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NEIGHBORHOOD EFFECTS AND PARENTAL INVOLVEMENT IN THE INTERGENERATIONAL TRANSMISSION OF EDUCATION *

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ABSTRACT: We analyze the intergenerational transmission of education focusing on the interplay between family and neighborhood effects. We develop a theoretical model suggesting that both neighborhood quality and parental effort are of importance for the education attained by children. This model proposes a mechanism explaining why and how they are of importance, distinguishing between high- and low-educated parents. We then bring this model to the data using a longitudinal data set in Britain. The available information on social housing in big cities allows us to identify the role of neighbourhood in educational outcomes. We find that the better is the quality of the neighborhood, the higher is the parents' involvement in their children's education. A novel finding with respect to previous US studies is that family is of importance for children with highly-educated parents while it is the community that is crucial for the educational achievement of children from low-educated families.

JEL Codes: I21, J13, J24

Keywords: Education, cultural transmission, cultural substitution, peer effects, social tenants.

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1 Introduction

Explaining the educational outcomes of children is one of the most challenging questions faced by economists. Most studies have found that school quality (e.g., Card and Krueger, 1992, 1996, and Hanushek, 2002) and family background (e.g., Ermisch and Francesconi, 2001, Sacerdote, 2002, Plug and Vijverberg, 2003) have a significant and positive impact on the level of education of children.[1] However, the effect of neighborhood quality seems to be less clear (see e.g., Durlauf, 2004). For example, Solon et al. (2000), Oreopolous (2003), and the papers using the Moving to Opportunity (MTO) programs (like e.g. Katz et al., 2001) find little evidence of neighborhood effects on education. The general consensus seems to be that the neighborhood where individuals grow up is of importance, although the effects are not large after controlling for individual and family characteristics and parental selection of residential neighborhood. The main open question is whether family background and, in particular, parental education, do proxy for more subtle mechanisms responsible for intergenerational persistence. When the data provide information on the differences in attitudes towards children's education between high and low-skilled parents, these attitudes show a significant impact on children's educational attainment (Patacchini and Zenou, 2009).

The aim of the present paper is to go further by looking at the interplay between family and neighborhood effects. To be more precise, we develop a theoretical framework in which parents' involvement in education as well as the neighborhood where children live are the key ingredients in explaining educational outcomes.[2] Indeed, based on some works on anthropology and sociology (see, in particular, Boyd and Richerson, 1985 and Cavalli-Sforza and Feldman, 1981), there is a recent literature initiated by Bisin and Verdier (2000, 2001) arguing that the transmission of a particular trait (religion, ethnicity, social status, etc.) is the outcome of a socialization inside and outside the family (like e.g. peers and role models). These two types of socialization are cultural substitutes (complements) if parents have less

[1] See also the literature survey by Haveman and Wolfe (1995) who compare the sociological and economic approaches.

[2] There are, in fact, theoretical papers that analyze either the effects of parents' input (see e.g. Becker and Tomes, 1979, Leibowitz, 1974) or neighborhood quality (see e.g. De Bartolome, 1990, Benabou, 1993) on children's educational attainment. Our model links these two approaches and, as a result, gives a mechanism through which both effects affect children's outcomes.

(more) incentive to socialize their children, the more widely dominant are their values in the population. We use this idea to explain children's educational attainment. Altruistic parents, who can either be educated or not, have to decide how much time they spend in educating their children. This is costly since parents have to give up leisure, but also rewarding since it positively influences the chances for their children of being educated. Contrary to the cultural transmission literature cited above, where each parent wants his/her children to be like him/her, here only educated parents conform to this behavior since uneducated parents spend time with their children trying to help them become different, i.e. educated. Indeed, education is not, like for example religion or ethnicity, a trait that is horizontally differentiated (so that it is a matter of taste which trait is considered better) but a trait, or more exactly a characteristic, that it is vertically differentiated (so that everybody agrees that more education is better than less). As in the cultural transmission model, children can become educated either because parents have been successful in educating them (socialization inside the family) or, if this is not the case, because the neighborhood where they live is of sufficiently high-quality in terms of human capital (socialization outside the family). We then model a possible interplay between these different influences by assuming that the cost of parental effort in the children's education depends on neighborhood quality. We give the conditions on the cost function that yield cultural complementarity (higher neighborhood quality leads to higher effort) and substitutability (higher neighborhood quality leads to lower effort). Then, we show how these conditions affect the probability of the child being educated. We also distinguish between high- and low-educated parents by assuming that the cost of effort for their children's education (e.g. doing homework with their children) is lower for the former than for the latter.

We test our theoretical predictions by merging data on parents and children from the UK National Child Development Study (NCDS) with data on neighborhood characteristics from the 1971 UK Census (when children were 13 years old). Because of their longitudinal aspect (members of the cohort are followed from age 7 to 33), the NCDS data are ideal for our purpose. Our empirical strategy consists of providing an evaluation of the reduced-form effects of parental involvement and neighborhood quality on children's educational qualification. This approach relies on the available information on families living in *council houses*

in big cities in the United Kingdom in the 1970s. We provide qualitative and quantitative evidence revealing that the assignment of eligible families to council flats was indeed random with respect to parental education. As a result, the location of families who live in council houses in big cities in Britain can be considered as exogenous and the impact of neighborhood effects on educational outcomes can be identified.[3]

We find a significant and positive effect of neighborhood quality on the parents' effort in their children's education, suggesting cultural complementarity.[4] Both parental investment and neighborhood quality contribute positively to children's education attainment. However, the effect of parental investment seems to be more potent for children of high-educated parents while neighborhood quality shows a more important role for children of low-educated parents.

Our empirical evidence for the UK complements the results obtained for the US. As stated above, the latter indicate a limited role for neighborhood factors in accounting for inequality in educational attainment (Solon et al., 2000, Durlauf, 2004), which may be interpreted as the fact that family is of greater importance than neighborhood. In the present paper, we go further by differentiating between high- and low-educated families. Family seems to play the most important role for children of high-educated parents while neighborhood displays the most (direct) influential effect on children's educational attainment for low-skilled parents.

The interrelations between parental education and neighborhood effects are, however, complex and our analysis only provides one possible approach suggesting that both *parental effort* and *neighborhood quality* might play a role, which is different depending on the educational level of parents. Since peers usually live in the same neighborhood, our paper also contributes to the literature on the influence of peers on own educational achievement.

[3]The use of information on families living in public houses was also adopted by Goux and Maurin (2007) to identify neighborhood effects on early performance at school in France and by Di Addario and Patacchini (2008) to identify wage differentials between urban and non-urban areas in Italy. A similar institutional argument has also been used by Oreopoulos (2003) and Jacob (2004).

[4]To the best of our knowledge, few papers have tested whether cultural substitution or cultural complementarity prevails. A rare exception is Bisin et al. (2004) for the transmission of religion who, in contrast to this paper, find cultural substitution. This is quite intuitive since they are dealing with religion and thus, the more isolated is a religion in an area, the higher is parents' effort in transmitting it. For education, we find the contrary because education and the quality of the neighborhood are more complementary in nature.

However, it is extremely difficult to disentangle neighborhood effects from peer effects and, as noted by Goux and Maurin (2007), there is no consensus on the importance of peer effects on own achievement in this literature.[5]

Our model has highlighted one possible channel of interaction between family and neighborhood inputs through the effect of neighborhood quality on parental involvement in their children's education. Our empirical analysis reveals that this is an important channel and shows that neighborhood quality also has a direct effect (which may, for example, also act through endogenous effects, i.e. the educational attainment of peers), which is particularly relevant for children from low-educated families. However, our reduced-form analysis does not allow us to separate endogenous from exogenous (contextual) effects. Nevertheless, it provides evidence of a relevant effect of the social context over and above the influence of family background and school quality effects. Socialization both inside and outside the family is found to be important in the intergenerational transmission of education, with a magnitude of the effects that differs between high- and low-educated families.

The remainder of the paper is organized as follows. In the next section, we survey the literature on the impact of neighborhood effects on the intergenerational transmission of human capital. The basic theoretical model and its main predictions are exposed in section 3. Section 4 is devoted to the description of the data and the definition of the variables. Section 5 deals with the empirical model and presents the estimation results. Finally, section 6 concludes the paper.

2 Neighborhood effects and the intergenerational transmission of human capital

There are different papers that have studied the relationship between neighborhood and the intergenerational transmission of human capital. Here, we review three important contribu-

[5] There is an extensive literature on peer effects in educational performance. See the references in Goux and Maurin (2007, p. 1195) and the two recent literature surveys by Ioannides (2010) and Ioannides and Topa (2010).

tions to this literature. First, Kremer (1997) proposes the following equation:

$$h_{i,t+1} = a_0 + \frac{\alpha}{2}\left(h_{f_i,t} + h_{m_i,t}\right) + \beta h_{\nu(i),t} + \varepsilon_i, \tag{1}$$

where $h_{i,t+1}$ denotes the human capital of a member of the ith dynasty in generation $t+1$ (i.e. the child), $h_{f_i,t}$ and $h_{m_i,t}$ are the human capital levels of members of the same dynasty in generation t (i.e. the parents) with f_i designing the father and m_i the mother, and $h_{\nu(i)t}$ is the human capital level of the neighborhood $\nu(i)$ where the individual lives at time t. If n_i denotes the size of this neighborhood, then $h_{\nu(i)t} = \frac{1}{n_i}\sum_{j\in\nu(i)} h_{jt}$. As usual, ε_i is a stochastic shock. Estimating equation (1) using the Panel Study of Income Dynamics (PSID), Kremer (1997) found that the estimate of β, the neighborhood effect, is large when it is compared to the effect of parents' education (α).

Borjas (1992) explores equation (1) in more detail by focussing on ethnic groups. In his model, parents value their own consumption as well as the human capital of their offsprings. However, the crucial equation is the one that relates the human capital obtained by a child belonging to ethnic group g, $h_{ig,t+1}$, to that of his/her parents, $h_{p_{ig},t}$ (with p_{ig} denoting the parent of child i belonging to ethnic group g), and the average human capital of his/her ethnic group, $\overline{h}_{g,t} = \frac{1}{n_g}\sum_{j\in g} h_{p_j,t}$, where n_g is the size of the ethnic group. Formally,

$$h_{ig,t+1} = \gamma_1 h_{p_{ig},t} + \gamma_2 \overline{h}_{g,t} + \xi_{ig,t}. \tag{2}$$

Naturally, the variables "neighborhood" and "ethnicity" are highly correlated since minorities tend to live together. The main findings of Borjas (1992) are to show that using the General Social Surveys and the National Longitudinal Surveys of Youth, ethnic capital (as measured by $\overline{h}_{g,t}$, the average human capital level of the ethnic group in the parents' generation) plays a crucial role in intergenerational mobility, and slows down the convergence in the average skills of ethnic groups across generations.

Finally, Ioannides (2002, 2003) deepens the analysis of intergenerational transmission of human capital by explicitly developing a dynamic model of human capital formation with a neighborhood selection. He estimates this model using the Panel Study of Income Dynamics (PSID). Thus, Ioannides generalizes the two previous papers (Kremer and Borjas) by focussing on nonlinear dynamic models. Following Borjas (1992), he assumes that parents

value their consumption and the human capital of their children. The key human capital transmission equation to be estimated is nonlinear and given by:

$$\ln h_{i,t+1} = a_0 + a_p \ln \left[D\, h_{f_i,t}^{1-1/\phi} + (1-D)\, h_{m_i,t}^{1-1/\phi} \right] + \ln \left(\sum_{j \in \nu(i)} \mu_{\nu(i)j} h_{j,t}^{1-1/\psi} \right)^{\frac{\psi}{\psi-1}}, \qquad (3)$$

where $\mu_{\nu(i)j}$ denotes the frequency of the value of h_{jt} within the distribution of educational attainment of the population in neighborhood $\nu(i)$ at time t, and $\mu(.)$ is the entire distribution. The idea here is to study the impact of parental education and the distribution of educational attainment within a relevant neighborhood on child educational attainment. From a theoretical viewpoint, Ioannides obtains a complete characterization of the properties of the intertemporal evolution of human capital. From an empirical viewpoint, he finds that there are strong neighboring effects in the transmission of human capital and that parents' education and neighbors' education have nonlinear effects that are consistent with the theory.

As we will see below, our model is different since we focus on the interaction between cultural transmission and neighboring effects and their impact on the intergenerational transmission of human capital. To be more precise, the key distinguishing features of our model are twofold: (i) the suggestion of both direct and indirect mechanisms through which neighborhoods might affect human capital accumulation; and (ii) the differences across households at different levels of education.

3 Theoretical model

In this section, we analyze the intergenerational transmission of education. The key question we would like to answer is how much parents are influenced by the local environment when deciding on their educational effort level. As in Bisin and Verdier (2000, 2001), the transmission of education is modeled as a mechanism interacting socialization *inside* the family (*vertical* socialization) with socialization *outside* the family (*oblique* socialization) via imitation and learning from individuals living in the same neighborhood.

There are two types of parents/workers: high-educated, $i = h$, and low-educated parents

(workers), $i = l$.[6] There is a continuum of each of them. The expected utility of a parent of type $i = h, l$ is given by:

$$EV^i = \underbrace{z^i}_{\text{Utility from consumption}} + \underbrace{U(\lambda^i, e^i) - \delta^i \Psi(e^i, q)}_{\text{Utility from putting effort in educating children}} + \underbrace{W\left(a, e^i, q, w^h, w^l\right)}_{\text{Utility from children's educational achievement}}$$

where z^i is the quantity of a consumption good (taken as the numeraire) consumed by parents, λ^i is the time spent on leisure, e^i is the time (effort) they spend with their children trying to educate them, q is the proportion of *high-educated* individuals in the neighborhood, $\delta^h = 1$ and $\delta^l = \delta$, with $\delta > 1$, $0 < a < 1$ is the degree of altruism that is common for both educated and uneducated parents, and w^i is the per-hour wage (with $w^h > w^l$). $U(.)$ is assumed to be increasing in λ^i and decreasing in effort e^i and concave in both arguments.

This utility function EV^i has three terms. The first one, z^i, is the utility of consuming the composite good. The second term, $U(\lambda^i, e^i) - \delta^i \Psi(e^i, q)$, is the utility that parents derived from putting effort in educating their child. $U(\lambda^i, e^i)$ captures the fact that the time spent with children and the time spent on leisure are not independent activities for parents. For that, we assume that the cross-derivative of λ^i and e^i is positive, i.e.

$$\frac{\partial^2 U(\lambda^i, e^i)}{\partial \lambda^i \partial e^i} \geq 0$$

The utility cost of effort, $\delta^i \Psi(e^i, q)$, is *increasing* and *convex* in e^i, and *decreasing* in q. The latter is due to the fact that the higher is the proportion of high-educated families in the neighborhood, the lower is the cost of putting in effort because of peer effects (positive externalities, peer pressure, etc.). For example, if a low-educated parent wants to help his/her child do his/her homework in mathematics, it will be easier if his/her neighbors are highly educated because they can either help him/her or pressure him/her to do so. Furthermore, for a given q, this cost $\delta^i \Psi(e^i, q)$ is assumed to be higher for low-educated than

[6] We could generalize the model in order to have a *continuous* education variable. For example, we could assume that education is a continuous variable whose c.d.f. is defined on the interval $[\underline{h}, \overline{h}]$. This would not change the analysis to any greater extent since, in order to define q, we would still need to have two types of education. For this purpose, we would need to define a cutoff point, $\widetilde{h} \in [\underline{h}, \overline{h}]$, so that all individuals belonging to $[\underline{h}, \widetilde{h}]$ would be uneducated and all individuals belonging to $[\widetilde{h}, \overline{h}]$ would be educated. This would not change the main result of our model, just complicate the analysis.

for high-educated parents. Indeed, it is quite natural to assume that it is less costly for a high-educated parent to put effort into education than for a low-educated parent because of knowledge due to the initial education. For example, it is certainly less costly for an engineer to teach mathematics to his/her child than for a parent from the working class who did not get any education. The same will apply for a parent who, for example, is an English teacher and who wants to help his/her child with English as compared to a non-educated parent. To capture this effect, we assume the total cost of providing effort to be equal to: $\delta^i \Psi(e^i, q)$, where $\delta^h = 1$ and $\delta^l = \delta$, with $\delta > 1$. In other words, $\delta \equiv \delta^l/\delta^h$ expresses the relative cost of spending effort for low-educated parents. Observe that the multiplicative nature of the term $\delta^i \Psi(e^i, q)$ implies that parental education has a Hicks-neutral effect on the cost of teaching one's own children, which means that the trade-off between e_i and q in the cost function is not impacted by the education of the parent.

The last term, $W\left(a, e^i, q, w^h, w^l\right)$, is the utility that parents derived from their child's educational achievement. It a function of a, their degree of altruism, e^i, the effort their put in educating their child, q, the percentage of educated people in the neighborhood, and w^i, the wage that their child will obtain when adult.[7]

The budget constraint of a parent $i = h, l$ can be written as follows:

$$w^i T = z^i, \tag{4}$$

where T denotes the amount of working hours. T is assumed to be the same and constant across workers, an assumption that agrees with most jobs in the vast majority of developed countries.[8] In (4), all income is assumed to be spent on own consumption and none on the child's education. This is just for simplicity since adding educated-related expenses in (4) will not change any of our results. It will just add to the notation.

[7] In fact, if time was introduced in this model, we should have written:

$$h^{i,t+1} = W\left(a, e^{i,t}, q, w^{h,t+1}, w^{l,t+1}\right)$$

since parent i puts effort today at time t (so that we have $e^{i,t}$) but the achievement of their child occurs at time $t+1$ (so that we have $w^{h,t+1}$ and $w^{l,t+1}$, and thus $h^{i,t+1}$). Because we basically use a static model (there is no discount rate), we assume that all events appear simultaneously.

[8] We could have assumed that more highly educated parents work more hours than less educated parents. This would not affect any of our results.

Each parent provides a fixed amount of labor time T and spends some time on leisure and with his/her children. Thus, the time constraint of a parent $i = h, l$ can be written as:

$$1 - T = \lambda^i + e^i, \tag{5}$$

where the total amount of time is normalized to 1 without loss of generality.

By plugging (4) and (5) into the utility function, we obtain the following expected utility for parents of type $i = h, l$:

$$EV^i = w^i T + U\left(1 - T - e^i, e^i\right) - \delta^i \Psi(e^i, q) + W\left(a, e^i, q, w^h, w^l\right). \tag{6}$$

Since both leisure λ^i and parental educational effort e^i determine utility $U(.)$, the assumption that $U(.)$ is increasing in λ^i and decreasing in e^i means, in particular, that educational effort has a disutility besides reducing leisure. This is a plausible albeit not necessary assumption. A typical costly educational effort is the parent's fatigue and the possible conflict between the child and the parent when doing homework together.

Let us now explain how education transmission works. We denote by π^{ij} the probability that a child of type$-i$ parent ($i \in \{h, l\}$) obtains education $j \in \{h, l\}$. Since there is a continuum of agents, by the Law of Large Numbers, π^{ij} also denotes the fraction of children having a type$-i$ parent and reaching an education level j. As in Bisin and Verdier (2000, 2001), we assume that for both the educated and the non-educated parent, education will be successful with a probability equal to the education effort e^i.[9] This is the *vertical transmission* of education (i.e. from the parent to the child). If transmission is thus not successful, then the *horizontal transmission* (i.e. from people of the neighborhood to the child) will play a major role and, in that case, the child will adopt the average education of his/her neighborhood. Therefore, it is at this second stage, after the parents' unsuccessful transmission of education, that children are influenced by the people living in his/her neighborhood. We obtain the following transition probabilities:

$$\pi^{hh} = e^h + (1 - e^h)q \tag{7}$$

[9] We could have assumed a more general function so that education would be successful with a probability which a function of education effort e^i. We would have to impose some conditions on this function but no analytical solution would be obtained in that case.

$$\pi^{hl} = (1 - e^h)(1 - q) \tag{8}$$

$$\pi^{ll} = (1 - e^l)(1 - q) \tag{9}$$

$$\pi^{lh} = e^l + (1 - e^l)q. \tag{10}$$

Let us interpret equation (7). The child of a highly educated parent will also be highly educated if either his/her parents' education transmission is successful (probability e^h) or the parent fails to transmit his/her trait (probability $1 - e^h$) and the child picks up the education trait from his/neighborhood (probability q). Equation (8) gives the probability that a child of educated parents is not educated: it is because both the parents and the neighborhood were unsuccessful in educating the child. For low-educated parents (equations (9) and (10)), we have a similar interpretation.

We are now able to write explicitly $W\left(a, e^i, q, w^h, w^l\right)$, the utility that parents derived from their child's educational achievement. We assume that all parents (educated or not) are altruist and thus do care about the future job situation of their children. We denote by V^{ij}, $i = h, l$, $j = h, l$, the future utility of a child j whose parent is of type i. Note that this utility is evaluated by the parents and thus takes their point of view (this is referred to as *imperfect empathy* by Bisin and Verdier, 2000, 2001). The simplest interpretation of these utilities is in terms of the child's future income, given that $w^h > w^l$. In other words, all parents (educated or not) will be better off if their children achieve high education and thus make more money. For simplicity and without loss of generality, we have:

$$V^{hh} = V^{lh} = w^h$$

$$V^{hl} = V^{ll} = w^l.$$

As a result, using (7)−(10), the (expected) utility that *educated* parents derived from their child's educational achievement is equal to:

$$\begin{aligned} W\left(a, e^h, q, w^h, w^l\right) &= \pi^{hh}V^{hh} + \pi^{hl}V^{hl} \\ &= a\, e^h\,(1 - q)\left(w^h - w^l\right) + a\left[qw^h + (1 - q)w^l\right] \end{aligned}$$

while that of *low-educated* parents is:

$$\begin{aligned} W\left(a, e^l, q, w^h, w^l\right) &= \pi^{ll}V^{ll} + \pi^{lh}V^{lh} \\ &= a\, e^l\,(1 - q)\left(w^h - w^l\right) + a\left[qw^h + (1 - q)w^l\right] \end{aligned}$$

Let us now focus on the parents' choice of effort $e^i \in [0, 1-T]$. The expected utility of educated and non-educated parents is, respectively, given by:[10]

$$EV^h = w^h T + U\left(1-T-e^h, e^h\right) + a\, e^h\,(1-q)\left(w^h - w^l\right) + a\left[qw^h + (1-q)w^l\right] - \Psi(e^h, q)$$

$$EV^l = w^l T + U\left(1-T-e^l, e^l\right) + a\, e^l\,(1-q)\left(w^h - w^l\right) + a\left[qw^h + (1-q)w^l\right] - \delta\Psi(e^l, q).$$

Let us now determine e^i, the effort choice of parents $i = h, l$. If we use the following notations $U_{\lambda^i} \equiv \frac{\partial U}{\partial \lambda^i}$, $U_{e^i} \equiv \frac{\partial U}{\partial e^i}$, $\Psi_{e^i} \equiv \frac{\partial \Psi(e^i,q)}{\partial e^i}$, the first-order conditions for educated and uneducated parents are given by (we only focus on interior solutions):[11]

$$-U_{\lambda^i} + U_{e^i} + a\,(1-q)\left(w^h - w^l\right) - \delta^i \Psi_{e^i} = 0, \tag{11}$$

where $\delta^h = 1$ and $\delta^l = \delta$, with $\delta > 1$. The solution of (11) is denoted by e^{i*}, which is equal to $e^{h*}(q)$ and $e^{l*}(q, \delta)$ for high- and low-educated parents, respectively. Let us denote by: $U_{\lambda^i\lambda^i} \equiv \frac{\partial^2 U}{\partial \lambda^i \partial \lambda^i}$, $U_{e^ie^i} \equiv \frac{\partial^2 U}{\partial e^i \partial e^i}$, $U_{\lambda^i e^i} \equiv \frac{\partial^2 U}{\partial \lambda^i \partial e^i}$, $\Psi_{e^ie^i} \equiv \frac{\partial^2 \Psi^i(e^i,q)}{\partial e^i \partial e^i}$, and $\Psi_{e^iq} \equiv \frac{\partial^2 \Psi^i(e^i,q)}{\partial e^i \partial q}$. By totally differentiating (11), we obtain:

$$\frac{\partial e^{i*}}{\partial q} = \frac{a\,\left(w^h - w^l\right) + \delta^i \Psi_{e^iq}}{U_{\lambda^i\lambda^i} - 2U_{\lambda^i e^i} + U_{e^ie^i} - \delta^i \Psi_{e^ie^i}}. \tag{12}$$

We have the following proposition:

[10] The altruistic model was made famous by Becker (1974, 1991). For a literature survey on these types of models, see Laferrere and Wolff (2004).

[11] For each parent $i = h, l$, the second-order condition is given by:

$$U_{\lambda^i\lambda^i} + U_{e^ie^i} - 2U_{\lambda^i e^i} - \delta^i \Psi_{e^ie^i}.$$

Since we have assumed that $U_{\lambda^i\lambda^i} < 0$, $U_{e^ie^i} < 0$, $U_{\lambda^i e^i} \geq 0$, and $\Psi_{e^ie^i} > 0$, the second-order condition is always satisfied.

Proposition 1

(*i*) *High-educated parents spend more time (i.e. exert more effort) educating their offspring than low-educated parents, and this difference increases by* δ*, the relative cost difference in providing effort.*

(*ii*) *If* $\Psi_{e^i q} > 0$*, then for both educated and uneducated parents, the higher is the proportion of high-educated families in the area, the lower is the effort parents put into educating their children, that is:*

$$\frac{\partial e^{i*}}{\partial q} < 0, \text{ for } i = h, l.$$

This is referred to as cultural substitution.

(*iii*) *Assume that* $\Psi_{e^i q} < 0$ *and* $-\Psi_{e^i q} > a\left(w^h - w^l\right)/\delta^i$*. Then, for both educated and uneducated parents, the higher is the proportion of high-educated people in the area, the higher is the effort parents put into educating their children, that is:*

$$\frac{\partial e^{i*}}{\partial q} > 0, \text{ for } i = h, l.$$

This is referred to as cultural complementarity.

The first-order condition (11) shows that the choice of e^* involves a trade off between the short-run costs of spending time with children (both in terms of forgone leisure and direct cost $\Psi^i(e^i)$) and its long-run expected benefits, which consist of a better chance of having an educated child. The sign of $\frac{\partial e^{i*}}{\partial q}$ clearly depends on $\frac{\partial^2 EV^i}{\partial e^i \partial q}$. Indeed, if this cross-derivative is negative (positive), meaning that the higher is q, the lower (higher) is the marginal expected utility of effort, then cultural substitution (complementarity) prevails. More precisely, when $\Psi_{e^i q} > 0$, i.e. the higher is effort e, the higher is the marginal cost of effort, then the short-run costs are higher, and therefore the parents put in less effort, the higher is the level of education in the neighborhood (cultural substitution). In contrast, when $\Psi_{e^i q} < 0$ and $-\Psi_{e^i q} > a\left(w^h - w^l\right)/\delta^i$, parents put in more effort, the higher is the level of education in the neighborhood (cultural complementarity).

We can now calculate the expected school achievement of each individual by focusing on the different transition probabilities.

Proposition 2

(*i*) *For educated parents whose effort is* $e^{h*}(q)$ *and given by (11), the probability that their child will be educated is:*

$$\pi^{hh} = q + e^{h*}(q)\,(1-q)\,,$$

while the probability that their child will not be educated is:

$$\pi^{hl} = \left[1 - e^{h*}(q)\right](1-q).$$

(*ii*) *For low-educated parents whose effort is* $e^{l*}(q)$ *and given by (11), the probabilities that their child will be educated and non-educated are respectively given by:*

$$\pi^{ll} = \left[1 - e^{l*}(q,\delta)\right](1-q)$$

$$\pi^{lh} = q + e^{l*}(q,\delta)\,(1-q)\,.$$

(*iii*) *For both parents (educated or not), if there is cultural complementarity, a better-quality neighborhood increases the probability of being educated and decreases the probability of being uneducated, that is* $\frac{\partial \pi^{hh}}{\partial q} > 0$, $\frac{\partial \pi^{lh}}{\partial q} > 0$ *and* $\frac{\partial \pi^{hl}}{\partial q} < 0$, $\frac{\partial \pi^{ll}}{\partial q} < 0$. *If there is cultural substitution, all these effects are undetermined. Finally, for a given neighborhood quality* q*, parents' effort always increases the chance for their offspring of being educated, that is* $\frac{\partial \pi^{hh}}{\partial e^{h}} > 0$, $\frac{\partial \pi^{lh}}{\partial e^{l}} > 0$ *and* $\frac{\partial \pi^{hl}}{\partial e^{h}} < 0$, $\frac{\partial \pi^{ll}}{\partial e^{l}} < 0$.

Results (*i*) and (*ii*) just express the transition probabilities (7)-(10) in terms of optimal parents' effort. The interesting result is (*iii*) since it shows the impact of both the quality of the neighborhood and parents' involvement in children's educational attainment. Since the education process is in two stages (first the parents' involvement e^i and then the neighborhood's quality q) and since both stages are influenced by q, there are two effects: an *indirect* one, where e^i hinges on q, and a *direct* one, because if e^i fails, then only q affects children's educational attainment. So, when there is cultural complementarity, these two effects reinforce each other since a higher q implies larger indirect (the higher the quality of the neighborhood, the higher the parents' effort) and direct effects. If, in contrast, there is cultural substitution, then a better quality neighborhood reduces the chances of being

educated by parents (since parents spend less time with their kids) but increases the chances of being educated by "peers" (since q is higher, the chances of meeting a high-educated peer are higher). The net effect is thus ambiguous.

Finally, we have the following result, which is a consequence of the two above propositions:

Proposition 3 *For low-educated parents,*

(*i*) *the higher is the cost of education δ, the lower is the educational effort e^{l*}, i.e. $\frac{\partial e^{l*}}{\partial \delta} < 0$;*

(*ii*) *the higher is the cost of education δ, the higher is the probability of the child being uneducated and the lower is the probability of being educated, i.e. $\frac{\partial \pi^{ll}}{\partial \delta} > 0$ and $\frac{\partial \pi^{lh}}{\partial \delta} < 0$;*

(*iii*) *When δ is sufficiently high, the effort e^{l*} provided by uneducated parents is negligible and thus, the quality of the neighborhood q has no impact on e^{l*}. In that case, the probability of being educated or not only depends on the quality of the neighborhood, that is $\pi^{ll} = 1 - q$ and $\pi^{lh} = q$.*

This last proposition focuses on low-educated parents. If educational effort is too costly, then obviously only the environment where children live (i.e. peers and role models) will affect children's educational attainment.

To summarize, the key feature of this model is that both socialization *inside* the family (the role of parents) and socialization *outside* the family (the role of peers living in the same neighborhood) play an important role in the educational process of children. This means that there are differential effects on the child's education because of parental education and the interactions of neighborhood quality and parental investment. Depending on the assumptions on the cost function, there is either cultural substitution (i.e. better neighborhood quality leads to more parental investment) or cultural complementarity (i.e. better neighborhood quality leads to less parental investment). If we focus on the extreme cases, then if children live in a "good" environment with educated parents who take care of them, the chances of obtaining a high education level is very high. If, in contrast, they live in a rundown area with low-quality schools and negative peer pressures and if, on top of that, their parents are not educated and do not spend time with them, then the probability of being educated is quite low for these children.

4 Data and descriptive evidence

4.1 Data

Our empirical analysis is based on data from the National Child Development Study (NCDS). It is a longitudinal survey that follows all British individuals who were born between the 3rd and 9th of March 1958, with follow-up surveys in 1965 at the age of 7 (NCDS sweep one), in 1969 at the age of 11 (NCDS sweep two), in 1974 at the age of 16 (NCDS sweep three), in 1981 at the age of 23 (NCDS sweep four), and in 1991 at the age of 33 (NCDS sweep five). This dataset is ideal for the purpose of this paper as it contains detailed parental and child information, as well as data on family background, school quality and area of residence identifiers for cohort members' residential addresses. Good family background information is essential when trying to find evidence of neighborhood effects since neighborhood characteristics may proxy for unobservable family characteristics. The information on the residential location allows us to match NCDS data with the 1971 Census data, thus obtaining a detailed picture of the residential neighborhood community when cohort members were teenagers (age 13). Census information is taken from the Small Area Statistics (SAS) datasets. In particular, data on education, economic activity and occupation of each residential community area are only available for the 10% sample survey. This implies extremely small sample sizes per area if the most basic census spatial unit, i.e. enumeration district (with an average of 300-400 residents), is used as a neighborhood measure. Therefore, we are forced to choose the next available level of spatial disaggregation: we use *ward* level data, providing 17,500 areas in the UK in 1971 with an average of 3,000-4,000 residents. A Census ward roughly contains ten enumeration districts and thus, it is quite small: it is equivalent to a Census tract in the US (which on average contains 4,000 inhabitants).

Our empirical analysis matches information on individuals' educational attainment at the age of 33 from the NCDS fifth sweep with the information on parental characteristics, quality of the school attended at age 16, ability in the childhood from earlier NCDS sweeps and residential neighborhood information from the 1971 Census (when the individuals are 13 years old).

4.2 Definition of variables

The key variables in the theoretical model are parents' effort in their children's education (e^i), transition probabilities (π^{ij}) and neighborhood human capital (q).

Let us first discuss our empirical proxy for parental interest in the child's education. The ideal variable for measuring parents' effort would have been the number of hours spent investing in children's education (reading to the child, meeting teachers, etc...). Unfortunately, this variable is not directly available in the NCDS. However, the NCDS provides rich qualitative information on parental interest in the child's education at different ages of the child. In particular, in the NCDS sweep one (parental questionnaire), it is asked: "Does the mother/father read to, or read with, the child?", and the possible answers suggested are "Yes, at least every week; Yes occasionally; Never or hardly ever" and it is stated to put a circle around/encircle the appropriate definition (only one for each parent).[12] We rank the parents according to the highest frequency declared by each couple and code the responses using a dichotomous variable. Such a variable (labeled as "parents read to child") takes the value of one if the parents read to the child at least once every week and zero otherwise (i.e., if they read to the child only occasionally or never or hardly ever).[13] Observe that we obtain this information from the NCDS sweep one (age 7 in 1965), i.e. when the child has just started school and has not yet been "educated". This choice should ensure that this indicator of parental interest in a child's education is not driven by the child's schooling performance. Indeed, the parents' frequency of reading to their child at that early stage should closely proxy parental care (in the sense used in the model, namely the amount of time spent caring for a child's education) independently of the child's future schooling achievements.

Let us now turn to the empirical counterparts of the other key variables of the theoretical model, that is π^{ij} and q. The NCDS sweep five (the child is now a 33 year old adult in 1991) provides information on the highest qualification obtained by the cohort members. We define

[12] Non-response is not an issue here. Missing values are reported in less than **5%** of the observations. A residual category "Don't know or inapplicable" occurs in less than 2% of the responses. We group these responses with the "low involvement" category.

[13] A different coding of this variable allowing more than two levels that leads to the estimation of ordered probit models does not qualitatively change our results.

high-educated individuals as those with A-levels[14] or higher qualifications and the remaining ones as low-educated individuals. As a proxy for average neighborhood education quality in an area k at time t, i.e. $q_{k,t}$, we use the percentage of individuals aged above 18 years holding a A-level or higher in a ward k from the Census 1971 data, i.e. when the child is 13 years old.

Finally, the parents' education is measured using completed years of schooling. This information is derived from the age at which the parents left school, which is reported in 1974 (NCDS sweep three). We define parents of type $i = h$ if the mother and the father's average years of schooling exceed 12 years and parents of type $i = l$ otherwise. So, for example, $\pi^{hh}_{n,t+1}$ is the probability that an adult n who is aged 33 in $t + 1 = 1991$ has at least an A-level degree given that his/her parents have (on average) more than 12 completed years of schooling.

To summarize, we evaluate parents' effort when the child is 7 (in 1965), the quality of the neighborhood and parents' level of education when the child is 13 (in 1971) and the child's educational attainment when he/she is 33 years old (in 1991).

5 Identification strategy and estimation results

5.1 Institutional background: the allocation policy of social housing in the UK

The legislation governing the allocation of social housing in the UK has changed over time. In 2002 (Homelessness Act 2002), the procedure for allocating council houses to tenants was revised and Choice-Based Letting (CBL) schemes were introduced. CBL schemes now allow applicants for social housing to apply for available vacancies that are widely advertised. Applicants can see the full range of available properties and can bid for any home to which they are matched. The successful bidder is the one with the highest priority under the

[14]The A-level (or the Advanced Level General Certificate of Education) is a qualification offered by most educational institutions in the UK that is widely recognised around the world. It is the standard entry qualification for assessing the suitability of applicants for academic courses in UK universities. Most students study for this qualification from the age of 16 to 18.

scheme. As a result, social tenants in the UK are now given a greater choice in housing.

However, in the 1970s, the period in which our analysis is performed, the allocation of tenants to council houses was completely under the management of council officers seeking to match applicants to available vacancies giving a "reasonable preference" to certain categories of people in identified housing needs (Hills, 2007). The requirement to give "reasonable preference" to certain applicants dates back at least to the 1936 Housing Act, but even in the 1957 Housing Act, there was little guidance on how to do so and there were no precisely defined need-based criteria (Greenhalgh and Moss, 2009). At the same time, part of the philosophy of post-war social housing was to avoid the kind of polarization between areas that market forces might create. As expressed by Aneurin Bevan, UK Minister of Health, in 1949: "We should aim to introduce what has always been the lovely feature of the English and Welsh village, where the doctor, the grocer, the butcher and the farm labourer all lived in the same street ... the living tapestry of a mixed community." As a result, during the 1960s, social housing did accommodate a population with a mix of incomes (Hills, 2007).[15] The allocation procedure was essentially by date-order, with the flexibility to advance cases on the waiting list on basis of some social (or medical) reasons. An important "social reason" was "local connection" (or "contribution to the community"): applicants had to live or work in the council area to obtain a new flat to rent (Greenhalgh and Moss, 2009). In practice, this ruled out any scope for "gaming" the local council and moving to a Local Authority with a shorter waiting list (or better neighborhoods).

Roughly speaking, the allocation of council tenants to council houses was functioning as follows. Interested people applied to the Local Authority (LA) where they habitually resided. The LA put them on a waiting list and considered their family characteristics (mainly how many children, their age, labor force status, special needs) to decide which type of flat to allocate them to (i.e. how large). Applicants could express a preference for where to be located but demand outstripped supply, and little consideration was given to preferences. In particular, for areas such as London and other big cities, the number of applicants was far greater than the available space and no consideration at all was given to preferences:

[15] The fact that there is a social mix in the council housing population in the UK in the 1970s gives our results some considerable external validity.

the length of time on the waiting list was the most important screening criterion. When an applicant had worked his/her way up to the head of the queue by patience, he/she received the first available offer which was "that or nothing" (Regan and Patrick, 2001). Refusal to accept an offer of accommodation was associated with a severe penalty (for example, suspension from the waiting list for a long period of time) and never happened in practice. Therefore, the neighborhood location of an allocated council home at the beginning of the 1970s was largely unrelated to the resources and preferences of the tenant, especially in big cities. In addition, rents in the social sector were considerably lower than in the private sector and the turnover was also very low. One of the reasons at the basis of the revision of the system, which started in the 1980s, was exactly the fact that the waiting lists were becoming excessively long.[16] Our discussion so far seems to point towards the fact that the information contained in our data set offers a setting where the influence of the social context can be evaluated. In the following section, we will provide some evidence in support of our identification strategy using our data.

5.2 Identification strategy

We focus on the families who live in council provided accommodations in 1974 (NCDS sweep three) in big cities. In our data, the "cities" are all those Census districts listed as 'C.B.' (major cities and towns in England and Wales), 'L.B.' (London Boroughs), and 'Cities' in Scotland. Around 40% of the NCDS sample of families were resident in such districts in 1974 and living in council houses.

Our identifying assumption is that the allocation of council tenants to neighborhoods is unrelated to the tenants' own education or concern for their child's education. A test of the validity of this assumption is to regress parents' education on neighborhood educational status (with local authority dummies). We then investigate the relationship between

[16] At the same time, the local authority housing stock has declined, mainly due to Right to Buy (RTB) programs introduced in the 1980s for registered social tenants, which were not accompanied by corresponding new public investments in building new houses. The new inflow of tenants thus became increasingly determined by strict need-based criteria, which each council was obliged to publish after the 1996 Housing Act.

the parents' (mean) years of education and the ward-proportion of adults with A-levels and above for families living in houses in the private sector and the social sector (council tenants). Table 1 reports the OLS estimation results. The first column contains the results for families in private accommodations and reveals a highly significant correlation between the two variables, with an elasticity at about 0.035. The second column shows the results of the same regression but only for families living in council-provided accommodation. Interestingly, it shows that there is no correlation between the level of education of the parents and the average human capital of the neighborhood. The last two columns report the results which are obtained when using quality of schools ("school composition" as defined in Table A1) rather than the percentage of high-skilled population as a measure of neighborhood quality. The evidence remains qualitatively unchanged.

[*Insert Table* 1 *here*]

Table 2 displays the characteristics of the residential neighborhood, distinguishing between high-educated and low-educated parents. We find that the means are not statistically different between the two groups. Therefore, the assignment of council tenants across neighborhoods in big cities appears to be random with respect to parental education. The validity of such an assumption thus allows us to provide an evaluation of the reduced-form equation of our model.

[*Insert Table* 2 *here*]

5.3 Estimation results

Let us now test propositions 1, 2, that is the influence of the local environment (quality of the peers) on the parents' decision of spending time with their children and the impact of both parents' investment and local environment quality on the ultimate education attainment of the children. Our final sample consists of 2,598 children (and 4,960 parents) from families living in council houses in UK cities in the 1970s. Table A1 in the Appendix (and Table 2 above) contains the description of the variables available for this sample and the

corresponding summary statistics, for high-educated and low-educated parents separately. The table does not show any marked differences between the two groups.

Let us begin by considering Proposition 1.

We model the underlying parents' propensity in investing in their children's education (e^i) as a linear function of parental, child, household and neighborhood characteristics. A probit specification is employed where the dependent variable is equal to one if the parents spend substantial time on their child's education and zero otherwise. From Proposition 1, the following model is considered:

$$e^i_{n,k,t} = \alpha q_{k,t} + \sum_{m=1}^{M} \beta_m x_{m,t} + \varepsilon_{n,t} \qquad n = 1, ..., N, \tag{13}$$

where $e^i_{n,k,t}$ is the time spent by the parents of child n of type $i = h, l$ who resides in area $k = 1, ..., K$ at time t on educating the child; $q_{k,t}$ is the average quality in terms of education of area k at time t; $x_{m,t}$ (for $m = 1, ..., M$) is a set of M control variables at the parental, child, household and area level at time t, accounting for differences in socio-economic characteristics between parents, children, families and areas (listed in Tables 2 and A1); $\varepsilon_{n,t}$ is a white noise error term. A test of this equation will allow us to evaluate the prediction of the theoretical model. First, for high-educated parents ($i = h$), an α significantly different from zero will indicate either cultural substitution (if negative) or cultural complementarity (if positive). Moreover, even if this coefficient is not statistically significant, it will provide information on the form of the trade-off between neighborhood composition and parental investment in education.

Table 3 reports the marginal effects (at the sample means) and standard errors (in parentheses) of our measure of neighborhood quality (i.e. percentage of high-skilled population) based on an OLS estimation of model (13), when using an increasing set of controls.[17]

[Insert Table 3 here]

The estimated neighborhood quality influence decreases by more than one third (for both types of parents) when including family background variables (specification 2), but it

[17] Because the use of cross-equation restrictions is always rejected by our data, model (13) is estimated separately for children of high-educated and low-educated parents.

remains statistically significant and sizeable even when purging our estimates from the role of the school chosen by the parents (specifications 3 and 4). When the most extensive set of our controls is included (specification 4), for both types of parents, we find a positive and statistically significant effect of neighborhood quality on parental effort in the child's education. This suggests *cultural complementarity* in parents' behavior since the better the quality of the neighborhood, the more they invest in their child's education. Regarding the magnitude of the effect, for high-educated parents, a marginal increase (a 1 percent increase) in the average level of education of the neighborhood increases the probability that the parents devote more effort to their children's education by roughly 0.05. For low-educated parents, the estimated effect is still positive and significant but largely reduced in magnitude (about 0.02). In conformity with Propositions 1 and 3, this may be due to the fact that δ, the cost of exerting effort for low-educated parents, is relatively high. A $t-$test on the contrast between the estimated coefficients for high and low-educated parents always rejects the null hypothesis of equal effects (the t statistics range between 4.08 and 4.65 in the various specifications). This provides a formal test of differences in neighborhood effects on parents with different levels of education.

Focusing our attention on the test of Proposition 2, we model the likelihood of a successful or unsuccessful intergenerational transmission of education (transition probabilities) as follows:

$$\pi^{ij}_{n,t+1} = \phi q_{k,t} + \gamma e^{i}_{n,k,t} + \rho(q_{k,t}.e^{i}_{n,k,t}) + \sum_{m=1}^{M} \theta_m x_{m,t} + \eta_{n,t+1} \qquad n = 1, ..., N, \qquad (14)$$

where $\pi^{ij}_{n,t+1}$ is the probability that an adult n at time $t+1$ (who was a child n at t) whose parents are of type $i = h, l$ attains the level of education $j = h, l$; $q_{k,t}$ is the quality of the neighborhood k when the adult was a child at time t; $e^{i}_{n,k,t}$ is parental involvement when the adult was a child at time t; and $\eta_{n,t+1}$ is a white noise error term. The control variables included in the set $x_{m,t}$ (for $m = 1, ..., M$) are allowed to have a different impact on $\pi^{ij}_{n,t+1}$ than they had on $e^{i}_{n,k,t}$. This is of particular interest for our target variable $q_{k,t}$, which has been separated from the set of control variables for ease of clarity.

The probabilities π^{ij}_{t+1} are analyzed using probit models, each of them having the dependent variable equal to one if the (observed) implied child's educational attainment is achieved

and zero otherwise. A successful test of Proposition 2 would imply that for children of high-educated parents, the effect of both $q_{k,t}$ and $e^i_{k,t}$ must be significant, whereas for children of low-educated parents, both effects are expected to be significant only if δ is sufficiently low, otherwise only the impact of $q_{k,t}$ should be of importance. Indeed, as δ increases, not only should the effort for low-educated parents decline but, by comparing (7) and (10), the effect of similar neighborhood composition q should be higher for low-educated households.

Finally, if there is cultural complementarity, one would expect both the impacts of $q_{k,t}$ and $e^i_{n,k,t}$ to be positive for π^{hh} and π^{lh} (and negative for π^{hl} and π^{ll}) while, with cultural substitution, their signs would be undetermined.

The estimation results of equation (14) show that the impact of the interaction term (the estimate of ρ in model (14)) is never significant in any model specification (i.e., with different sets of controls)[18] and the effects of the other variables are almost unchanged (only slightly higher in absolute value) after its exclusion. This indicates that the impact of parental interest on children's education attainment does not vary with the average human capital of the neighborhood.[19] Thus, we focus on the results in Table 4, which exclude the interaction term from the regressors.[20]

Tables 4 reports the marginal effects (at the sample means) and standard errors (in parentheses) of parental effort in the child's education and residential community human

[18] The results with the interaction term are not reported here for brevity but are available upon request.

[19] The fact that ρ is not significant has no implication on cultural substituability or cultural complementarity. Indeed, cultural substitution is defined as (see Proposition 1):

$$\frac{\partial e^{i*}}{\partial q} < 0, \text{ for } i = h, l.$$

and cultural substitution is:

$$\frac{\partial e^{i*}}{\partial q} > 0, \text{ for } i = h, l.$$

while

$$\rho = \frac{\partial \pi^{ij*}}{\partial e^{i*} \partial q}$$

[20] We have also estimated a version of the model including interactions between our school-level variables and both parental effort and neighborhood quality. We find non-statistically significant effects for all interaction terms included in the model. This evidence suggests that the impact of parental inputs and neighborhood quality do not vary significantly with school quality.

capital when using an increasing set of controls.[21,22] The dependent variables are the transition probability π^{ij} described in Proposition 2. Clearly, conditionally on parental education, the probabilities that a child achieves an A-level degree (or above) and that she/he does not, sum to one. Thus, we only report the results for π^{hh} and π^{lh} ($\pi^{hl} = 1-\pi^{hh}$ and $\pi^{ll} = 1-\pi^{lh}$), focussing the analysis on the successful transmission of education.

[*Insert Table 4 here*]

We start with a specification (specification 1), which only includes the quality of the neighborhood, our selection of neighborhood characteristics and local authority dummies. It appears that the neighborhood education level is an important factor for a successful transmission of education and its importance appears to be different between high-educated and low-educated parents. Moving to specification 2, we include our other variable of theoretical interest, i.e. "parents read to child". Such an inclusion largely reduces the estimated coefficient on the neighborhood quality variable, in particular for high-educated parents. This evidence indicates that a sizeable portion of the effect of the neighborhood quality acts through parental effort and therefore supports our theoretical mechanism. We then look at the impacts of neighborhood quality and parental effort, conditional on the characteristics of the children's parents and family (specification 3). They are only slightly reduced in magnitude and remains statistically significant even when we control for the child's ability (specification 4). Finally, we investigate whether neighborhood quality effects operate purely through the quality of local schooling. Thus, we first use the proportion of boys or girls studying for GCE O-levels as an indicator of school quality (specification 5) and then add dummy variables for school type categories (specification 6) to rule out the possibility that the neighborhood effect is merely picking up residual unobserved characteristics of local secondary schooling. We find that the estimated effect of neighborhood quality remains

[21] Note that among the individual-level variables, we include both arithmetic and reading test scores when the child is 7, aiming at controlling for the child's ability. Moreover, among the area-level controls, we include total area population to control for agglomeration effects. Indeed, any intergeneration link may be affected by different degrees of individuals' social networks and physical proximity.

[22] Also in this case, the use of cross-equation restrictions is always rejected by our data. Therefore, also model (14) is estimated separately for children of high-educated and low-educated parents.

statistically significant and positive. This finding of the importance of neighborhood factors over and above secondary schooling is in line with Garner and Raudenbush (1991).

Let us discuss our results in more detail, looking at the specification that includes the most extensive set of controls (specification 6). It appears that parental investment and neighborhood quality both contribute positively to children's education attainment, but the effect of parental investment seems to be more potent for children of high-educated parents while neighborhood quality shows a more important role for children of low-educated parents. A high level of parental effort raises the average probability of having a high-educated child by about 0.11 for high-educated parents whereas, for low-educated parental, this effect is roughly equal to 0.02. On the other hand, a one percentage point increase in the proportion of neighbors with A- level or above raises the average probability of a successful transmission of education by roughly 0.07 and 0.13 for high-educated and low-educated parents, respectively. Returning to the model, it can be conjectured that this evidence is due to a high δ, that is low-educated parents have a higher cost of effort than high-educated parents.

Our results, however, should be taken with caution. The "high-skilled population" and "parents read to child" variables are noisy measures of the underlying variables of interest, namely "neighborhood quality" and "parental effort". The discrepancies between empirical and theoretical variables might be different for different parental types. Our evidence should thus be taken as only suggestive that the effects of neighborhood quality and parental investment in the intergenerational transmission of education might differ for children whose parents are high-skilled or low-skilled. Besides, our analysis shows that parental effort in children's education is an important channel mediating neighborhood effects.

5.4 Robustness Checks

Tables 5 and 6 collect our main results when performing a series of robustness checks. Let us start discussing the evidence contained in panel (a). If our identification strategy of Section 5.2 is correct, this would imply that the estimates of the neighborhood effect would be positively biased in a sample of home owners. Panel (a) contains the results of this check. Neighborhood effects are clearly larger. In particular, compare to Tables 4 and 6, it appears that the neighborhood effect is more than twice as large for low-educated parents, and almost

three times larger for high-educated parents.

In panel (b), we collect our main results, which are obtained when the analysis is performed considering adopted children (of council tenants) only. This exercise addresses concerns related to the possible presence of (unobserved) inherited characteristics that affect a child's educational attainment. If cognitive ability is a heritable trait, it may be argued that the better schooling performance of children of high-educated (high-ability) parents may be the result of the transmission of genes for high ability rather than of parental investment. Tables 5 and 6 show that our results remain (qualitatively) unchanged, suggesting this not to be the whole story. Let us now turn our attention to investigating whether our results are robust to alternative definitions of our target variables. Our analysis has already shown that our results are not excessively sensitive to the inclusion of an extensive list of controls. Let us now check if our evidence is specific to the definition of parental effort used. Panel (c) contains our results when using an alternative proxy for parental interest. Specifically, we use the children's teachers and the headmasters' perception of parental involvement when the child has just started school (based on parents' telephone calls asking for information about courses and textbooks, frequency of parental visits to the school, meetings with teachers, etc...). Indeed, the school questionnaire of the NCDS sweep one (child's age 7 in 1965) contains the following question: "With regard to the child's educational progress, does the mother/father appear: over concerned about the child's progress and/or expecting too high a standard? Very interested? To show some interest? To show little or no interest?", and it is stated to put a circle around/encircle the appropriate definition (only one for each parent).[23] We rank the parents according to the highest level of involvement reported for each couple. We use a dichotomous variable taking the value of one if the parents appear over concerned or very interest in their child's education and zero otherwise (i.e., if they only show some or little or no interest).[24] We find that the correlation between our two alternative proxies of

[23] Observe that both measures of parental interest (from the parent and from the school principals) are self reported. Parents' education may influence how they report on their reading habits, conditional on their actual reading habits. Similarly, the norms of the neighborhood and the school could influence how principals report on parental involvement. Because we have school dummies and control for the percentage of educated families in the neighborhood, we believe that these issues should not be too important.

[24] Consistently with the strategy adopted for our alternative indicator of parental interest, we group the

parental effort in a child's education is quite high (equal to 0.71) and that our main results remain roughly unchanged (Tables 5 and 6, panel (c)).

Finally, we test whether our results are robust to an alternative definition of parental education. Let us then define parental education using the maximum number of years of schooling of the two parents rather than using the average.[25] Looking at the corresponding results in Tables 5 and 6 (panel (d)), it can be seen that they do not change to any considerable extent.

[*Insert Tables* 5 and 6 *here*]

6 Conclusion

This paper has proposed a microeconomic mechanism of neighborhood effects on educational attainment based on parents' involvement in education. The theoretical model provides potential interactions between residential community environment and parental investment in a child's education. The residential neighborhood average human capital has both a direct and an indirect effect on children's educational attainment as it affects parents' effort in their children's education which, in turn, plays an important role in determining the child's educational achievement. These potential interactions depend on the parents' educational level. Using an identification strategy based on council housing in big cities in Britain, our empirical evidence supports these predictions. In particular, the effect of parental investment on children's educational attainment seems to be more potent for high-educated parents while neighborhood quality shows a more important role for the education attainment of children of low-educated parents.

Our analysis may offer interesting policy implications. Our analysis may indicate that

"Can't say or inapplicable" responses (which also in this case occur in less than 2% of the cases) with the "low involvement" category.

[25] The choice of a different cutoff point in terms of years of schooling to distinguish high-educated and low-educated parents is, in principle, more problematic because consistency with the aggregation used for cohort members' education implies that high-educated individuals are those that left school at an age above 18, i.e. with more than 12 years of schooling (and low-skilled otherwise).

neighborhoods matter, differentially depending on parental education. If we believe that this is the case, then neighborhood regeneration policies would be the right tool to use. Such policies have been implemented in the US and in Europe through the enterprise zone programs (Papke, 1994; Boarnet and Bogart, 1996; Mauer and Ott, 1999; Bondonio and Engberg, 2000; Bondonio and Greenbaum, 2007) and the empowerment zone programs (Busso and Kline, 2008). The enterprise zone policy consists in designating a specific urban (or rural) area, which is depressed, and targeting it for economic development through government-provided subsidies to labor and capital. The aim of the empowerment zone program is to revitalize distressed urban communities and it represents a nexus between social welfare policy and economic development efforts. The effect on employment are mixed, with some policies having strong effects while other having no effects at all.

We have also seen that the interaction between low- and high-educated families could help the former increase the educational level of their children (peer effects). If we believe these results, any policy promoting social integration would have positive effects on these children's educational achievement. Such policies, like the Moving to Opportunity (MTO) programs (Katz et al., 2001; Kling et al., 2005), have been implemented in the United States. By giving housing assistance to low-income families, the MTO programs help them relocate to better and richer neighborhoods. It is true that in the US, the MTO experiment did not find any effects on educational outcomes (Katz et al., 2001; Kling et al., 2005) because these programs basically moved families from *extremely poor neighborhoods* to *poor neighborhoods* (see, in particular, Quigley and Raphael, 2008). We believe, however, that social mixing such as the MTO programs could work in England because families are less poor and thus, moving these families to richer areas will increase the chance for the children of increasing their educational level because of better neighborhood quality q.

If we believe that the "reads to child" variable is a good proxy for "quality time" with children, then we could put forward a policy that directly acts on the education of poor parents or help them spend better time with their offspring. This type of discussions is at the heart of today's socio-economic debate in England. Here, individual responsibility and programmes targeting individuals are located exactly at the opposite extreme "policy-option" distribution relative to interventions that target neighborhoods and other "aggregated" areas

(like the enterprise zone or the MTO programs).

Finally, we found that cultural complementarity prevails. This implies that neighborhoods and parental investment are not substitutes, so we would not expect improvements in neighborhoods to be offset by reductions in parental effort. As a result, a mix of regeneration and social mixing policies (which act on the neighborhood) and individual policies acting directly on the educational effort of poor parents could be promoted to improve the situation of kids coming from low-educated families.

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Table 1 Exogenous Neighborhood Membership of Social Tenants in Cities

	dep.var.: parental education			
	private houses	council houses	private houses	council houses
high-skilled population	0.0352*** (0.0102)	0.0038 (0.0087))	-	-
school composition	-	-	0.0201*** (0.0069)	0.0053 (0.0057))
Control set:				
LA dummies	yes	yes	yes	yes
No. Obs.	4,746	2,598	4,746	2,598

Notes: OLS estimated coefficients and standard errors (in parentheses) are reported. Variables are expressed in logs.

Table 2: Neighborhood characteristics by parental education

-Sample of council tenants in cities-

HEP : High educated parents; LEP: Low educated parents

▪ neighborhood variables	(Census 1971)	***HEP***	***LEP***
young population (×100)	Census ward proportion of persons aged less than 21	32.40 (14.00)	33.15 (15.12)
total population (thousands)	Census ward total residing population	5.34 (2.22)	5.35 (2.12)
unemployment rate	Census ward unemployed over active population	0.11 (0.05)	0.11 (0.07)
activity rate	Census ward active population (aged more than 15) over present population	0.61 (0.41)	0.59 (0.53)
professional employment	Census ward professional and managerial employees over active population	0.16 (0.11)	0.17 (0.13)
unskilled employment	Census ward unskilled employees over active population	0.08 (0.20)	0.09 (0.24)
amenities	Census ward proportion of households lacking or sharing hot water and/or inside toilet	0.09 (0.15)	0.08 (0.17)
n. obs.		1,019	1,579

Notes: Means and standard deviations (in parentheses) are reported. T-tests for differences between means have been reported. None of the differences is statistical significant at any traditional statistical level.

Table 3 Neighborhood education effect on parental effort

	dep. var.: parents read to child							
	(1)		(2)		(3)		(4)	
	HEP	LEP	HEP	LEP	HEP	LEP	HEP	LEP
high-skilled population	0.1012***	0.0761**	0.0910***	0.0655**	0.0503***	0.0201**	0.0485***	0.0194**
	(0.0350)	(0.0309)	(0.0301)	(0.0272)	(0.0177)	(0.0102)	(0.0169)	(0.0091)
young population	0.1543	0.1012	0.1233	0.0905	0.1201	0.0910	0.1203	0.0909
	(0.1967)	(0.1715)	(0.2213)	(0.1805)	(0.2121)	(0.1804)	(0.2122)	(0.1804)
total population	0.0002	0.0003	0.0002	0.0003	0.0002	0.0003	0.0002	0.0003
	(0.0003)	(0.0005)	(0.0002)	(0.0005)	(0.0002)	(0.0005)	(0.0002)	(0.0005)
unemployment rate	-0.2915***	-0.2017***	-0.2565**	-0.1920**	-0.2450**	-0.1888**	-0.2444**	-0.1858**
	(0.0987)	(0.0656)	(0.1098)	(0.0766)	(0.1002)	(0.0788)	(0.1001)	(0.0787)
activity rate	0.0671	0.0888	0.0673	0.0890	0.0672	0.0895	0.0677	0.0901
	(0.0569)	(0.0787)	(0.0601)	(0.0790)	(0.0615)	(0.0799)	(0.0616)	(0.0800)
professional employment	0.1015	0.0564	0.0881	0.0470	0.0730	0.0390	0.0711	0.0376
	(0.1116)	(0.1011)	(0.1066)	(0.1015)	(0.0790)	(0.0812)	(0.0781)	(0.0808)
unskilled employment	-0.0876	-0.1012	-0.0639	-0.0909	-0.0581	-0.0899	-0.0980	-0.0995
	(0.1231)	(0.1034)	(0.1021)	(0.0899)	(0.0977)	(0.0835)	(0.0977)	(0.0834)
amenities	-0.0999**	-0.0875***	-0.0797**	-0.0708***	-0.0798**	-0.0710***	-0.0798**	-0.0709***
	(0.0421)	(0.0293)	(0.0379)	(0.0252)	(0.0366)	(0.0244)	(0.0369)	(0.0240)
parents income			0.0246**	0.0541**	0.0110**	0.0225**	0.0108**	0.0200**
			(0.0111)	(0.0257)	(0.0052)	(0.0112)	(0.0052)	(0.0101)
parents age			0.0101	0.0154	0.0110	0.0166	0.0110	0.0161
			(0.0122)	(0.0149)	(0.0120)	(0.0159)	(0.0121)	(0.0148)
parents social class			0.0012	0.0088	0.0007	0.0046	0.0007	0.0041
			(0.0033)	(0.0101)	(0.0039)	(0.0109)	(0.0037)	(0.0108)
parents employed			-0.0134	0.0255	0.0071	0.0099	0.0067	0.01059
			(0.0155)	(0.0260)	(0.0100)	(0.0244)	(0.0101)	(0.0248)
parents born in UK			0.0302**	0.0454***	0.0290**	0.0415***	0.0288**	0.0400***
			(0.0137)	(0.0125)	(0.0140)	(0.0138)	(0.0145)	(0.0126)
single parent families			0.0166	-0.0233	0.0171	-0.0209	0.0171	-0.0209
			(0.0175)	(0.0269)	(0.0170)	(0.0250)	(0.0170)	(0.0250)
house size			0.0122**	0.0178***	0.0129**	0.0185***	0.0127**	0.0184***
			(0.0043)	(0.0051)	(0.0048)	(0.0065)	(0.0048)	(0.0061)
family size			-0.0465**	-0.0203**	-0.0400**	-0.0156**	-0.0403**	-0.0145**
			(0.0222)	(0.0105)	(0.0199)	(0.0075)	(0.0201)	(0.0070)
special education			0.0534	0.0606	0.0330	0.0396	0.0320	0.0388
			(0.0672)	(0.0670)	(0.0566)	(0.0586)	(0.0565)	(0.0580)
female			0.1023	0.0983	0.1021	0.1090	0.1123	0.1087
			(0.1124)	(0.1055)	(0.1129)	(0.1069)	(0.1125)	(0.1059)
school composition					0.0402***	0.0110**	0.0329**	0.0100**
					(0.0145)	(0.0052)	(0.0152)	(0.0050)
school dummies	no	no	no	no	no	no	yes	yes
LA dummies	yes	yes	yes	yes	yes	yes	yes	yes

Notes: Probit estimation results of model 13. Marginal effects at the sample means and standard errors in parentheses. Errors are clustered at the neighborhood level. HEP : High educated parents; LEP: Low educated parents. Precise list and definition of control variables are in Tables 1 and A1. Coefficients marked with one (two) [three] asterisks are significant at 10 (5) [1] percent level.

Table 4 Neighborhood education effect on Child's qualification

	Dep. Var.: transition probabilities:											
	(1)		(2)		(3)		(4)		(5)		(6)	
	π^{hh}	π^{lh}	π^{hh}	π^{lh}	π^{hh}	π^{lh}	π^{hh}	π^{lh}	π^{hh}	π^{lh}	π^{hh}	π^{lh}
high-skilled population	0.2042**	0.3595**	0.0910***	0.2266***	0.0903***	0.1667***	0.0849***	0.1473***	0.0740***	0.1309***	0.0715***	0.1293***
	(0.0951)	(0.1520)	(0.0302)	(0.0727)	(0.0307)	(0.0550)	(0.0292)	(0.0421)	(0.0256)	(0.0348)	(0.0232)	(0.0245)
parents read to child	-	-	0.1333***	0.0427**	0.1208***	0.0388***	0.1120***	0.0257***	0.1089***	0.0190***	0.1075***	0.0169***
			(0.0329)	(0.0215)	(0.0299)	(0.0201)	(0.0295)	(0.0129)	(0.0290)	(0.0069)	(0.0277)	(0.0045)
young population	0.1221	0.1954	0.1022	0.1595	0.0952	0.1505	0.0945	0.1501	0.0889	0.1450	0.0890	0.1450
	(0.1777)	(0.1977)	(0.1555)	(0.1809)	(0.1459)	(0.1810)	(0.1450)	(0.1811)	(0.1224)	(0.1800)	(0.1224)	(0.1799)
total population	0.0004	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003	0.0004	0.0003	0.0004
	(0.0006)	(0.0005)	(0.0006)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
unemployment rate	-0.1529**	-0.1620***	-0.1052**	-0.1303***	-0.0853**	-0.1023**	-0.0849**	-0.1020**	-0.0812**	-0.0992**	-0.0810**	-0.0992**
	(0.0719)	(0.0465)	(0.0507)	(0.0450)	(0.0425)	(0.0444)	(0.0424)	(0.0443)	(0.0402)	(0.0444)	(0.0401)	(0.0441)
activity rate	0.0446**	0.0177	0.0400*	0.0169	0.0405*	0.0155	0.0400*	0.0151	0.0374	0.0125	0.0370	0.0123
	(0.0225)	(0.0178)	(0.0220)	(0.0170)	(0.0225)	(0.0166)	(0.0229)	(0.0160)	(0.0230)	(0.0156)	(0.0231)	(0.0151)
Professional employment	0.0815**	0.0555**	0.0800**	0.0550**	0.0717	0.0475**	0.0715	0.0471**	0.0667	0.0462**	0.0667	0.0459**
	(0.0404)	(0.0269)	(0.0400)	(0.0259)	(0.0399)	(0.0231)	(0.0385)	(0.0231)	(0.0381)	(0.0229)	(0.0382)	(0.0226)
unskilled employment	-0.0387	-0.1010	-0.0377	-0.1012	-0.0389	-0.1012	-0.0390	-0.1010	-0.0383	-0.0098	-0.0389	-0.0098
	(0.1002)	(0.1050)	(0.0980)	(0.1056)	(0.1002)	(0.1061)	(0.1001)	(0.1062)	(0.0091)	(0.1015)	(0.0091)	(0.1014)
amenities	-0.1001***	-0.0787***	-0.0991***	-0.0770***	-0.0905***	-0.0708***	-0.0901***	-0.0707***	-0.0890***	-0.0695***	-0.0889***	-0.0691***
	(0.0369)	(0.0259)	(0.0365)	(0.0250)	(0.0307)	(0.0259)	(0.0305)	(0.0259)	(0.0301)	(0.0255)	(0.0301)	(0.0252)
parents income					0.1554***	0.0550***	0.1455***	0.0462***	0.1231***	0.0355**	0.1215***	0.0328**
					(0.0519)	(0.0171)	(0.0455)	(0.0169)	(0.0385)	(0.0157)	(0.0358)	(0.0147)
parents age					-0.0044	-0.0077	-0.0046	-0.0075	-0.0040	-0.0070	-0.0040	-0.0067
					(0.0107)	(0.0121)	(0.0110)	(0.0120)	(0.0106)	(0.0119)	(0.0107)	(0.0118)
parents social class					0.0915	0.1201	0.0900	0.1182	0.0900	0.1177	0.0879	0.1168
					(0.0898)	(0.1506)	(0.0899)	(0.1495)	(0.0878)	(0.1468)	(0.0869)	(0.1449)
parents employed					-0.0477	0.0788	0.0455	0.0769	0.0361	0.0727	0.0313	0.0721
					(0.0456)	(0.0699)	(0.0459)	(0.0669)	(0.0360)	(0.0617)	(0.0306)	(0.0612)
parents born in UK					0.0671	0.0569	0.0647	0.0506	0.0634	0.0500	0.0604	0.0485
					(0.1101)	(0.1021)	(0.1075)	(0.1012)	(0.1067)	(0.1012)	(0.1047)	(0.0981)
single parent families					-0.0875	-0.1002	-0.0839	-0.1255	-0.0783	-0.1002	-0.0768	-0.1000
					(0.1345)	(0.1093)	(0.1095)	(0.1090)	(0.1079)	(0.0980)	(0.1069)	(0.0974)
house size					0.1313**	0.1779**	0.1454**	0.1590**	0.1220**	0.1379**	0.1215**	0.1375**
					(0.0642)	(0.0847)	(0.0670)	(0.0871)	(0.0643)	(0.0700)	(0.0632)	(0.0663)
family size					-0.0209	-0.0487**	-0.0200	-0.0445**	-0.0122	-0.0344	-0.0120	-0.0333
					(0.0221)	(0.0244)	(0.0211)	(0.0220)	(0.0208)	(0.0212)	(0.0201)	(0.0202)
female							0.2901	0.2115	0.2534	0.2001	0.2525	0.2002
							(0.3209)	(0.2206)	(0.2698)	(0.2065)	(0.2687)	(0.2060)
arithmetic test score							0.0671***	0.0888***	0.0456**	0.0528***	0.0446**	0.0519***
							(0.0235)	(0.0217)	(0.0224)	(0.0188)	(0.0220)	(0.0182)
reading test score							0.0115	0.0256	0.0099	0.0205	0.0085	0.0197
							(0.0111)	(0.0222)	(0.0100)	(0.0201)	(0.0087)	(0.0202)
school composition									0.1016**	0.1599***	0.1001**	0.1565***
									(0.0511)	(0.0489)	(0.0505)	(0.0460)
school dummies									no	no	yes	yes
LA dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

Notes: Probit estimation results of model 14. Marginal effects at the sample means and standard errors in parentheses. Errors are clustered at the neighborhood level.. Precise list and definition of control variables are in Tables 1 and A1. Coefficients marked with one (two) [three] asterisks are significant at 10 (5) [1] percent level.

Table 5 Neighborhood education effect on parental effort
ROBUSTNESS CHECKS

	dep. var.: parental effort							
	(a) Sample of home owners		(b) Sample of council tenants with adopted children		(c) Alternative definition of parental effort		(d) Alternative definition of parental education	
	HEP	LEP	HEP	LEP	HEP	LEP	HEP	LEP
high-skilled population	0.1093***	0.0426***	0.0490**	0.0216**	0.0502**	0.0211**	0.0468***	0.0187***
	(0.0214)	(0.0120)	(0.0175)	(0.0104)	(0.0247)	(0.0103)	(0.0155)	(0.0068)
Control set:								
neighborhood variables	yes	yes	yes	yes	yes	yes	yes	yes
family background variables	yes	yes	yes	yes	yes	yes	yes	yes
school variables	yes	yes	yes	yes	yes	yes	yes	yes
LA dummies	yes	yes	yes	yes	yes	yes	yes	yes
n. obs.	2,690	2,056	751	779	1,019	1,579	1,019	1,579

Notes: Probit estimation results of model 13. Marginal effects at the sample means and standard errors in parentheses. Errors are clustered at the neighborhood level. HEP : High educated parents; LEP: Low educated parents. Precise list and definition of control variables are in Tables 1 and A1. Coefficients marked with one (two) [three] asterisks are significant at 10 (5) [1] percent level.

Table 6 Neighborhood education effect on Child's qualification
ROBUSTNESS CHECKS

	dep. var.: transition probabilities:							
	π^{hh}	π^{lh}	π^{hh}	π^{lh}	π^{hh}	π^{lh}	π^{hh}	π^{lh}
	(a) Sample of home owners		(b) Sample of council tenants with adopted children		(c) Alternative definition of parental effort		(d) Alternative definition of parental education	
high-skilled population	0.1998***	0.2639***	0.0700**	0.1251***	0.0721***	0.1290***	0.0689***	0.1218***
	(0.0423)	(0.0452)	(0.0297)	(0.0302)	(0.0243)	(0.0255)	(0.0225)	(0.0236)
parental effort	0.1653***	0.0784***	0.1069***	0.0175***	0.1012***	0.0156***	0.1198***	0.0165***
	(0.0388)	(0.0222)	(0.0333)	(0.0062)	(0.0289)	(0.0050)	(0.0269)	(0.0046)
Control set:								
neighborhood variables	yes	yes	yes	yes	yes	yes	yes	yes
family background variables	yes	yes	yes	yes	yes	yes	yes	yes
child variables	yes	yes	yes	yes	yes	yes	yes	yes
school variables	yes	yes	yes	yes	yes	yes	yes	yes
LA dummies	yes	yes	yes	yes	yes	yes	yes	yes
n. obs.	2,690	2,056	751	779	1,019	1,579	1,019	1,579

Notes: Probit estimation results of model 14. Marginal effects at the sample means and standard errors in parentheses. Errors are clustered at the neighborhood level..Precise list and definition of control variables are in Tables 1 and A1. Coefficients marked with one (two) [three] asterisks are significant at 10 (5) [1] percent level.

APPENDIX

Table A1: Description of data

-Sample of council tenants in cities-

high educated parents: HEP; low educated parents: LEP

▪ key variables		HEP	LEP
high skilled population (×100)	Census ward proportion of over-18s persons with A-levels (highest grade at age 16 exams) or above qualifications	13.70 (7.88)	13.11 (8.65)
parents read to child	dummy variable taking value one if the parents read at least every week to the child	0.51 (0.50)	0.49 (0.50)
parental involvement	dummy variable taking value one if the parents appear over concerned or very interested in the child's education	0.61 (0.48)	0.58 (0.49)
parent education***	average completed years of schooling (derived from age left full-time education) of the mother and the father	13.57 (2.95)	10.01 (3.78)
▪ child variables			
special education	dummy variable taking value one if the child has been ascertained as in need of special education	0.24 (0.43)	0.23 (0.42)
arithmetic test score**	child's age-7 arithmetic test scores, coded 0 to 10	5.55 (2.90)	5.01 (2.67)
reading test score	child's age-7 reading test scores, coded 0 to 30	22.04 (6.88)	21.66 (6.35)
female	dummy variable taking value one if the child is female	0.45 (0.46)	0.55 (0.49)
▪ family background variables			
parents income	weekly net wage of father (or mother if no father figure), 12 bands, mid-points of each range considered	22.15 (13.28)	21.85 (12.11)
parents age	average parents' age at the childs's age 16	38.16 (9.87)	39.72 (8.89)
parents social class	social class of father (or mother if no father figure), coded 1 to 5: unskilled, semi-skilled manual, skilled manual, skilled non-manual, professional	3.10 (2.30)	3.07 (1.40)
parents employed**	dummy variable taking value one if both parents are working	0.57 (0.50)	0.46 (0.25)
parents born in UK	dummy variable taking value one if both parents are born in Great Britain	0.83 (0.38)	0.81 (0.40)
single parent families	dummy variable taking value one if there is no regular father figure or there is no natural mother	0.004 (0.06)	0.003 (0.05)
house size	number of rooms in household accommodation	0.18 (0.21)	0.19 (0.28)
family size	number of people in household	4.02 (1.43)	3.89 (1.80)
▪ school variables			
school composition	proportion of boys or girls studying for GCE O-levels in the school attended by the child at age 16, 9 bands, coded 1 to 9	4.81 (3.01)	4.77 (2.89)
school grammar	dummy variable taking value one if the school attended by the child at age 16vis grammar; school type dummies, reference category: comprehensive school	0.05 (0.23)	0.03 (0.19)
school secondary modern	dummy variable taking value one if the school attended by the child at age 16vis grammar: school type dummies.	0.21 (0.40)	0.18 (0.39)
school private	dummy variable taking value one if the school attended by the child at age 16 is private: school type dummies	0.12 (0.34)	0.09 (0.30)
n. obs.		1,019	1,579

Notes: Means and standard deviations (in parentheses) are reported. T-tests for differences between means have been reported. Variables marked with *, **, *** show test statistics significant at the 10, 5, 1 percent level respectively.

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