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 beetween family and neighborhood effects. We develop a theoretical model suggesting that both neighborhood quality and parental effort matter in the education attained by children. This model proposes a mechanism explaining why and how they matter, 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 allow us to identify the role of neighborhood 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 the previous US studies is that family matters for highly-educated parents while it is the community that is crucial for the education achievement of children coming from low-educated families.

Key words: Education, cultural transmission, cultural substitution, peer effects, social tenants.

JEL Classification: I21, J13, J24.

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1 Introduction

Explaining children educational outcomes 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 matters, 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, 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 (more) incentive

[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's quality (see e.g. De Bartolome, 1990, Benabou, 1993) on children's educational attainement. Our model links these two approaches and, as a result, gives a mechanism through which both effects affect children's outcomes.

to socialize their children the more widely dominant their values are 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 chance for their children to be 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 to become different, that is 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 yields cultural complementarity (higher neighborhood quality leads to higher effort) and substituability (higher neighborhood quality leads to lower effort). We then show how these conditions affect the probability for the child to be educated. We also distinguish between high- and low-educated parents by assuming that the cost of effort of 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 (cohort's members are followed from age 7 to 33), the NCDS data are ideal for our purpose. Our empirical strategy consists in providing an evaluation of the reduced-form effects of parental involvement and neighborhood quality for relatively poor families in the UK. This approach relies on the available information on families living in council houses

in cities. Indeed, in Britain, applicants can express a preference in which area they want to reside, but for areas such as London and other big cities demand outstrips supply, and thus little consideration is given to preferences (need and availability are the deciding factors). Our own evidence reveals that the assigment of eligible families to council flat was indeed random with respect of 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] For high-educated parents, we find that both parents' involvement in education and neighborhood's quality significantly affect the intergenerational transmission of education, the former being more potent than the latter. On the other hand, we show that for low-educated parents only the quality of the neighborhood has a sizeable impact on children's educational attainment.

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 matters more 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 it is the neighborhood that 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 provides only one possible approach suggesting that both parental

[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.

[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 and, contrary 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 parents' effort in transmitting it. For education, we find the contrary because education and the quality of the neighborhood are more complementary in nature.

effort and neighborhood quality might play a role, which is different depending on the education level of parents.

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.

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. We review here three important contributions to this literature. First, Kremer (1997) proposes the following equation:

$$H_{it+1} = a_0 + \frac{\alpha}{2}\left(h_{it} + h'_{it}\right) + \beta h_{\nu(i)t} + \varepsilon_i \tag{1}$$

where H_{it+1} denotes the human capital of a member of the ith dynasty in generation $t+1$ (i.e. the child), h_{it} and h'_{it} are the human capital levels of members of the same dynasty in generation t (i.e. the parents) with i designing the father and 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 in more details equation (1) by focussing on ethnic groups. In his model, parents value their own consumption as well as the human capital of their offsprings. The crucial equation is however the one that relates the human capital obtained by a child belonging to ethnic group g, H_{igt+1}, to that of his/her parents, h_{igt} (which could be his/her father or mother), and of the average human capital of his/her ethnic group,

$\overline{h}_{gt} = \frac{1}{n_g} \sum_{j \in g} h_{jt}$, where n_g is the size of the ethnic group. Formally,

$$H_{igt+1} = \gamma_1 h_{igt} + \gamma_2 \overline{h}_{gt} + \xi_{igt} \tag{2}$$

Of course, the variables "neighborhood" and "ethnicity" are highly correlated since minorities tend to live together. The main findings of Borjas (1992) is to show that, using the General Social Surveys and the National Longitudinal Surveys of Youth, ethnic capital (as measured by h_{igt}, 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). By doing so, 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:

$$\ln H_{it+1} = a_0 + a_p \ln \left[D h_{it}^{1-1/\phi} + (1-D) \left(h'_{it} \right)^{1-1/\phi} \right] + \ln \left(\sum_{j \in \nu(i)} \mu_{\nu(i)j} h_{jt}^{1-1/\psi} \right)^{\frac{\psi}{\psi-1}} \tag{3}$$

where $\mu_{\nu(i)j}$ denotes the frequency of the value of h_{jt} within the distribution of educational attainment of 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 of the distribution of educational attainment within a relevant neighborhood on the 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

is twofold: (i) the suggestion of both direct and indirect mechanisms through which neighborhoods might affect human capital accumulation; (ii) the differences across households of different education levels.

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 their educational effort level. As in Bisin and Verdier (2000, 2001), the transmission of education is modeled as a mechanism that interacts socialization *inside* the family (*vertical* socialization) with socialization *outside* the family (*oblique* socialization) via imitation and learning from peers and role models.

There are two types of parents/workers: high-educated, $i = h$, and low-educated parents, $i = l$. There is a continuum of each of them. The instantaneous utility of a parent of type $i = h, l$ is given by:[5]

$$z^i + U(\lambda^i, e^i)$$

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 and e^i is time (effort) they spend with their children trying to educate them. $U(.)$ is assumed to be increasing in λ^i and decreasing in effort e^i, and concave in both arguments. This choice of the utility function aims at capturing the fact that the time spent with children and on leisure are not independent activities for parents.

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

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

where w^i is the per-hour wage (with $w^h > w^l$) and 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.[6]

[5] None of our results is affected by the fact that the utility function $U(.)$ is separable.

[6] We could have assumed that more educated parents work more hours than less educated workers. 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 their 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 instantaneous indirect utility for parents of type $i = h, l$:

$$V^i(e^i) = z^i + U(\lambda^i, e^i) = w^i T + U\left(1 - T - e^i, e^i\right) \tag{6}$$

Let us explain how education transmission works. For both the educated and non-educated parent, with a probability equal to the education effort e^i, education will be successful. If education is not successful, then the child remains without education and gets randomly matched with someone else whose education he/she will adopt. It is at this second stage, after the parents' unsuccessful education transmission, that children are influenced by their peers or teachers (role models). 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. Denoting by q the proportion of *high-educated* individuals in the neighborhood, we obtain the following transition probabilities:

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

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

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

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

Let us interpret equation (7). The child of a high-educated parent will also be highly educated if either his/her parent's education transmission is successful (probability e^h) or if 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 the expected utilities of parents. We assume that all parents (educated or not) are altruist and thus do care of 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 take 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, the expected utility of educated and non-educated parents are respectively given by:[7]

$$EV^h = V^h(e^h) + a\ \left[\pi^{hh}V^{hh} + \pi^{hl}V^{hl}\right]$$

$$EV^l = V^l(e^l) + a\ \left[\pi^{ll}V^{ll} + \pi^{lh}V^{lh}\right]$$

where $0 < a < 1$ is the degree of altruism that is common to both educated and uneducated parents.

Let us now focus on the parent's choice of effort $e^i \in [0, 1-T]$. There is a cost of effort, denoted by $\Psi(e^i, q)$, with is *increasing* and *convex* in e^i, and *decreasing* in q. The latter is due to the fact that the higher the proportion of high-educated families in the neighborhood, the lower is the cost of putting effort because of peer effects (positive externalities, peer pressure, etc.). For example, if a low-educated parent wants to help his/her child to do his/her homework in mathematics, then 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 $\Psi(e^i, q)$ is assumed to be higher for low-educated than high-educated

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

parents. Indeed, it is quite natural to assume that it is less costly for a high-educated parent to put effort in education than for a low-educated parent because of knowledge due to 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 is, for example, 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 that the total cost of providing effort is 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. As a result, using (7)−(10), the expected utility of each parent $i = h, l$ is given by:

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

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

Let us now determine e^i, the effort's choice of parents $i = h, l$. If we use the following notations $U_{\lambda^i} \equiv \frac{\partial U}{\partial \lambda^i}$, $U_{e^i} \equiv \frac{\partial U}{\partial e^i}$, $\Psi_{e^i} \equiv \frac{\partial \Psi(e^i,q)}{\partial e^i}$, then the first order conditions for educated and uneducated parents are respectively given by (we only focus on interior solutions):[8]

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

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:

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

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

and is assumed to be negative.

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 with* δ*, the relative cost difference in providing effort.*

(*ii*) *If* $\Psi_{e^i q} > 0$*, then for both educated and uneducated parents, the higher the proportion of high-educated families in the area, the lower the effort parents put in 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* $\Psi_{e^i q} < 0$ *and* $-\Psi_{e^i q} > a\left(w^h - w^l\right)/\delta^i$*. Then, for both educated and uneducated parents, the higher the proportion of high-educated people in the area, the higher the effort parents put in 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 in 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 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 effort e, the higher the marginal cost of effort, then the short-run costs are higher, and therefore the parents put less effort, the higher the level of education in the neighborhood (cultural substitution). On the contrary when $\Psi_{e^i q} < 0$ and $-\Psi_{e^i q} > a\left(w^h - w^l\right)/\delta^i$, parents put more effort the higher 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* $e^*(q)$*, 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, 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 to be educated and decreases the probability to be 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 to be 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 on children's education 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, in which 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 parents' effort) and direct effects. If, on the contrary, there is cultural substitution, then a better quality neighborhood reduces the chance to be educated

by parents (since parents spend less time with their kids) but increases the chance to be educated by peers (since q is higher the chance to meet a high-educated peer is higher). The net effect is thus ambiguous.

We have finally the following result, which is a consequence of the two propositions above:

Proposition 3 *For low-educated parents,*

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

(*iii*) *When δ is high enough, 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 to be 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 education 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, schools and role models) play an important role in the education process of children. If they live in a "good" environment with educated parents who take care of them, then the chance to reach a high education level is very high. If, on the contrary, 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 to be 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 persons who were born between the 3rd and 9th of March 1958, with follow-up surveys in 1965 at age 7 (NCDS sweep one), in 1969 at age 11 (NCDS sweep two), in 1974 at age 16 (NCDS sweep three), in 1981 at age 23 (NCDS sweep four), and in 1991 at age 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's 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, obtaining a detailed picture of the residential neighborhood community when cohort's 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 area residential community 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 UK in 1971 with an average of 3,000-4,000 residents. A Census ward contains roughly ten enumeration districts,[9] and it is thus quite small: it is equivalent to a Census tract in the US (which contains on average 4,000 inhabitants).

Our empirical analysis matches information on individuals' education attainment at age 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 individuals are 13 years old).

[9] Experiments on the available data at enumeration district level provide the same qualitative results. Thus, the size of the neighborhood group does not appear to be so critical.

4.2 Definition of variables

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

Let us first discuss our empirical proxy for parental interest in child's education. The ideal variable to measure 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. We use two alternative proxies, one that is based on the children's teachers and headmasters perception of parental involvement and the other that is derived from parental self-reported information.[10] Specifically, the school questionnaire of different NCDS sweeps (1965, 1969, 1974) contains the following question: "With regard to the child's educational progress, do 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? Can't say or inapplicable", and it is stated to ring the appropriate definition (only one for each parent). We exclude the mothers and fathers answering "Can't say or inapplicable" category and we rank the parents according to the highest level of involvement reported in each couple. We use the NCDS sweep one (age 7 in 1965), i.e. when the child has just started school and has not yet be "educated".[11] 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' interest in his/her child education at that early stage as perceived by headmasters (based on parent's telephone calls asking information about courses and textbooks, frequency of parental visits to the school, meetings with teachers, etc...) 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 from children future schooling

[10] This avoids problems in the measure of parental inputs due to the fact that parental involvement at school might not correspond to parental investment at home. Indeed, there may be ample investment at home for parents too shy and too deferential to visit the school. On the other hand, there may be relatively little investment at home from parents who are very assertive at school. We use both sources of information (i.e. school and home).

[11] Non-response is not an issue here. Missing values are reported in less than 5 % of the observations.

achievements.[12]

Our alternative proxy is based on parental self-reported information on the frequency they read to their child. It is also taken when the child is at age 7. Specifically, 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 never; Don't know or inapplicable". Here also we exclude mothers and fathers who answer: "Don't know or inapplicable", and we rank the parents according to the highest frequency declared by each couple. Both proxies are coded as dichotomous variables. The first takes value one if the parents appear over concerned or very interest in the child's education and zero otherwise (i.e., if they show only some or little or no interest). The second takes value one if the parents read at least every week to the child and zero otherwise (i.e., if they read to the child only occasionally or never or hardly never).[13]

[*Insert Table 2 here*]

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 years old adult in 1991) provides information on the highest qualification obtained by the cohort's members. We define high-educated individuals the ones with A-levels[14] or above qualifications and low-educated individuals otherwise. As a proxy for the average neighborhood education quality in an area k at time t, i.e. $q_{k,t}$, we use the percentage of persons over 18 years old holding a A-level or more in a ward k from the Census 1971 data, i.e. when the child is 13 years old.

Finally, the information on the parents' education is derived from the age the parents left school, which is reported in 1974 (NCDS sweep three). The parents' education is measured using completed years of schooling. Consistently with the aggregation used for cohort's

[12] The use of other indicators of parental interest from later sweeps (including a continuous variable reporting the number of parents/teachers meetings from NCDS third sweep) does not anyway change qualitatively our results. We also construct a combined variable from different indicators obtained using a factor analysis (reliability assessed by Cronbach's alpha), but no qualitatively different results are obtained.

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

[14] The A-level in the UK is equivalent to the SAT in the US or the baccalaureat in France.

member education, implying that high-educated individuals are those that left school at an age greater than 18 years (and low-skilled otherwise), we define parents of type $i = h$ if the mother and the father's average years of schooling is greater than 12 years and parents of type $i = l$ otherwise. So, for example, $\pi^{hh}_{n,t+1}$ is the probability that an adult n of 33 years old 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.

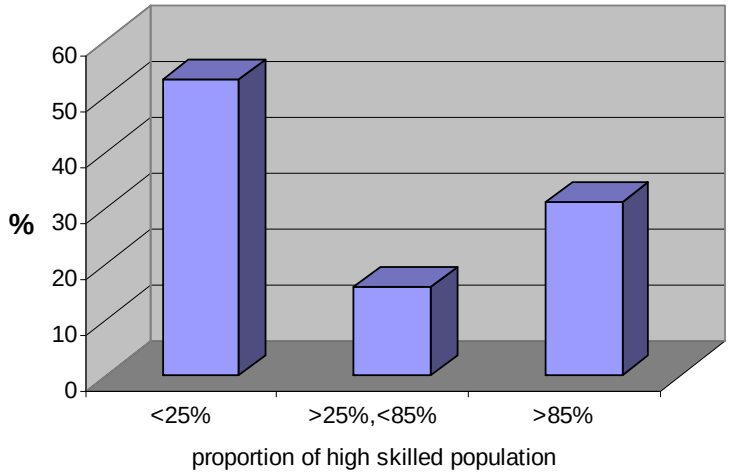
To summarize, we evaluate parents' effort when the child is 7 (in 1965), the quality of the neighborhood and parents' level of education when the child is 13 (in 1971) and the child's education attainment when he/she is 33 years old (in 1991).

4.3 Descriptive evidence

In this section, we provide some descriptive evidence on the link between children's education attainment and the quality of neighborhood where they live.

First, looking at the distribution of UK Census wards by average human capital of the residential community (i.e., the proportion of high-skilled workers per ward), we find that most neighborhood residential communities are highly homogeneous with respect to their educational attainment. In Figure 1, we consider the percentage of high-skilled (that is the percentage of persons over 18 years old holding a A-level or higher qualification) in a ward (neighborhood) and the percentage of wards having a certain level of average human capital. It can be seen that roughly 50 percent and nearly 30 percent of wards have respectively less than 25 percent and more than 85 percent of high-skilled workers. This means that almost 80 percent of these areas are very homogenous along the education dimension (since they have either less than 25 percent or more than 85 percent of high-skilled workers).

Figure 1. Distribution of neighborhoods by average human capital quality



Second, Figure 2 displays the relationship between the average neighborhood human capital quality and the average frequency that a child, having parents of type $i = h, l$, is of type $j = h, l$. To be more precise, for each ward k, we calculate the following empirical probability:

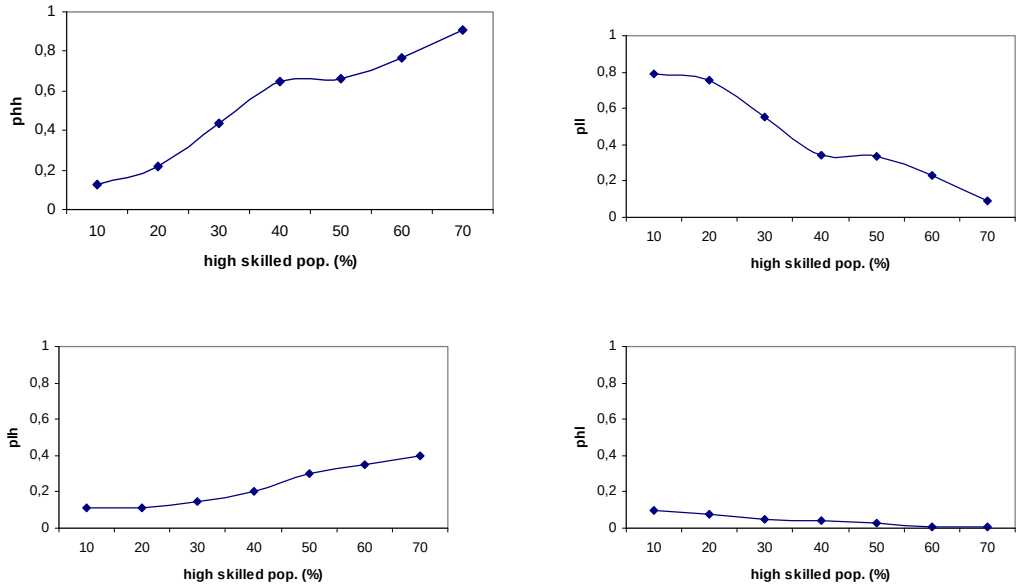
$$p_k^{ij} = \frac{1}{N_k} \sum_{n=1}^{N_k} s_n^{ij}$$

where N_k denotes the number of observations (children) in each area k, s_n^{ij} is a dummy variable that is equal to one if a child n $(n = 1, ..., N_k)$, of type $j = h, l$, who resides in ward k $(k = 1, ..., K)$, has a parent of type $i = h, l$, and is equal to zero otherwise. Thus, for each ward k, the four probabilities p_k^{hh}, p_k^{ll}, p_k^{lh} and p_k^{hl} sum up to one. These empirical frequencies are then averaged over the areas with a similar proportion of high skilled population, that is:

$$p_r^{ij} = \frac{1}{K_r} \sum_{k_r=1}^{K_r} p_{k_r}^{ij}$$

where K_r is the number of wards having an observed percentage interval r $(r = 10, ..., 70)$ of high-skilled residents and $p_{k_r}^{ij}$ is the empirical probability for each area k in the different groups.

Figure 2. Average frequencies per neighborhood quality*



*p^{lh} is rescaled by 100

For example, for $r = 20$, p_{20}^{ij} is the observed average frequency of children of type j whose parents are of type i and who reside in neighborhoods with a percentage of high-skilled people between 10 and 20 percent. The values p^{ij} (i.e. the p_r^{ij} for different values of r) are reported in Figure 2, where a line has been drawn between the different points in each panel. It is striking to observe the patterns of the correlations between neighborhood quality and the probability to be educated. Indeed, both p^{hh} and p^{lh} appears as increasing functions of the residential neighborhood quality whereas both p^{ll} and p^{hl} are decreasing functions of the same variable. This documents a positive assortative matching of these frequencies along the neighborhood human capital quality, which suggests that, irrespective of parental education, better quality neighborhoods might be associated with higher chances to be educated. If we investigate further, it also appears that parents' education may play a role. Take for example $r = 10$, i.e. very low quality neighborhoods (less than 10 percent high-skilled workers). If one compares children whose parents have different backgrounds, then, conditionally on the neighborhood quality, the chance to be uneducated seems to be much higher for those with low-educated parents ($p_{10}^{ll} \approx 80\%$) than with high-educated parents ($p_{10}^{hl} \approx 10\%$). At

the opposite, in a good quality neighborhood (60-70 percent are skilled), the chance to be uneducated for a child whose parents are educated (p_{70}^{hl}) appears virtually zero while for a child whose parent is not educated (p_{70}^{ll}) it is roughly 10 percent.

Even though this evidence can be driven by an endogenous sorting of families into residential locations, it suggests the possibility that both the family background and the quality of the neighborhood may affect the educational attainment of children growing up in the area. In order to better understand these results, we now test the predictions of our theoretical model where the relationship between parents' involvement in education, the quality of the neighborhood and children's educational attainment is explicitly analyzed.

5 Identification strategy and estimation results

5.1 Identification strategy

The information contained in our data set offers a setting where the influence of the social context can be evaluated. Indeed, we are able to select a sub-sample of families for which the residential neighborhood can be considered as "exogenous". We focus our analysis on council tenants in big cities.[15] In 2002 (Homelessness Act 2002) the procedure to allocate council houses to tenants has been revised and choice-based letting (CBL) schemes were introduced. CBL allows now applicants for social housing to apply for available vacancies which are advertised widely. 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 scheme. As a result, social tenants in the UK are now given greater choice in housing.

However, in the 1970s, when 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 on the basis of a point-system giving priority to families in greater need. The number of eligible families was far greater than the available space and the neigh-

[15] Council tenants refer to families who live in council provided accommodations. These programs are equivalent to the housing projects in the US. In our whole sample, roughly 40 percent of families are under this scheme.

borhood location of an allocated council home was largely unrelated to the resources and preferences of the tenant. 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) in order to decide which flat to allocate them to (how big and exactly where). Applicants could express a preference, but for areas such as London and other big cities demand outstripped supply, and little consideration was given to preferences (need and availability are the deciding factors). Refusal to accept an offer of accomodation was often associated with a penalty, for example, suspension from the waiting list for a period of time. Rents in the social sector were considerably lower than the private sector and the turnover was also very low. One of the reasons at the basis of the revision of the system was precisely the fact that the waiting lists were becoming excessively long.[16] Therefore, the sample of council tenants in UK cities in the 1970s provide a suitable group to identify the influence of the social context in the intergenerational transmission of education by standard regressions. Although low-educated families are over-sample here, we still find enough variation to appreciate differences between high- and low skilled families.

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 parent's education on neighborhood educational status (with regional and local authority controls). The longitudinal nature of our data set allows us to follow the family residential moves and therefore also the allocation of council tenants to council flats. 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 were resident in such districts in 1971. We then select the families that have just moved into a neighborhood of a city and we investigate the relationship between the parents' mean years of education and the ward-

[16] At the same time, the local authority housing stock has been declined mainly due to Right to Buy (RTB) programs for registered social tenants, which were not accompanied by corresponding new public investments in building new houses.

proportion of adults with A-levels and above for families moving in houses in the private sector and in the social sector (council tenants). Table 1 reports the OLS estimation results. The first column contains the results for families in private accomodations and reveals a very significant correlation between the two variables, with an elasticity at about 0.04 The second column shows the results of the same regression but only for families moving into a council-provided accomodation. Interestingly, it shows that there is no correlation between the level of education of the parents and the average human capital of the neighborhood. 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 allow us to provide an evaluation of the reduced-form equation of our model.

[*Insert Table* 1 *here*]

5.2 Estimation results

We can now test propositions 1, 2 (and 3), that is the influence of the local environment (quality of the peers) on the parents' decision in 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 is of 2,566 children (and 4,897 parents) from families living in council houses in UK cities in the 1970s. Table A1 in the Appendix contains the description of the variables available on this sample and the corresponding summary statistics, for high educated and low educated parents separately.

Let us begin by considering Proposition 1 (and Proposition 3).

We model the underlying parent's propensity in investing in their children 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 for 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 for 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 Table 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). Also, 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.

Because the estimation results are qualitatively the same if one uses as dependent variable either the frequency parents read to the child or the level of parental interest in the child's education, we discuss our analysis using the first proxy only. Table 2 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 OLS estimation of model (13), when using the most extensive set of controls (listed in Table A1).[17,18] For high-educated 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, a marginal increase (1 percent increase) in the average level of education of the neighborhood increases the probability that the parents devote more effort in their children education by roughly 0.05. For low-educated parents, the estimated effect is still positive and significant but largely reduced in magnitude (slightly more than 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 rejects

[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.

[18]For the sake of brevity, we do not comments the results related to our control variables, which are anyway in line with the expectations. Different selections of control variables have also been used, but the qualitative results remain unchanged.

always the null hypothesis of equal effects. This provides a formal test for differences in neighborhood effects on parents of different education levels.

[*Insert Table 2 here*]

Focusing now our attention to the test of Proposition 2 (and Proposition 3), we model the likelihood of a successful or unsuccessful intergenerational transmission of education (transition probabilities in Proposition 2) 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 the parental involvement when the adult was a child at time t; $\eta_{n,t+1}$ 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 out 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, both the effect of $q_{k,t}$ and $e^{i}_{k,t}$ have to be significant, whereas for children of low-educated parents, both effects are expected to be significant only if δ is low enough, otherwise only the impact of $q_{k,t}$ should matter. Indeed, as δ increases, not only the effort for low-educated parents should 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 (estimate of ρ in model (13)-(14)) is never significant in any model specification (i.e., with

different sets of controls)[19] 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 neighborhood's average human capital. As a result, we focus on the results contained in Table 4, which excludes the interaction term from the regressors.[20]

Tables 3 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 capital when using the most extensive 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 a A-level degree and that she/he does not, sum up to one. Thus, we only report the results for π^{hh} and π^{ll} ($\pi^{hl} = 1 - \pi^{hh}$ and $\pi^{lh} = 1 - \pi^{ll}$).

[*Insert Table 3 here*]

Let us start with high-educated parents and thus focus on π^{hh} (and π^{hl}). All estimated coefficients are always significant both for parental interest and neighborhood quality and

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

[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 the 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.

[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. Also, among the area-level controls, we include the proportion of employed workers in the agriculture sector to account for area industry specialization on education choices, and the total area population to control for agglomeration effects. Indeed, children that grow up in agricultural areas will be more likely to leave school to continue in agriculture work, regardless of the parental involvement in their education; and 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. Similarly to Table 2, we report the results obtained using our first proxy of parental care in a child's education (i.e. frequency of reading to the child). Those obtained using our alternative proxy are qualitatively the same, thus not discussed and not reported here for brevity. Also, we again focus on the estimated impact of our target variables. The results related to our control variables are in line with the expectations. Different selections of control variables have also been used, but the qualitative results remain unchanged.

with a positive sign (thus negative for π^{hl}). In words, children whose parents are educated are more likely to be *educated* if parents spend time educating them and if the neighborhood where they live is of good quality. On the contrary, the less parents are interested in their child's education and the worse the neighborhood quality, the more likely children, whose parents are educated, will be *uneducated*. Comparing the magnitudes of the effects, it appears that parental interest has a higher impact than neighborhood quality. When all control variables are included, a marginal increase in the quality of the neighborhood raises the average probability of a successful transmission of the parental education level by about 0.07 whereas, for parental interest, the effect is roughly equal to 0.11. This indicates that the latter effect is more potent than the former.

Concerning low-educated parents, i.e. π^{ll} (and π^{lh}), it is instead the quality of the neighborhood that shows the more influential effect on children's educational attainment. Going back to the model, one can conjecture that this result is due to a high δ, that is low-educated parents have a high cost of effort. The estimated impact of parental effort is roughly 0.02 in absolute value. Concerning the influence of the neighborhood, we obtain the expected sign, that is negative for π^{ll} (and positive for π^{lh}). In words, a better quality neighborhood has a negative impact on the chance to be uneducated (and a positive impact on the chance to become educated). Observe that, by including all the control variables, when the quality of the neighborhood increases marginally, the decrease in the average probability that a child remains low educated is equal to -0.12. This implies that the effect of neighborhood quality is much larger for π^{lh} (1.12) than for π^{hh} (0.07), which means that the percentage of high-skilled population in a neighborhood plays a major role in determining the chance to become educated for a child whose parents are not educated (in respect of its influence in producing a similar child if the parents are highly educated).

These results suggest that a failure in transmitting education for high-educated parents is more related to their lack of interest or time rather than to a negative influence of the local environment. On the other hand, children whose parents are low-skilled have some chance to obtain higher degrees if they live in a good neighborhood. In that case, parental dedication to education seems to play a minor direct role.[23]

[23] Our analysis has also been performed considering adopted children only. This exercise addresses concerns

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

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 indirect effect on children's education attainment as it affects parents' effort in their children's education, which, in turn, plays an important role in determining the child's education achievement. These potential interactions depend on the parents' education level. Using an identification strategy based on council housing in big cities in Britain, our empirical evidence supports these predictions. In particular, the children's educational attainment of high-educated parents appears to be more influenced by parents' involvement while, for low-educated parents, it is instead the neighborhood quality that is more potent.

Our analysis offers interesting policy implications. For children whose parents are low-

related to the possible presence of (unobserved) inherited characteristics that affect a child's education attainment. If cognitive ability is a heritable trait, one may argue 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. Our results remain (qualitatively) unchanged, suggesting that this is not the whole story.

educated, we have shown that the neighborhood where they are raised is important. In that case, neighborhood regeneration policies are 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 empowerment zone program is to revitalize distressed urban communities and represents a nexus between social welfare policy and economic development efforts.

We have also seen that interaction between low- and high-educated families can help the former increasing the education level of their children (peer effects). As a result, any policy promoting social integration would also have positive effects on these kids' 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 to relocate to better and richer neighborhoods. The results of the present paper support such policies and suggest that the implementation of such policies in England might be beneficial.

Another policy could act directly on the education of poor parents or help them spend better time with their offspring. This type of discussions are at the heart of today's socio-economic debate in England. Here individual responsibility and programmes targeting individuals directly come 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).

To conclude, in the light of our analysis, we believe that the right policies that help poor children to obtain better education are a mix of regeneration and social mixing policies (which act on the neighborhood) and individual policies acting on education effort of poor parents directly. This is mainly because we find cultural complementarity, meaning that parental effort and neighborhood quality are complements rather than substitutes.

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Table 1. Exogenous Neighborhood Membership of Social Tenants in Cities

-Families who just moved into the neighborhood-

	dep.var.: parental education	
	private houses	council houses
high-skilled population	0.0384***	0.0031
	(0.0101)	(0.0077))
Control set:		
LA dummies	yes	yes
Regional dummies	yes	yes
No. Obs.	1,956	731

Notes:

- Variables are expressed in logs.

- OLS etimated coefficients and

standard errors (in parentheses) are reported

Table 2. Probit estimation results of model (13)

	dep. var.: parents read to child
high-educated parents	
high-skilled population	0.0497***
	(0.0166)
low-educated parents	
high-skilled population	0.0202**
	(0.0099)
Control set:	
child variables	yes
neighborhood variables	yes
family background variables	yes
school variables	yes
regional dummies	yes

Notes:

- precise list and definition of control variables are in Table A1

- marginal effects at the sample means and standard errors in parentheses

- coefficients marked with one (two) [three] asterisks

are significant at 10 (5) [1] percent level

- errors are clustered at the neighborhood level

Table 3. Probit estimation results of model (14)

	dep. var.: π^{hh}
parents read to child	0.1088^{***}
	(0.0291)
high skilled population	0.0707^{***}
	(0.0214)
	dep. var.: π^{ll}
parents read to child	-0.0190^{***}
	(0.0042)
high skilled population	-0.1211^{***}
	(0.0223)
Control set:	
child variables	yes
neighborhood variables	yes
family background variables	yes
schooling variables	yes
regional dummies	yes

Notes:

- precise list and definition of control variables are in Table A1

- marginal effects at the sample means and standard errors in parentheses

- coefficients marked with one (two) [three] asterisks

are significant at 10 (5) [1] percent level

- errors are clustered at the neighborhood level

Table A1: Description of data

-Sample of council tenants in cities-

high educated parents: HEP; low educated parents: LEP

		HEP	LEP
✓ key variables			
high skilled population	Census ward proportion of over-18s persons with A-levels (highest grade at age 16 exams) or above qualifications	13.76 (7.89)	13.01 (8.65)
parents read to child	dummy variable taking value one if the parents read at least every week to the child	0.52 (0.53)	0.49 (0.56)
parental involvement	dummy variable taking value one if the parentsappear over concerned or very interested in the child's education	0.62 (0.67)	0.58 (0.69)
parent education	average completed years of schooling (derived from age left full-time education) of the mother and the father	13.55 (2.96)	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 (speech defect, physically handicapped, partially sighted/ hearing)	0.24 (0.46)	0.23 (0.51)
arithmetic test score	child's age-7 arithmetic test scores, coded 0 to 10	5.55 (2.90)	5.12 (3.67)
reading test score	child's age-7 reading test scores, coded 0 to 30	22.55 (6.88)	21.26 (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	22.59 (13.53)	21.85 (12.11)
parents age	average parents' age at the childs's age 16	38.11 (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	3.55 (2.38)	3.07 (1.39)
parents employed	dummy variable taking value one if both parents are working	0.57 (0.38)	0.46 (0.41)
parents born in UK	dummy variable taking value one if both parents are born in Great Britain	0.83 (0.80)	0.79 (0.75)
single parent families	dummy variable taking value one if there is no regular father figure or there is no natural mother	0.005 (0.066)	0.003 (0.059)
household financial problems	dummy variable taking value one if the family experienced financial difficulties	0.16 (0.20)	0.19 (0.28)
house size	number of rooms in household accommodation	4.09 (1.39)	3.79 (1.80)
family size	number of people in household	4.65 (2.45)	4.95 (2.35)

✓ school variables			
school composition	proportion of boys or girls studying for GCE and SCE O-levels in the school attended by the child at age 16, 9 bands, coded 1 to 9	4.89 (3.01)	4.75 (2.85)
school private	dummy variable taking value one if the school attended by the child at age 16 is private	0.15 (0.25)	0.09 (0.27)
school grammar	dummy variable taking value one if the school attended by the child at age 16 is grammar	0.06 (0.21)	0.03 (0.19)
school secondary modern	dummy variable taking value one if the school attended by the child at age 16 secondary modern	0.11 (0.30)	0.07 (0.34)
✓ neighborhood variables	(Census 1971)		
young population	Census ward proportion of persons aged less than 21	32.40 (13.99)	33.14 (15.12)
total population (thousands)	Census ward total residing population	53.45 (52.21)	53.53 (51.77)
unemployment rate	Census ward unemployed over active population	0.11 (0.05)	0.10 (0.07)
activity rate	Census ward active population (aged more than 15) over present population	0.62 (0.43)	0.59 (0.53)
professional employment	Local Authority professional and managerial employees over active population	0.16 (0.11)	0.18 (0.15)
unskilled employment	Local Authority unskilled manual employees over active population	0.07 (0.22)	0.10 (0.24)
agriculture employment	Local Authority proportion of workers in agriculture employment	0.01 (0.07)	0.02 (0.09)
amenities	Census ward proportion of households lacking or sharing hot water and/or inside toilet	0.09 (0.15)	0.08 (0.18)
car access	Census ward proportion of households with no car	0.18 (0.51)	0.19 (0.49)
n. obs.		998	1,568

Notes:

- GCE (General Certificate of Education)and SCE (Scottish Certificate of Education) O-levels (Ordinary levels) were taken at age 16 mainly by pupils in grammar schools and independent schools-nationally the top 20% of the population by ability

- A parent is the mother or the father or the person acting as mother or father respectively

- Mean values and standard deviations (in parentheses) are reported