decision denoted by a_j. The utility of individual i if she smokes is:

$$f_i + sa_j - p(1 - a_j),$$

where f_i is the private benefit from smoking, p is the disutility due to the presence of a non-smoking partner and s is the extra utility from smoking if the partner smokes as well. Both parameters are assumed to be non-negative in the theoretical model. They capture, respectively, a smoking enhancing and a smoking deterring effect related to the partner's behavior. The utility of a non-smoker is normalized to zero up to the disutility linked to passive smoking when the partner smokes. It is thus equal to:

$$-ra_j,$$

where r is the disutility imposed by a smoking partner on a non-smoker.

It is important to highlight that positive values of s, p and r may be motivated by consumption externalities, altruism or learning. On the one hand, having a smoking partner could make smoking more valuable because of the possibility of smoking together or because it reinforces beliefs that smoking is not too unhealthy. On the other hand, having a non-smoking partner could reduce the utility from smoking for multiple reasons. First, the non-smoker could impose a cost on the smoker, sometimes succeeding in having the latter quit. Second, the individual could be altruistic toward a non-smoking partner, and voluntarily impose on himself the transportation costs of smoking outside or the costs related to guilt. Finally, the non-smoking status of the partner might convey information on the harmful effects of smoking, reducing the pleasure of tobacco consumption.

3 Also the impossibility to write down legally binding contracts between partners might justify strategic behavior. On the alternative models of health-decisions making within the household, see Bolin et al. (2001, 2002).

The utility from smoking of a single is simply f_i, while her utility from non-smoking is normalized to zero. Using the dummy variable D_i taking value one if the individual lives with a partner and zero otherwise, we can write the utility from smoking for individual i in a more general form as:

$$f_i + sa_jD_i - p(1-a_j)D_i.$$

In the same way, the utility of a non-smoker is thus equal to:

$$-ra_jD_i.$$

We assume that the payoff from smoking is a linear function of a vector of observed variables $\tilde{x}_i$, and of an individual shock, unobservable by the econometrician, ε_i:

$$f_i = \lambda\tilde{x}_i + \varepsilon_i, .$$

The past smoking behavior is an important characteristic to be included in $\tilde{x}_i$, given the addictive nature of tobacco consumption.

The utility U_i of individual i can be written as a function of the individual's decision to smoke a_i, the partner's decision to smoke a_j and the individual characteristics:

$$\begin{aligned} U_i(a_i, a_j, x_i, \varepsilon_i) &= a_i\left[\lambda\tilde{x}_i + \varepsilon_i + sa_jD_i - p(1-a_j)D_i\right] - [1-a_i]ra_jD_i \\ &= a_i\left[\lambda\tilde{x}_i - pD_i + \varepsilon_i\right] - ra_jD_i + a_ia_j[s+p+r]D_i \\ &= \lambda_1 a_i x_i + \lambda_2 a_i a_j D_i + \lambda_3 a_j D_i + a_i\varepsilon_i, \end{aligned}$$

where $x_i = (\tilde{x}_i, D_i)$, $\lambda_1 = (\lambda, -p)$, $\lambda_2 = p + r + s$, $\lambda_3 = -r$. As the parameters s, r and p should be non-negative, we expect in particular that $\lambda_2 \geq 0$.

We assume that both partners take their decision simultaneously. The decision is taken under incomplete information because the attitude of both partners toward smoking might depend on idiosyncratic shocks on their preferences that are private information. Think about smoking cessation (which is empirically very relevant in our sample as will be illustrated in the following): this choice might depend on some health or taste or psychological shock. Thus, the individual shock, ε_j, is assumed to be unobservable by the partner and the expected payoff of individual i depends on the probability that the other partner smokes which we denote $\sigma_j(x_i, x_j) = Pr\left(a_j = 1|x_i, x_j\right)$. The belief of each individual about the partner's probability of smoking is constructed using all the available information. In other words, beliefs are contingent to (x_i, x_j), the set of both the individual's and the partner's characteristics, which is publicly known within the household. We thus look at a Bayesian Nash equilibrium.

An individual i does smoke ($a_i = 1$) if and only if

$$\Delta EU_i \equiv E_{a_j}\left[U_i(1, a_j, x_i, \varepsilon_i)\right] - E_{a_j}\left[U_i(0, a_j, x_i, \varepsilon_i)\right] > 0. \quad [1]$$

Since $U_i(a_i, a_j, x_i, \varepsilon_i)$ is linear in the unknown action a_j, in equilibrium the expected payoff of strategy a_i can be written as

$$E_{a_j}\left[U_i(a_i, a_j, x_i, \varepsilon_i)\right] = \lambda_1 a_i x_i + \lambda_2 a_i \sigma_j\left(x_j, x_i\right) D_i + \lambda_3 \sigma_j\left(x_j, x_i\right) D_i + a_i \varepsilon_i,$$

where $\sigma_j(x_{j,} x_i)$ is the equilibrium probability that the partner smokes. Substituting this expression in eq. [1] one can rewrite the smoking condition for individual i as

$$\Delta EU_i = \lambda_1 x_i + \lambda_2 \sigma_j\left(x_j, x_i\right) D_i + \varepsilon_i > 0.$$

This condition shows that it will be impossible to identify the parameter $\lambda_3 = -r$. The model only allows to identify $\lambda_1 = (\lambda, -p)$, and $\lambda_2 = p + r + s$. Our estimation will thus permit to recover the structural parameters p and $r + s$.

3 Identification and Estimation Strategy

Given data available we now turn to study how to identify and estimate the model parameters.

Our theoretical model shows that the decision to smoke of individual i depends on whether $\lambda_1 x_i + \lambda_2 \sigma_j\left(x_j, x_i\right) D_i + \varepsilon_i$ is positive or not. In our application, we will always condition on past smoking behavior (which is included in x_i) such that the decision should be interpreted as the decision to quit smoking (for smokers) or to start smoking (for non-smokers – even if much less frequent at adult age). Under the assumption that the preference shocks ε follow a logistic distribution, we obtain the following expression for the probability that individual i smokes conditional on the individual's and the partner's characteristics, $\sigma_i(x_i,\ x_j)$:

$$\begin{aligned}\sigma_i\left(x_i, x_j\right) &= Pr\left(a_i = 1 | x_i, x_j\right) = Pr\left(\lambda_1 x_i + \lambda_2 \sigma_j\left(x_i, x_j\right) D_i + \varepsilon_i > 0\right) \\ &= \frac{\exp\left(\lambda_1 x_i + \lambda_2 \sigma_j\left(x_i, x_j\right) D_i\right)}{1 + \exp\left(\lambda_1 x_i + \lambda_2 \sigma_j\left(x_i, x_j\right) D_i\right)} \\ &= \frac{\exp \Delta EU_i(x_i, x_j)}{1 + \exp \Delta EU_i(x_i, x_j)}\end{aligned}$$

and the same holds for the partner j.

We thus obtain the following system of equations for couples

$$\sigma_i(x_i, x_j) = \frac{\exp(\lambda_1 x_i + \lambda_2 \sigma_j(x_i, x_j) D_i)}{1 + \exp(\lambda_1 x_i + \lambda_2 \sigma_j(x_i, x_j) D_i)}$$

$$\sigma_j(x_i, x_j) = \frac{\exp(\lambda_1 x_j + \lambda_2 \sigma_i(x_i, x_j) D_j)}{1 + \exp(\lambda_1 x_j + \lambda_2 \sigma_i(x_i, x_j) D_j)}$$

We prove in the Appendix 1 that this system admits at least one solution $\left(\sigma_i^*(x_i, x_j),\ \sigma_j^*(x_i, x_j)\right)$ such that $\sigma_i^*(x_i, x_j) \in (0,1)$ and $\sigma_j^*(x_i, x_j) \in (0,1)$. Furthermore, a sufficient condition for this system to have a unique solution is that $|\lambda_2| < 4$. The unique solution then corresponds to a Bayesian Nash equilibrium of our model.

The problem in estimating such a model is that the equilibrium probabilities $\sigma_i^*(x_i, x_j)$ and $\sigma_j^*(x_i, x_j)$ are unknown. In order to estimate the model parameters, we use a two-step procedure as in Bajari et al. (2010). We first estimate $\widehat{\sigma}_i(x_i, x_j)$ and $\widehat{\sigma}_j(x_i, x_j)$ using a logit regression. Under the assumption that individuals do not have better information than the econometrician (that is to say, the partner's ε is unknown to each individual), $\widehat{\sigma}_j$ corresponds to the belief that individual i holds about the partner's smoking decision which are the equilibrium ones. Then we use the "Hotz-Miller" (1993) inversion to obtain expected utilities given observables:

$$\Delta\widehat{EU}_i(x_i, x_j) = \ln \widehat{\sigma}_i(x_i, x_j) - \ln\left(1 - \widehat{\sigma}_i(x_i, x_j)\right)$$

$$\Delta\widehat{EU}_j(x_i, x_j) = \ln \widehat{\sigma}_i(x_i, x_j) - \ln\left(1 - \widehat{\sigma}_i(x_i, x_j)\right).$$

These are the empirical counterparts for the expected utility from smoking of individuals i and j. In equilibrium, these estimated expected utilities must coincide with the true expected utility of smoking $\lambda_1 x_i + \lambda_2 \sigma_j(x_i, x_j) D_i + \varepsilon_i$ where σ_j is the equilibrium belief σ_j^* for the rest of the paper. In a second step, we use the following moment condition

$$E\left[\left(\Delta\widehat{EU}_i(x_i, x_j) - \lambda_1 x_i - \lambda_2 \widehat{\sigma}_j(x_i, x_j) D_i\right)\right] = 0, \qquad [2]$$

and minimize in λ_1 and λ_2 the empirical counterpart of this moment condition across individuals.

Of course, some unobservable characteristics might in fact enter the beliefs of each partner and affect the smoking behavior. As mentioned above, a crucial assumption in the model is that the partners and the econometrician share the same information on the characteristics of each individual and that any information unknown to the econometrician is irrelevant to predict the belief about the partner smoking decision (given the observables). This ensures that the true belief $\sigma_i^*(x_i, x_j)$ depends on observables x_i, x_j only. This sufficient identifying assumption can however be slightly relaxed. If the individual i has superior information relative to the econometrician such that some unobserved ω_i affects the expected probability that the partner smokes, $\sigma_i(x_i, x_j, \omega_i) = Pr(a_i = 1|x_i, x_j, \omega_i)$ and ω_i. In this case, $\Delta EU_i(x_i, x_j, \omega_i) = \ln \sigma_i(x_i, x_j, \omega_i) - \ln(1 - \sigma_i(x_i, x_j, \omega_i))$. If we define $\Delta EU_i(x_i, x_j) = E[\Delta EU_i(x_i, x_j, \omega_i)|x_i, x_j]$, the moment condition [2] will be true if $E[f(\sigma_i(x_i, x_j, \omega_i))|x_i, x_j] = f(E[(\sigma_i(x_i, x_j, \omega_i))|x_i, x_j])$, where the function f is defined as $f(x) = \ln(\frac{x}{1-x})$. As f is symmetric around 1/2, (because $f(1-x) = -f(x)$), a sufficient (but not necessary) condition for eq. [2] to be true is that $\sigma_i(x_i, x_j, \omega_i)$ is distributed symmetrically around 1/2. Of course this is not an appealing assumption, since it would imply that each individual expects that the probability that the partner will smoke is symmetrically distributed around 1/2. As f is linear around 1/2, concave on $(0, 1/2)$, and convex on $(1/2, 1)$, the ordering of $E[f(\sigma_i(x_i, x_j, \omega_i))|x_i, x_j]$ and $f(E[(\sigma_i(x_i, x_j, \omega_i))|x_i, x_j])$ will depend on the distribution of $\sigma_i(x_i, x_j, \omega_i)$ on the $(0, 1)$ interval. We thus prefer to maintain the assumption that each partner probability of smoking depends only on observable characteristics x_i, x_j.

Note also that the structural model parameters are identified if and only if some variables affect only the individual smoking behavior. In particular, in the utility function of individual i, we need that x_j enters only through $\widehat{\sigma}_j(x_i, x_j)$ and is excluded from the direct utility function of individual i.

As emphasized by Manski (1993), or more recently by Blume et al. (2011), correlation between outcomes in a social group (here the household) can be produced by several mechanisms: (i) direct interdependences between the choices (endogenous interactions or peer effects); (ii) the impact of observable group-level characteristics or common shocks (contextual effects); (iii) the impact of unobserved common shocks and endogenous selection in the peer group on the basis of unobserved characteristics that also affect the outcome of interest (correlated effects).

If tobacco consumption was a relevant characteristic in the choice of a partner, a correlation between smoking behaviors might be explained by correlated effects. To tackle this problem, we control for the past smoking behavior of each partner. Under the assumption that the couple was already formed in the previous period, and that the mating decision did not depend on the future propensity to smoke, controlling for past smoking decisions permits to take into account the endogeneity due to assortative mating. The resulting peer effect parameter can thus be interpreted as the effect of the expected smoking behavior of the partner on the own decision to smoke today, *given* the individual past smoking status and *given* the characteristics of the partner the individual is assigned to. So the decisions we capture in the empirical model are either to quit smoking or to start smoking.

Assortative mating would also imply that any correlation of spouses smoking behaviors can be explained by the correlation of unobservable characteristics of the partners. Clark and Etilé (2006), for instance, study how the present smoking status depends on the past smoking status of the partner and they conclude that the correlation between smoking behaviors is explained solely by the correlation of unobservables across spouses. Our strategy is to control for a number of characteristics of the partner, which enter the belief of her probability of smoking.

4 Empirical Estimation and Results

4.1 Data Description

The French health survey 2002–2003, carried out by the French National Statistical Institute (INSEE), includes data on the demography, socioeconomic status, health status, and health consumption of 25,000 households in France. Data were collected on about 40,797 individuals, interviewed three successive times. Adult individuals (over 18) were also required to fill an auto-evaluation, in which they were asked to report their perceived health and their prevention behavior, including alcohol and tobacco consumption. A similar but adapted questionnaire was proposed to kids aged between 11 and 17. Out of 30,997 adults in the survey, 25,931 complied and returned an auto-evaluation. We dropped the observations containing missing values either on the reported smoking habit or on the socio-demographic variables of interest. We also limit the analysis to adults being the household reference person or the partner of the reference person and in this subgroup, we consider only individuals with an age between 25 and 60. In the case of couples, we drop the households in which the husband is more than 60-years old. Our sample reduces this way to 12,770 adult individuals, 10,540 of which live in a couple.

Our endogenous variable is the smoking behavior. We construct a dummy equal to one if the individual reports being a smoker. An individual is considered a smoker if she reports to be smoking every day.

Individual variables include the age, a dummy equal to one if the level of education is above high school (HS), and the body mass index (BMI). Descriptive statistics on the whole adult population of the survey point to a negative correlation between smoking and BMI. Another variable susceptible to influence smoking behavior is the exposure to smoke at the workplace. This variable is self-reported by each individual and takes the form of a dummy equal to one if the individual is currently exposed to smoke at work. It is worth noticing that in France smoking bans in public places were not as strict in 2002 as they are today. Consequently the exposure at work variable exhibits some variability, and almost 15% of the individuals in our sample reported to be exposed to smoke at the workplace. Finally, the past smoking behavior is included in the analysis: in particular, we use the two years lagged smoking behavior. A two years period is short enough to reasonably assume that most couples did not change their partner; at the same time it is a period long enough to have some variation between past and current smoking behaviors. Taking longer lags would raise the problem of having to deal with individuals changing partner or moving from single to couple. We do not include in the explanatory variables the price of cigarettes for the simple reason that this price in France is regulated and homogeneous at the national level. Another variable that is often used in smoking models is the price (or the price variation) of cigarettes during the adolescence of the individual, that is to say when the individual was more likely to start smoking.[4] We refrain from using this variable, since it would be the same for all individuals in the same age cohort, and thus reduce to a mere proxy for age.

Household-specific variables include the family income adjusted for the number of people in the household, according to the OECD-modified scale (assigning a weight of 1 to the household head, of 0.5 to each additional adult, and of 0.3 to each child), and a dummy variable taking value 1 if at least one child under the age of 15 belongs to the household. Note that the presence of children does not mean that these are the children of the reference individuals (they could be the children of just one of the two partners). For our purposes, this is not problematic, since we want to estimate the impact of the presence of children in the same household on the smoking behavior. Finally, we control for the number of children under age 15 living in the household.

4.2 Reduced Form Results on Smoking Behavior

In the first stage of the empirical analysis, we estimate a reduced form model in order to recover the estimated probability of smoking of each individual and the empirical analogue of her expected utility.

We run a logit regression where the endogenous variable is the smoking dummy. We include in the explanatory variables individual characteristics of

4 See for instance Douglas and Hariharan (1994).

both the individual and her partner, if any. In particular we include the past smoking behavior, in the form of a dummy taking value one if the individual smoked two years ago. We use a two years lag to have more variation across present and past smoking status without having to deal with changing partners. Remark that the correlation across past and present behavior is very high, probably because of addiction. In particular, in our sample, the probability of being a smoker is equal to 25.9%. However, this probability is equal to 85.6% for past smokers and to just 1.17% for people who did not smoke in the past. This piece of evidence shows that among adults quitting smoking is much more frequent than starting smoking.[5] Since we control for the past smoking behavior, we will be able to look at the impact of spousal smoking on the probability of switching behaviors and in particular on the probability of smoking cessation.

We also include in the analysis the gender, the age, the education level and the current work exposure to smoke of the individual. Some household characteristics are also taken into account: for instance, we distinguish among individuals being singles and the ones living in couple. The number of children under 15 and the presence of at least one child under 15 are variables that are susceptible to influence smoking behavior. Finally, we include the family income, adjusted for the size of the household. Descriptive statistics for people living in couple and singles are reported in Tables 1 and 2.

Table 1: Individuals in couple: descriptive statistics.

Variable	Mean	Std. Dev.
Smoking	0.242	0.4286
Smoking two years before	0.278	0.4480
Gender (1: man, 0: woman)	0.500	0.5000
Age	41.907	9.7213
Education > High School	0.380	0.4854
BMI	24.670	4.1080
Work exposure	0.143	0.3499
At least one child under 15 years	0.529	0.49962
Number of children under 15 years	0.920	1.0491
Income	17,912	11,286
Observations	10,540	

5 This is a pattern common to other countries. In 2012, 88% of smoking adults in the US reported starting smoking before age 18. See US Department of Health and Human Services (2012). In the UK, the proportion was 73% in 2008. See Robinson and Bugler (2008).

Table 2: Singles: descriptive statistics.

Variable	Mean	Std. Dev.
Smoke	0.335	0.4709
Smoked two years before	0.361	0.4804
Gender (1: man, 0: woman)	0.3910	0.4896
Age	42.596	9.8718
Education higher than high school	0.434	0.4957
BMI	23.931	4.3927
Work exposure	0.153	0.3604
At least one child under 15	0.195	0.3963
Number of children under 15	0.294	0.6943
Income	17,173	11,924
Observations	2,230	

The results of the reduced form logit regression are reported in Table 3. Heteroscedasticity-robust standard errors allowing for clustering at the household level are reported in parentheses.

The current smoking behavior is strongly correlated with the past smoking behavior, as expected. The level of education correlates negatively with the probability to smoke, as well as the BMI for people living in a couple. The presence of children does not display any correlation with the probability of smoking. For couples, the past smoking behavior of the partner has a positive and highly significant effect on the probability of smoking, while the partner's level of education affects negatively the probability of smoking. These parameters, however, do not correspond to the structural model parameters. As pointed out by Clark and Etilé (2006), the effect of the partner's past smoking behavior could be overestimated due to the exclusion of individual effects. The first step estimation is thus only instrumental to getting the estimated probability $\widehat{\sigma}_i(x_i, x_j)$ that individual i smokes conditional on the observables. For our purposes, it does not matter whether the partner's smoking behavior affects $\widehat{\sigma}_i(x_i, x_j)$ directly or through the correlation of individual effects. All that matters is that $\widehat{\sigma}_i(x_i, x_j)$ is an unbiased estimate of the equilibrium individual beliefs, whose effect on smoking decisions we want to test. In order to recover the structural parameters, we use the Hotz–Miller inversion and we obtain an estimate of the expected utility from smoking for each of individual i:

$$\Delta\widehat{EU}_i(x_i, x_j) = \ln \widehat{\sigma}_i(x_i, x_j) - \ln\left(1 - \widehat{\sigma}_i(x_i, x_j)\right)$$

Table 3: Smoking behavior: Logit model.

Variables	Parameter	(Standard error)
Smoking at year-2*couple	6.097***	(0.1243)
Smoking at year-2*single	6.798***	(0.2914)
Gender*couple	0.325***	(0.1142)
Gender*single	0.082	(0.2431)
Age*couple	0.081*	(0.0442)
Age2*couple	−0.001*	(0.0005)
Age*single	0.057	(0.1080)
Age2*single	−0.001	(0.0013)
Education higher than High School*couple	−0.352***	(0.1114)
Education higher than High School*single	−0.6882***	(0.2540)
BMI*couple	−0.235**	(0.0928)
BMI2*couple	0.003	(0.0017)
BMI*single	−0.2244***	(0.008)
BMI2*single	0.003***	(0.0012)
Work exposure*couple	0.118	(0.1225)
Work exposure*single	0.562*	(0.3163)
Partner smoking at year-2*couple	0.824***	(0.0995)
Partner’s age*couple	0.007	(0.0106)
Partner’s education > HS*couple	−0.280**	(0.1120)
Partner’s BMI*couple	0.007	(0.0123)
Partner’s work exposure*couple	−0.077	(0.1300)
Couple	0.888	(2.9193)
At least one child under 15*couple	0.3899	(0.2917)
At least one child under 15*single	−4,955	(0.9296)
Number of children under 15*couple	−0.437	(0.2792)
(Number of children under 15)2*couple	0.111**	(0.0618)
Number of children under 15*single	0.267	(0.9034)
(Number of children under 15)2*single	−0.019	(0.1795)
Income*couple	−2.42e-05***	(8.93e-06)
Income2*couple	2.31e-10**	(9.54e-11)
Income*single	−4.93e-05**	(1.99e-05)
Income2*single	4.84e-10**	(2.04e-10)
Constant	−1.396	(2.5248)
Observations	12,770	

*Significant at the 10% level; **Significant at the 5% level; and ***Significant at the 1% level.

Remind that, under our assumptions, $\hat{\sigma}_j(x_i, x_j)$ is a consistent estimate of the beliefs that individual i holds about the probability of smoking of her partner. In equilibrium, the beliefs coincide with the true probabilities. Thus, $\Delta\widehat{EU}_i(x_i, x_j)$ is the empirical analogue of the expected utility of individual i. We can then proceed with the second step of our analysis.

4.3 Structural Estimation of Smoking Behavior

Once an unbiased estimation of the expected utility from smoking has been recovered, it is possible to recover the parameters of the structural model under the sole moment condition discussed above, $E\left[\left(\Delta\widehat{EU}_i(x_i, x_j) - \lambda_1 x_i - \lambda_2 \widehat{\sigma}_j\left(x_i, x_j\right) D_i\right)\right] = 0$. In particular, we obtain estimates of the coefficients $\lambda_1 = (\lambda, -p)$ and $\lambda_2 = p + r + s$. Both p and $r + s$ are identified.

Remark that the assumption that allows us to recover these parameters is that partner's characteristics x_j enter the individual expected utility function only through the beliefs about the partner's smoking behavior $\widehat{\sigma}_j\left(x_i, x_j\right)$ and thus are excluded from the direct utility of the individual.

The results of the described regression are reported in Table 4. Bootstrap standard errors are reported in brackets.[6]

Table 4: Expected utility of smoking (OLS).

Variables	Parameter	(Standard Error)
Smoked at t–2	6.256***	(0.1184)
$\hat{\sigma}_j(r + p + s)$	0.547***	(0.1239)
Couple (-p)	−0.339**	(0.1952)
Age	0.082*	(0.0435)
(Age)2	−0.001	(0.0005)
Gender (1: man, 0 woman)	0.186**	(0.0870)
Education higher than High School	−0.534***	(0.0967)
BMI	−0.080***	(0.0117)
Work exposure	0.171	(0.1159)
At least one child under 15	−0.085	(0.1585)
Number of children under 15	0.065	(0.0751)
Income	−1.11e-05***	(4.02e-06)
Constant	−3.379***	(0.9293)
Observations	12,770	

*Significant at the 10% level; **Significant at the 5% level; and ***Significant at the 1% level.

The past smoking behavior affects positively the utility of smoking. The corresponding parameter is strongly significant and quantitatively important. This is not surprising, since the smoking behavior is persistent over time. Remember that, on the one hand, only about 15% of past smokers succeeded in giving up

6 A bootstrap procedure is motivated by the fact that in the second stage we include estimated variables. The bootstrapping procedure was performed at the household level, in order to preserve the information concerning both partners in each bootstrap sample.

smoking by the time of the interview. On the other hand, individuals that were non-smokers two years before are very unlikely to start smoking. This accounts for the explanatory power of the past smoking behavior.

However, given the past smoking behavior, other variables significantly affect the present utility from smoking. Males seem to be more prone to smoke than women. The BMI is negatively correlated with the utility of smoking. This piece of evidence suggests that overweight people might be more concerned about the health damages of smoking; the fact that obesity and tobacco consumption could be substitute and not complements is not new to the literature (see for instance, Gruber and Frakes, 2006 and Flegal et al., 1995). Of course, the BMI is potentially an endogenous variable. Smoking might substitute excessive eating and affect individual weight. However, the causal relationship between BMI and tobacco consumption goes beyond the scope of this paper, and the cross-sectional nature of our data does not permit us to trace back the evolution of the BMI, which is the result of long-term decisions. The level of education is negatively correlated with the expected utility of smoking. This is an intuitive result in line with previous findings from the literature (see for instance Kenkel, Lillard, and Mathios 2006). The exposure to smoke at work has no significant effect on the utility of smoking. The results also suggest that the utility from smoking decreases as family income increases, which is in line with previous findings. The presence of at least one child and the number of children in the household do not have any significant effect on individual smoking. This result is counterintuitive but quite robust to different specifications and in line with previous findings (see Clark and Etilé 2006). Parents do not seem to perceive an extra cost of smoking with respect to non-parents. This may be due to the fact that we control for the past smoking behavior, which has a large explanatory power due to addiction. Also, note that in the first stage regression (Table 3), the number of children matters in explaining beliefs about the spousal smoking behavior. This suggests that the number of children might enter indirectly in the utility from smoking, through the spousal peer effect.

Let us now discuss the parameters corresponding to peer effects. On the one hand, the impact of the probability of smoking of the partner is positive and strongly significant. This effect corresponds in the theoretical model to $p+r+s$ and is estimated to be 0.55. On the other hand, living in a couple has a negative and significant (at the 95% confidence level) effect estimated to be –0.34. The absolute value of this parameter corresponds to the cost of smoking when the partner does not, p. We can thus identify $r+s$. If the partner has a probability to smoke close to one, the individual expected utility function increases of around 0.55 in absolute value with respect to the case in which it is very unlikely that the partner will smoke. In the model, the presence of single individuals permits to decompose this effect. With respect to a single, an individual with a partner who smokes gets an extra utility from smoking. This extra utility is modeled through the parameter $r + s$ and is estimated to be about 0.21. Conversely, with respect to a single, an individual with a non-smoking partner gets a loss of utility if she smokes. This loss, corresponding to the parameter p in the model, is estimated to be equal to −0.34.

These findings suggest that the smoking behavior of the partner influences the utility from smoking in two distinct ways. First, if both partners smoke, this increases the benefit that they can both extract from tobacco consumption. This is a smoking enhancing effect linked to the presence of a smoker in the household. Second, if just one partner smokes, she will have to bear a cost due to the fact that she lives with a non-smoker. This extra cost might be linked to the partner complaints or to the internalization of some of the passive smoke externality. Furthermore, it could be due to the fact that a smoker matched with a non-smoker might have to smoke outside the house or reduce her tobacco consumption.

Finally, note that the estimated $\lambda_2 = r + p + s$ is smaller than four in absolute value. As shown in Section 3, this ensures that the Bayesian Nash equilibrium that we have empirically characterized is indeed unique.

The coefficients listed in Table 4 give us a qualitative idea of spousal peer effects. However, the results refer to the impact on the utility from smoking which is an ordinal quantity. Thus, they do not allow us to quantify the magnitude of the peer effects. As pointed out before, these magnitudes are important in order to measure the impact of smoking containment measures. In the next section, we present the marginal effects of spousal smoking behavior on the individual probability of smoking.

4.4 Marginal Effects

Given the estimated parameters, we now analyze the marginal effects of x_i or x_j (the characteristics of the partner of i) on the probability of smoking of an individual i. This probability is equal to

$$\sigma_i(x_i, x_j) = F\left(\Delta EU_i(x_i, x_j)\right),$$

where F is the logistic function satisfying $F'(u) = F(u)(1 - F(u))$ for all u.

Thus, we have

$$\frac{\partial}{\partial x_i}\sigma_i(x_i, x_j) = \sigma_i(x_i, x_j)\left[1 - \sigma_i(x_i, x_j)\right]\left[\lambda_1 + \lambda_2 \frac{\partial}{\partial x_i}\sigma_j(x_i, x_j) D_i\right]$$

for the marginal effect of an individual characteristic on its own likelihood to smoke, and

$$\frac{\partial}{\partial x_j}\sigma_i(x_i,x_j)=\sigma_i(x_i,x_j)\left[1-\sigma_i(x_i,x_j)\right]\left[\lambda_2\frac{\partial}{\partial x_j}\sigma_j(x_i,x_j)D_i\right]$$

for the marginal effect of a partner characteristic on the own likelihood to smoke.

Note that each individual characteristic has both a direct effect on the probability of smoking and an indirect effect through the partner's probability of smoking. The direct effect of x_i on the probability of smoking of i is $\lambda_1\sigma_i(x_i,x_j)\left[1-\sigma_i(x_i,x_j)\right]$. The indirect effect due to the implied change in the probability of smoking of the partner is equal to $\lambda_2\sigma_i(x_i,x_j)\left[1-\sigma_i(x_i,x_j)\right]\frac{\partial}{\partial x_i}\sigma_j(x_i,x_j)$. This indirect effect can either reinforce or reduce the effect of x_i on the probability to smoke.

Substituting the same expressions for $\frac{\partial}{\partial x_i}\sigma_j(x_i,x_j)$ and $\frac{\partial}{\partial x_j}\sigma_j(x_i,x_j)$ in the previous equations, after some rearrangements we get:

$$\frac{\partial}{\partial x_i}\sigma_i(x_i,x_j)=\frac{\lambda_1\sigma_i(x_i,x_j)\left[1-\sigma_i(x_i,x_j)\right]}{1-\lambda_2^2\sigma_j(x_i,x_j)\left[1-\sigma_j(x_i,x_j)\right]\sigma_i(x_i,x_j)\left[1-\sigma_i(x_i,x_j)\right]D_i},$$

and

$$\begin{aligned}\frac{\partial}{\partial x_j}\sigma_i(x_i,x_j)&=\frac{\lambda_1\lambda_2\sigma_i(x_i,x_j)\left[1-\sigma_i(x_i,x_j)\right]\sigma_j(x_i,x_j)\left[1-\sigma_j(x_i,x_j)\right]D_i}{1-\lambda_2^2\sigma_i(x_i,x_j)\left[1-\sigma_i(x_i,x_j)\right]\sigma_j(x_i,x_j)\left[1-\sigma_j(x_i,x_j)\right]D_i}\\&=\frac{\partial}{\partial x_i}\sigma_i(x_i,x_j)\left[\lambda_2\sigma_j(x_i,x_j)\left[1-\sigma_j(x_i,x_j)\right]D_i\right].\end{aligned}$$

The interaction effect increases the marginal effect of the own individual characteristics on the probability to smoke since

$$1-\lambda_2^2\sigma_j(x_i,x_j)\left[1-\sigma_j(x_i,x_j)\right]\sigma_i(x_i,x_j)\left[1-\sigma_i(x_i,x_j)\right]D_i<1$$

whenever $|\lambda_2|<4$, which is the case empirically.

We estimated the marginal effect of continuous variables for each individual, and we take the averages on the whole sample. Concerning the BMI, for a person measuring 1m70 the effect of a 3 kilos weight increase reduces the probability of smoking by a factor equal to 0.20 percentage points on average (ranging from –2% to 0). An increase in annual income of 10,000 euros corresponds to a decrease in the probability of smoking of 3.7 percentage points on average.

In Table 5 we report the average marginal effect for the peer effect parameters. The standard deviations are obtained by bootstrap. For individuals

Table 5: Marginal peer effects.

	Marg. Eff.	Std. Dev.
All individuals		
$\hat{\sigma}_j$ (couples only)	0.022	0.0008
Couple (non-smoking partner)	−0.015	0.0080
Couple (smoking partner)	−0.009	0.0077
Past smokers		
$\hat{\sigma}_j$ (couples only)	0.064	0.0026
Couple (non-smoking partner)	−0.041	0.0216
Couple (smoking partner)	−0.017	0.0204

living in couple, the effect of the probability that the partner smokes $s + r + p$ is equal to

$$\frac{\partial}{\partial \sigma_j} \sigma_i(x_i, x_j) = \lambda_2 \sigma_i(x_i, x_j)\left[1 - \sigma_i(x_i, x_j)\right],$$

and is estimated to be equal to 0.02 for individuals living in couple. This effect ranges from 0 to 0.13 depending on the value of σ_i. This effect seems low, compared to the existing empirical literature; for instance, Cutler and Glaeser (2007) find that a smoking partner increases the individual probability of smoking of 40%. However, we are already controlling for the past smoking behavior for which we know that there is a strong path dependence. Thus, marginal effects on transitions from smoking to non-smoking are generally low. In addition to that, the average marginal effect for individuals that smoked in the past $(t - 2)$ goes up to 6.4%. The interpretation of this number is that a smoker is about 6.4 percentage points less likely to give up smoking if her partner smoking probability moves from zero to one. Remember that the unconditional probability to quit smoking is equal to 15%. The estimated peer effect is therefore relatively important.

The marginal effect p of being in a couple on the probability of smoking is calculated as the difference in the probability of smoking of individual i when the couple dummy, D_i, passes from zero to one. Since for singles $\hat{\sigma}_j = 0$, in order to evaluate this marginal effect separately from the effect of $\hat{\sigma}_j$, one has to keep $\hat{\sigma}_j$ fixed and equal for all the individuals in the sample. First, we impose $\hat{\sigma}_j = 0$. The average marginal effect over the full sample is equal to −1.5%. This figure goes up to −4.1% for individuals who smoked two years before. This result suggests that smokers living in a couple and expecting the partner not to smoke are 4.1 percentage points more likely to give up smoking than singles.

We also look at the marginal effect of being in couple imposing $\hat{\sigma}_j = 1$. The effect is much smaller than the previous one both for smokers and the full sample. As one would expect, the smoking deterring effect of living in a couple is smaller if the partner is expected to smoke with probability one. Living with a smoking partner increases the probability of smoking by a number (corresponding to $s+r$ in the theoretical model) equal to the difference between the marginal effect of $\hat{\sigma}_j$ (corresponding to $s+r+p$) and the marginal effect of the couple dummy calculated at $\hat{\sigma}_j = 1$ (corresponding to $-p$). For past smokers, this increase is estimated to be equal to 1.7 percentage points.

The results from this section suggest that a non-smoking partner might reduce the individual utility from smoking. This effect might work through the three channels described above: consumption externalities, altruism and learning. If we were able to observe the qualitative aspects of the smoking behavior (smoke in/out, for instance), it would be possible to disentangle learning effects from consumption externalities and altruism, since the latter affect the behavior of the smoker. We do not observe these qualitative variables. However, in the next section, we consider partners with children and analyze the effects of parental smoking on the health of their children. If the deterring effect identified in this section reduces the individual utility through an obligation for the smoker not to smoke at home, we should find that, everything else equal, children whose both parents smoke are more exposed to passive smoking than children with a non-smoking parent. Thus, smoking externality and altruism seem to play a role in smoking spousal peer effects.

4.5 Gender-Specific Peer Effects

In a couple, male and female partners might be affected in different ways by the behavior of the partner. In this section we consider a different setting where the structural parameters p, r and s depend on gender. We denote the gender by $g \in \{f,\ m\}$ where m refers to male individuals and f to female ones. The utility of individual i of gender g equals:

$$\begin{aligned} U_{ig}(a_i, a_j, x_i, \varepsilon_i) &= a_i\left[\lambda_g \tilde{x}_i + \varepsilon_i + s_g a_j D_i - p_g(1-a_j)D_i\right] - [1-a_i] r_g a_j D_i \\ &= a_i\left[\lambda_g \tilde{x}_i - p_g D_i + \varepsilon_i\right] - r_g a_j D_i + a_i a_j\left[s_g + p_g + r_g\right] D_i \\ &= \lambda_{1g} a_i x_i + \lambda_{2g} a_i a_j D_i + \lambda_{3g} a_j D_i + a_i \varepsilon_i, \end{aligned}$$

where $x_i = (\tilde{x}_i, D_i)$, $\lambda_1 = (\lambda_g, -p_g)$, $\lambda_2 = p_g + r_g + s_g$, $\lambda_3 = -r_g$. The parameters s_g, r_g and p_g are expected to be non-negative for $g = f,\ m$.

We apply the same estimation method as in the previous sections. In the first stage regression (the results are omitted), we allow the parameters to be different for men and women. In the second stage, we estimate the gender-specific peer effects, by interacting the variables of interest, $\hat{\sigma}_j$ and the Couple dummy, with a dummy taking value one if the individual is male. The results of the analysis are reported in Table 6.

Table 6: Expected utility of smoking/gender differences (OLS).

Variables	Parameter	(Standard Error)
Smoked at *t*–2	6.283***	(0.1205)
$\hat{\sigma}_j(r+p+s)$	0.569***	(0.1655)
$\hat{\sigma}_j$ *Gender	−0.038*	(0.2117)
Couple (-p)	−0.367	(0.2246)
Couple*Gender	0.065	(0.2635)
Age	0.080*	(0.0431)
(Age)2	−0.001	(0.0005)
Gender	0.098	(0.2394)
Education > HS	−0.541***	(0.0978)
BMI	−0.079***	(0.0116)
Work exposure	0.170	(0.1168)
At least one child under 15	−0.091	(0.1601)
Number of children under 15	0.064	(0.0757)
Income	−1.11e-05***	(4.03e-06)
Constant	−3.953***	(0.9352)
Observations	12,770	

*Significant at the 10% level; **Significant at the 5% level; and ***Significant at the 1% level.

The results for the individual characteristics are very similar to the ones reported in Table 5, with the important exception of the gender dummy. Concerning the peer effects, however, there are some noticeable differences. Women seem to feel a higher peer pressure. In particular, the so-called smoking enhancing effect is greater for women than for men. The difference is statistically significant. In order to have a sense of the magnitude of these different effects, we calculated the average marginal effect of a smoking partner on the own probability of smoking. For both men and women, the probability of smoking is 2.1 percentage points higher if their partner smokes (the standard deviation is equal to 0.0060 and 0.0068, respectively).

The difference between men and women appears when computing the average marginal effect of σ_j for the subsample of past smokers. This is very high for women: a woman living in a couple is 6.8 percentage points less likely to give up smoking if her partner's smoking probability goes from zero to one (with standard deviation equal to 0.0192). For past smoking men, this figure is only of 6.2 percentage points (standard deviation of 0.0183). Under our interpretation, these results suggest that women get more pleasure from smoking with their partner or internalize more the externality imposed on their partner. These results are in line with the findings of McGeary (2015), who shows that women are more likely to quit smoking if their partner suffers a negative health shock. Concerning the smoking deterring effect, represented by the parameter p, the results suggest that there are no significant differences between men and women.

The gender dummy has no significant explanatory power in this specification, while in the previous one it was significant. This suggests that gender affects the smoking behavior only through the interaction with the expectations on the partner's smoking behavior.

4.6 Children's Health and Parents' Behavior

In this section, we study the relationship between the smoking behavior of parents and the number of non-chronic respiratory diseases of their children. The survey respondents were asked to report the diseases occurred to all household members between different waves of the survey. For each disease, they were asked when the disease occurred, its length, and whether it was chronic or not. Thus, the distinction between chronic and non-chronic diseases is based on the self-reported duration of the illness status. The reason why we focus on non-chronic conditions is twofold. First, we think that the relationship between chronic respiratory conditions and parental smoking behavior may be plagued by more severe endogeneity problems. Second, our aim is to test how the exposure of children to smoke depends on whether both parent smoke, or only one of them. We think that, for this purpose, looking at diseases occurring at the same time in which the smoking behavior takes place is more appropriate (rather than considering chronic diseases that surged in the past and that are likely to be correlated with past parental smoking).

We only include households in which the reference person lives in a couple. We also limit the analysis to the case in which the reference person is a man (only 10 households are removed) and is between the age of 25 and 60. There are 5,274 such households. For simplicity, in the following we will define the reference person as the husband and his partner as the wife, even though we do not control for their effective marital status. Overall, 2,791 such households have at least one child under the age of 15; 4,853 children live in these families. In these household, 670 husbands and 831 wives reported being smokers. In 374 cases both parents smoke (see Table 7).

Table 7: Children: descriptive statistics.

Variable	Obs	Mean	Std. Dev.
Non-chronic respiratory diseases	4,853	0.310	0.5782
At least one chronic condition	4,853	0.084	0.2773
Doctor visits-else than respiratory	4,853	0.401	0.8896
Sicknesses-else than respiratory	4,853	0.932	1.0878
Age	4,853	7.010	4.3335
Gender	4,853	0.512	0.5000
BMI	4,853	17.121	3.4891
Number of children under 15	4,853	2.117	0.9244
Only one parent smokes	4,853	0.268	0.4430
Both parents smoke	4,853	0.133	0.3393
Cigarettes if one parent smokes	1,301	14.862	7.9370
Cigarettes if both parents smoke	644	30.846	11.6197

We regress the number of non-chronic respiratory diseases on a set of individual variables, such as the age, the gender, the BMI of the child and a dummy equal to one if she is affected by a chronic respiratory condition; we also include in the regressors the number of children under 15 present in the household. The education level of both the mother and the father and their BMI are also taken into account, since these characteristics may influence the way parents care about the health of their children. Finally, we include two dummy variables summarizing parents' smoking behavior: we distinguish the case in which both parents smoke and the one in which just one parent smokes.

In our data set the number of sicknesses and the level of health care consumption of children is reported by parents. This can lead to measurement problems if parents tend to misreport the health status of their children. In the case of respiratory diseases, this difficulty seems to be particularly strong since some parents might report to the interviewer problems such as a light flu, while others would not. If this reporting bias is correlated with the variables of interest, this can lead to a misinterpretation of the coefficients. For instance, if smoking parents tend to underestimate the health problems of their children, we might find no effect of smoking on the non-chronic respiratory diseases of children, even though passive tobacco exposure actually affects their health. In order to reduce this bias, we control for the total number of non-respiratory diseases and the total number of doctor visits for health matters different from the respiratory ones. These variables are useful to control the global health of the child and might capture the reporting bias of parents, if the latter is systematically the same for any health condition.

Another problem to take into account is endogeneity. On the one hand if a parent observes that her children are often sick, this may affect her smoking behavior. On the other hand, even though we control for chronic respiratory conditions, which have a high chance to affect both the parents' behavior and the occurrence of non-chronic respiratory diseases, there could still be some correlation between our measures of parents' tobacco consumption and some unobservables affecting the occurrence of non-chronic respiratory diseases. For instance, smoking parents might be less concerned with the health status of their children as they are less by their own health. This would lead to an overestimation of the effect of smoking on children's health. Regressing naively the health status of children on the smoking behavior of parents might thus lead to biased results. In particular, the impact of smoking on children respiratory health could be underestimated. We try to overcome this problem using instruments. We use as instruments the age of both parents and their exposure to smoke at the workplace. The age of parents does not appear to be correlated with the error term once one controls for the age of children. We think that it is quite reasonable to consider the exposure to smoke at the workplace as exogenous to the health care of children by parents. Evans, Farrelly, and Montgomery (1999) using U.S. data showed that the sorting across jobs based on smoking status seems to be relatively weak. We perform an OLS and 2SLS regression. We run a Sargan test suggesting that the instruments are indeed valid (see Table 8).

Since we are dealing with count data (the number of respiratory diseases in the period of interest ranges from 0 to 4), we also run a Poisson regression and a Poisson regression with control functions in order to account for endogeneity (using the same instrumental variables as in the 2SLS). The latter estimates are obtained by a technique suggested by Blundell and Powell (2003). We perform a first stage regression of the endogenous variables on all exogenous variables and instruments and we use the residuals and polynomials of those residuals as additional control variables in the main regression. This seems to be a more appropriate estimation strategy, because of the zero inflated discrete distribution of the dependent variable.

Results of both the OLS and the IV regressions are reported in the first two columns of Table 8. Clustered standard errors at the household level are reported in brackets. The presence of chronic conditions seems not to influence the number of non-chronic respiratory diseases. However, the total number of doctor visits and the number of diseases different than respiratory both present positive and highly significant effect on the endogenous variable. As pointed out before, this could be due to the fact that these variables are proxies for the general health of the child. However, their positive impact might be linked to a systematic reporting bias of the parents. The age of the child affects positively

Table 8: Children non-chronic respiratory diseases (a).

Variables	(a)	(b)	(c)	(d)
	OLS	2SLS	Poisson	CF Poisson
One parent smokes	−0.005	−0.050	−0.020	2.420
	(0.0210)	(0.4180)	(0.0705)	(1.839)
Both parents smoke	0.040	0.668*	0.119	1.793
	(0.0319)	(0.3590)	(0.0951)	(1.548)
One chronic condition	−0.002	−0.029	−0.018	−0.083
	(0.0284)	(0.0359)	(0.0893)	(0.1010)
Visits-else than respiratory	0.035***	0.035**	0.045**	0.043
	(0.0126)	(0.0151)	(0.0226)	(0.0270)
Sicknesses-else than respiratory	0.047***	0.047***	0.160***	0.163***
	(0.0095)	(0.0136)	(0.0262)	(0.0349)
Age	−0.043***	−0.042***	−0.085***	−0.085***
	(0.0078)	(0.0089)	(0.0221)	(0.0243)
(Age)2	0.001**	0.001*	−0.001	−0.0004
	(0.0005)	(0.0006)	(0.0017)	(0.0018)
Gender (1: male, 0: female)	0.014	0.012	0.040	0.040
	(0.0163)	(0.0196)	(0.0524)	(0.0576)
BMI	−0.001	−0.002	−0.0042	−0.0070
	(0.0023)	(0.0026)	(0.0084)	(0.0094)
Number of children under 15	−0.029***	−0.027**	−0.096***	−0.077**
	(0.0097)	(0.0117)	(0.0349)	(0.0363)
Mother's education higher than HS	0.022	0.049*	0.080	0.144*
	(0.0227)	(0.0280)	(0.0708)	(0.0708)
Father's education higher than HS	0.052**	0.100***	0.165**	0.292***
	(0.0236)	(0.0363)	(0.0722)	(0.0998)
Mother's BMI	0.0005	0.0047	0.002	0.012
	(0.0022)	(0.0031)	(0.0073)	(0.0091)
Father's BMI	0.002	0.006*	0.007	0.017*
	(0.0028)	(0.0037)	(0.0088)	(0.0106)
Income	−3.30e-06***	−1.92e-06	−1.15e-05***	−7.93e-06*
	(1.04e-06)	(1.48e-06)	(3.84e-06)	(4.77e-06)
Constant	0.504***	0.179	−0.708**	−2.002***
	(0.0970)	(0.1610)	(0.3210)	(0.5490)
Observations	4,853	4,853	4,853	4,853
Sargan	.	0.857	.	.
	.	(P val. 0.6515)	.	.
R^2	0.067	.	.	.

*Significant at the 10% level; **Significant at the 5% level; and ***Significant at the 1% level.

the respiratory health of the child, as expected. The square of the age, the gender and the BMI have a small or insignificant effect in both specifications. The variable controlling for the number of children in the household presents a negative estimated parameter. This result seems counterintuitive since one could expect the presence of siblings to increase the risk to fall sick. The father's education level seems to have a positive correlation with the respiratory diseases of children. The mother's education and BMI have a small effect which is significant only under certain specifications. The fact that the father's education increases the number of non-chronic respiratory condition is at first sight counterintuitive too. One explanation could be that more educated households tend to report more respiratory diseases. The family income has a negative and significant effect on the number of sicknesses.

The results on smoking variables are the ones presenting a particular interest in order to test our smoking model. In the OLS specification, the estimates suggest no significant effect of the smoking behavior of parents. In the IV regression, however, the fact that both parents smoke has a significant (at the 90% confidence interval) and positive effect on the respiratory diseases of children. Having just one parent smoking at home does not affect significantly the children's health. The impact of the fact that both parents smoke is quantitatively very high (0.668), considering that in the period of observation, the average number of non-chronic respiratory diseases for children is equal to 0.3. If just one parent smokes, the effect of smoking on children seems to be null. This evidence supports the hypothesis that non-smoking parents might have a control role inside the household, protecting children from passive tobacco exposure.

In the third and fourth columns of Table 8, we report the results of the Poisson regressions. For most variables the results of the least square regression are confirmed. However, the parameters corresponding to the smoking behavior of parents are not significant in this specification.

These results weakly point toward a control role of a non-smoking parent. However, this first analysis does not take into account the number of cigarettes effectively smoked by each parents and thus lacks precision. We refine the analysis by looking at the effect of each cigarette smoked per day by household members. In particular, we constructed a variable corresponding to the daily tobacco consumption of the smoking parent when just one parent smokes, and a variable corresponding to the daily aggregate consumption when both parents smoke. No information concerning where these cigarettes are consumed is available. In particular, the available data does not allow us to know whether the parents smoke at home or not. The estimates of the smoking game suggest that when an individual is in couple with a non-smoker, this reduces its utility from smoking. Our interpretation is that this disutility might come from the fact that smokers living with non-smokers and having kids may be forced to smoke less at home or leave the house in order to smoke. Thus, we expect to see a smaller effect of each cigarette on the respiratory health of children when just one parent smokes instead of both.

In columns (a) and (b) of Table 9 we report the results of the OLS and the IV regressions. In the OLS regression, no effect of the smoking behavior is found. In the IV specification, the respiratory health of children seems to be affected by each extra cigarette that a parent smokes only if the other parent is also a smoker. The parameter is significant at the 95% confidence level. In column (3) of Table 9, we also include among the instrumented variables the square of the total number of cigarettes smoked by parents (if one or both smoke). This variable is meant to control for nonlinear effects of the number of cigarettes smoked. More precisely, we want to test for the hypothesis that the number of cigarettes matters only if a critical number of cigarettes is consumed (or that the negative effect on health is convex). The results seem to reject this hypothesis. Controlling for this variable, the marginal cigarette smoked leads to an increase of 0.06 in the number of respiratory diseases when both parents smoke. Again, no effect is detected in households where just one parent smokes. In columns (c) and (d), we report the results of a Poisson regression and of a Poisson with control functions (for endogeneity). The results are qualitatively similar to the previous ones. The number of cigarettes smoked in households where both parents smoke has a positive impact on the number of diseases.

As suggested by the medical literature (see for instance Cook and Strachan, 1999), younger children may be more sensitive to the smoking behavior of their parents. According to our model, this may be justified by the fact that younger children may spend more time with their parents and may thus be more exposed to parental smoking. In this case, a control role of non-smoking parents may be particularly important. To test for this intuition, we split the sample in two age groups: children below age 7 (included), and children between age 8 and 14 (included). The results for the smoking intensity model are reported in Table 10. At least in our Poisson specification, we find results similar to the ones above, but only for younger children. The number of cigarettes smoked has a negative impact on the respiratory health of children when both parents smoke, but not otherwise. The results also suggest some concavity in the effect of cigarettes on health. For children above age 8, we do not find any impact of parental smoking on non-chronic respiratory diseases. Thus, we think that the results of Tables 8 and 9 are mainly driven by younger children.

Finally, we reproduce the Poisson regressions of Tables 8 and 9, but using the dummy for chronic respiratory diseases as a dependent variable. We do not

Table 9: Children non-chronic respiratory diseases (b).

Variables	(a) OLS	(b) 2SLS	(c) 2SLS	(d) Poisson	(e) CF Poisson
Cigarettes if one smokes	0.0002	−0.010	0.039	0.003	0.120
	(0.0012)	(0.0176)	(0.0426)	(0.0064)	(0.1270)
Cigarettes if both smoke	0.001	0.022**	0.059**	0.007	0.162*
	(0.0009)	(0.0108)	(0.0295)	(0.0084)	(0.0891)
(Cigarettes)2			−0.001	−7.65e-05	−0.005
			(0.0010)	(0.0002)	(0.0031)
One chronic condition	−0.001	−0.022	−0.026	−0.017	−0.079
	(0.0283)	(0.0350)	(0.0349)	(0.0892)	(0.0977)
Visits-else than respiratory	0.035***	0.039**	0.029*	0.045* *	0.027
	(0.0126)	(0.0156)	(0.0165)	(0.0226)	(0.0363)
Sicknesses-else than respiratory	0.047***	0.042***	0.059***	0.160***	0.195***
	(0.0095)	(0.0127)	(0.0183)	(0.0261)	(0.0515)
Age	−0.043***	−0.043***	−0.042***	−0.086***	−0.085***
	(0.0077)	(0.0087)	(0.0085)	(0.0222)	(0.0231)
(Age)2	0.001**	0.001**	0.001**	−0.001	−0.0004
	(0.0005)	(0.0006)	(0.0006)	(0.0017)	(0.0018)
Gender (1: male, 0: female)	0.014	0.008	0.019	0.041	0.056
	(0.0163)	(0.0203)	(0.0214)	(0.0524)	(0.0636)
BMI	−0.001	−0.001	−0.002	−0.004	−0.008
	(0.0023)	(0.0026)	(0.0026)	(0.0084)	(0.0090)
Number of children under 15	−0.029***	−0.029**	−0.024**	−0.096***	−0.073**
	(0.0097)	(0.0120)	(0.0123)	(0.0348)	(0.0374)
Mother's education higher than HS	0.023	0.049*	0.035	0.082	0.111
	(0.0227)	(0.0283)	(0.0304)	(0.0708)	(0.0842)
Father's Education higher than HS	0.053**	0.096***	0.088**	0.168**	0.261***
	(0.0235)	(0.0355)	(0.0355)	(0.0721)	(0.0982)
Mother's BMI	0.0005	0.0049	0.003	0.002	0.007
	(0.0022)	(0.0033)	(0.0039)	(0.0072)	(0.0109)
Father's BMI	0.002	0.006	0.007*	0.007	0.019*
	(0.0028)	(0.0041)	(0.0040)	(0.0089)	(0.0114)
Income	−3.33e-06***	−2.20e-06*	−2.08e-06*	−1.14e-05***	−8.09e-06**
	(1.03e-06)	(1.27e-06)	(1.23e-06)	(3.84e-06)	(4.08e-06)
Constant	0.505***	0.210	0.188	−0.722**	−1.566***
	(0.0965)	(0.1660)	(0.1650)	(0.3210)	(0.4990)
Observations	4,853	4,853	4,853	4,853	4,853
Sargan	.	1.604	0.062	.	.
	.	(P val. 0.4484)	(P val. 0.8029)	.	.
R^2	0.675	.	.	.	.

*Significant at the 10% level; **Significant at the 5% level; and ***Significant at the 1% level.

Table 10: Children non-chronic respiratory diseases, by age group.

Variables	Age 0–7		Age 8–15	
	(1)	(2)	(3)	(4)
	2SLS	CF Poisson	2SLS	CF Poisson
Cigarettes if one parent smokes	0.080	0.199	0.001	−0.021
	(0.1010)	(0.1460)	(0.0359)	(0.2170)
Cigarettes if both parent smoke	0.090	0.204**	0.021	0.124
	(0.0576)	(0.1020)	(0.0335)	(0.1670)
(Cigarettes)2	−0.002	−0.007*	−0.0001	−0.001
	(0.0021)	(0.0036)	(0.0010)	(0.0054)
One chronic condition	−0.043	−0.064	−0.013	−0.131
	(0.0705)	(0.1110)	(0.0380)	(0.2030)
Visits-else than respiratory	0.020	0.018	0.010	0.036
	(0.0363)	(0.0416)	(0.0173)	(0.0789)
Sicknesses-else than respiratory	0.103**	0.218***	0.033**	0.148*
	(0.0492)	(0.0611)	(0.0154)	(0.0887)
Age	0.015	0.042	−0.038	−0.052
	(0.0269)	(0.0489)	(0.0721)	(0.3170)
(Age)2	−0.007**	−0.020***	0.001	−0.001
	(0.0036)	(0.007)	(0.0032)	(0.0145)
Gender (1: male, 0: female)	0.071	0.140*	−0.019	−0.133
	(0.0617)	(0.0749)	(0.0212)	(0.1170)
BMI	−0.0003	−0.012	−0.001	−0.002
	(0.0043)	(0.0103)	(0.0039)	(0.0171)
Number of children under 15	−0.016	−0.053	−0.021*	−0.124**
	(0.0332)	(0.0448)	(0.0118)	(0.0616)
Mother’s education higher than HS	0.002	0.027	0.061*	0.338**
	(0.0548)	(0.0972)	(0.0313)	(0.1590)
Father’s education higher than HS	0.070	0.164	0.102***	0.576***
	(0.0679)	(0.1140)	(0.0354)	(0.1830)
Mother’s BMI	−0.0003	0.001	0.004	0.022
	(0.0085)	(0.0126)	(0.0035)	(0.0207)
Father’s BMI	0.009	0.014	0.006	0.032
	(0.0073)	(0.0126)	(0.0045)	(0.0238)
INCOME	1.77e-08	−1.46e-06	−4.19e-06***	−2.34e-05***
	(2.32e-06)	(4.52e-06)	(1.20e-06)	(8.07e-06)
Constant	−0.008	−1.553***	0.230	−2.436
	(0.3360)	(0.5640)	(0.4110)	(2.0550)
Observations	2,598	2,598	2,255	2,255
Sargan	0.343		0.023	
	(P val. 0.5578)		(P val. 0.8798)	

*Significant at the 10% level; **Significant at the 5% level; and ***Significant at the 1% level.

find a causal relationship between current parental smoking behavior and children's chronic respiratory conditions (see Table 11 in Appendix 2). This result can be considered as some sort of placebo test. In fact, if chronic diseases are determined by the past smoking behavior of parents, which is correlated with current smoking behavior, we would find significant effects only if we were not able to disentangle the effect of current smoking from past behavior. The fact that current smoking does not affect chronic respiratory diseases after instrumentation suggests that our instruments are indeed valid and orthogonal to past smoking behavior of parents. Thus, we feel confident that the results for non-chronic diseases actually capture the current exposure of children to smoke and are not due to correlation with past behaviors.

Summarizing, there is some evidence that non-smoking parents exert a control role over smoking ones, in particular in protecting children from passive smoking. This points toward an interpretation of the empirical results of the smoking game in terms of consumption externalities or altruism. For instance, having one parent smoking 20 cigarettes a day may be less detrimental than having two parents smoking 10 cigarettes a day because of the unobserved change in behavior concerning smoking inside or outside, the smoker with a non-smoking partner being more likely to smoke outside.

5 Conclusion

In this paper we analyze intra-couple peer effects on smoking. Our empirical results suggest that the smoking behavior of the partner influences the individual probability of smoking in two ways. If the partner smokes, the individual utility from smoking is enhanced. If the partner does not smoke, the individual utility from smoking is smaller than the one of a single. We interpret this result as the effect of smoking externalities. Smoking together might be more pleasant than smoking alone. However, smoking alone as a single is better than smoking when living with a non-smoker. This might be due to the fact that the non-smoker imposes a cost on the smoking partner. This cost may materialize in a different smoking behavior: for instance smoking outside the house.

We quantify the impact of spousal tobacco consumption on the individual probability of smoking. More particularly, we find that smokers living in couple and expecting the partner not to smoke are 4.3 percentage points more likely to give up smoking within a period of two years with respect to singles. This might be due to the fact that individuals anticipate some extra cost from smoking if their partner does not smoke. However, if the partner is likely to smoke, this situation is reversed, and smokers living in couple are 8 percentage points less likely to give up smoking with respect to singles. Having a smoking partner enhances the utility an individual can get from smoking. This effect is higher for women than for men.

Finally, we look at the impact of smoking on children respiratory diseases. There seems to be some effect of parental smoking on children health only when both parents smoke. This result is consistent with the evidence from the smoking game we modeled above, and in particular with the fact that, if only one parent smokes, she might be obliged by the partner to protect the children from passive smoke.

The results show the importance of peer effects within the family and the role of partner's behavior in quitting smoking. They also suggest that the effect of smoking on other family members depends crucially on spousal interactions and on the control role of non-smoking partners. In terms of policy implications, this implies that the impact of public policies aimed to smoking cessations (information dissemination, smoking bans, subsidies on substitute treatments) may be amplified due to the presence of spousal peer effects. In addition to the direct effect of these policies on the individuals' propensity to smoke, there may be an indirect effect through the propensity to smoke of the partners, which should be taken into account when evaluating the impact of each policy. Furthermore, in households where both spouses smoke, a policy pushing only one spouse to quit smoking may have the same impact as a policy resulting in both spouses quitting, in terms of children respiratory health. This suggests that incentives to smoking cessation should be given in priority to couples of smokers, specially if they have children and even if they jointly do not smoke as much as singles.

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Appendix 1: Equilibrium of the Smoking Game

To prove that the smoking game has at least a Bayesian Nash equilibrium, $\left(\sigma_i^*\left(x_i, x_j\right),\ \sigma_j^*\left(x_i, x_j\right)\right)$, let us denote by F the logistic function ($F(Z) = \exp(Z)/(1+\exp(Z))$). Note that $F' = F(1-F)$ and define $G(z) = z - F\left(\lambda_1 x_i + \lambda_2 F\left(\lambda_1 x_j + \lambda_2 z D_j\right) D_i\right)$ for all z and $H(z) = z - F\left(\lambda_1 x_j + \lambda_2 F(\lambda_1 x_i + \lambda_2 z D_i) D_j\right)$. The two equations of our system can be rewritten as $G(\sigma_i(x_i,x_j)) = 0$ and $H(\sigma_j(x_i,x_j)) = 0$. Both $G(.)$ and $H(.)$ are continuous functions; furthermore, $G(0) < 0$, $G(1) > 0$. Then, there exists at least one $\sigma_i^*(x_i,x_j) \in (0,1)$ such that $G(\sigma_i^*(x_i,x_j)) = 0$. Similarly, it can be shown that there exists at least one $\sigma_j^*(x_i,x_j)$ such that $H(\sigma_j^*(x_i,x_j)) = 0$. Consequently, there exist at least one Bayesian Nash equilibrium such that $\sigma_i^*(x_i,x_j) \in (0,1)$ and $\sigma_j^*(x_i,x_j) \in (0,1)$. To show that the equilibrium is unique, it is sufficient to prove that both $G(.)$ and $H(.)$ are strictly increasing. The first derivative of $G(z)$ is

$$G'(z) = 1 - \lambda_2^2 D_i D_j \left[F'\left(\lambda_1 + \lambda_2 F\left(\lambda_1 x_j + \lambda_2 z D_j\right) D_i\right)\right] F'\left(\lambda_1 x_j + \lambda_2 z D_j\right) \geq 1 - D_i D_j \left(\frac{\lambda_2}{4}\right)^2,$$

since $0 \leq F'(Z) \leq \frac{1}{4}$ for all z. Then, $G'(.)$ is strictly positive if $|\lambda_2| < 4$. In this range of parameters, the equation $G(\sigma_i(x_i,\ x_j)) = 0$ has a unique solution. In the same way, it can be shown that $H'(.)$ is strictly positive whenever $|\lambda_2| < 4$, so that the system admits a unique solution $\left(\sigma_i^*(x_i,x_j),\ \sigma_j^*(x_i,x_j)\right)$.

Appendix 2: Parental Smoking and Chronic Respiratory Diseases

Table 11: Children chronic respiratory diseases.

Variables	(1)	(2)	(3)	(4)
	Poisson	CF Poisson	Poisson	CF Poisson
One parent smokes	0.051	3.870		
	(0.1230)	(3.3310)		
Both parents smoke	0.304**	0.472		
	(0.1460)	(2.8980)		
Cigarettes if one smokes			0.011	0.161
			(0.0123)	(0.2100)
Cigarettes if both smoke			0.028*	0.104
			(0.0159)	(0.1520)
(Cigarettes)2			−0.006	−0.002
			(0.0004)	(0.0052)
Visits-else than respiratory	−0.041	−0.071	−0.042	−0.073
	(0.0502)	(0.0541)	(0.0500)	(0.0679)
Sicknesses-else than respiratory	0.268***	0.318***	0.272***	0.303***
	(0.0414)	(0.0553)	(0.0500)	(0.0679)
Age	0.095**	0.076	0.095**	0.080*
	(0.0444)	(0.0466)	(0.0443)	(0.0447)

(*continued*)

Table 11: (*Continued*)

Variables	(1)	(2)	(3)	(4)
	Poisson	CF Poisson	Poisson	CF Poisson
(Age)2	−0.0075**	−0.006*	−0.007*	−0.006*
	(0.0030)	(0.0032)	(0.0030)	(0.0031)
Gender (1: male, 0: female)	0.639***	0.688***	0.637***	0.696***
	(0.0998)	(0.1050)	(0.0998)	(0.1120)
BMI	0.013	0.006	0.014	0.007
	(0.0133)	(0.0140)	(0.0131)	(0.0143)
Number of children under 15	−0.139**	−0.122*	−0.140**	−0.123*
	(0.0661)	(0.0674)	(0.0663)	(0.0668)
Mother's education higher than HS	−0.167	−0.102	−0.177	−0.110
	(0.1400)	(0.1500)	(0.1400)	(0.1660)
Father's education higher than HS	0.074	0.219	0.057	0.194
	(0.1350)	(0.1810)	(0.1340)	(0.1720)
Mother's BMI	0.005	0.003	0.005	0.004
	(0.0129)	(0.0166)	(0.0129)	(0.0188)
Father's BMI	−0.021	−0.025	−0.021	−0.031
	(0.0159)	(0.0195)	(0.0159)	(0.0215)
Income	−3.69e-06	−7.93e-06	−3.61e-06	−4.70e-06
	(7.59e-06)	(9.67e-06)	(7.62e-06)	(8.44e-06)
Constant	−2.786***	−3.367***	−2.763***	−2.955***
	(0.5270)	(0.9230)	(0.5220)	(0.8650)
Observations	4,853	4,853	4,853	4,853

*Significant at the 10% level; **Significant at the 5% level; and ***Significant at the 1% level.

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