Is there a spatial poverty trap? An empirical investigation of social housing neighbourhoods and school performance in England

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Abstract

This study exploits the exogenous nature of the timing of moving into social housing neighbourhoods that is a by-product of the long waiting times for social housing in high-demand areas in England. The resulting random differences in exposure times to low quality neighbourhoods are used to estimate neighbourhood effects on school performances. While this presents a new approach to measuring neighbourhood effects, the findings that young teenagers if anything benefit from moving into the worst social housing neighbourhoods has potentially wide-ranging implications for social housing policy in the UK.

1 Introduction

If it was true that living in a bad neighbourhood caused school results to deteriorate, this could in the extreme constitute a locking-in of the disadvantaged into a spatial poverty trap: 'once you get into a bad neighbourhood, you and your children won't get out'. Up to date, there is no consensus about the size and importance of these effects as they are notoriously difficult to quantify. The problem is that people choose where to live. Hence, own characteristics are potentially correlated with neighbourhood characteristics and unless one convincingly controls for the former, the latter cannot be identified.

This study exploits the exogenous nature of the timing of a move into social housing neighbourhoods that is a by-product of the long waiting times in some areas of England. This allows me to compare pupils who moved into statistically identical social housing neighbourhoods at different times. I also control for a

potential direct effect of moving. Constant family background characteristics and individual ability are captured in earlier test scores, while school fixed effects absorb school specific influences.

I demonstrate that once I control for moving into social housing neighbourhoods at some point, the negative finding of the 'standard' specification disappears. I find that that early movers into bad social housing neighbourhoods experienced significant positive effects on their school progress. At the same time, early and late movers into social housing neighbourhoods are balanced with regard to previous test scores and other background characteristics. Overall, this suggests that one way to control for unobservable characteristics in neighbourhood research is to compare like with like and to focus on temporal differentiation in situation where supply restrictions or other randomisation of the time of movement are present.

Note that this study does not address the question if neighbourhood effects are caused by role model effects or other forms of social interactions, but measures their overall size. Hence, rather than investigating the precise mechanisms through that neighbourhood effects could operate, this study focuses on the overall effect of moving into highly concentrated social housing neighbourhoods. These neighbourhoods belong to the worst neighbourhoods in England in terms of population density, qualification and unemployment level. Accordingly, more than 10% of social housing tenants in England are very dissatisfied with their neighbourhood, compared to about 3.5% for everyone else (Hills2007a:97).

The next section reviews the literature with an emphasis on methodological problems. I then explain in detail the specifications and identification strategy used by this study. Next, I present the data, the results and discuss their robustness. I conclude that my final specification constitutes a promising way for measuring neighbourhood effects. Furthermore my results challenge current social housing policy as they point to potentially significant opportunity costs of the promotion of mixed-income neighbourhoods.

2 A review of identification strategies

Recently, Economic Geographers have come up with new ways of empirically assessing the importance of neighbourhood effects, but there is still no consesus. Consider the following selection of studies: Gibbons (2002) finds significant but small neighbourhood effects, Goux and Maurin (2007) on the other hand find large effects, while Sanbonmatsu (et al. 2006) or Oreopoulos (2003) do not find any effects. In this section I explain the main problems in the estimation of neighbourhood effects. Rather than commenting on the findings of various studies I instead shortly review different identification strategies that are pursued by the recent literature. Before doing this, I re-visit the theoretical literature to outline the main identification problems.

One problem in the estimation of neighbourhood effects is that it is unclear if people are affected by neighbourhood outcomes or by neighbourhood characteristics. The former is Manski's (1993:532) 'endogenous effect', the latter the

'contextual effect'. As Moffitt (2001) demonstrates, identification is not possible unless additional information is available. However, as long as we are concerned with the pure existence of neighbourhood effects in the first place, and not with the specific mechanisms of how they work, this problem can be neglected. Moffitt (2001) shows that the following reduced form can be estimated where the coefficient of the neighbourhood effect is a combination of the endogenous and the contextual effect[1]:

1. $Y_{in} = \alpha + X_i\beta + X_n\gamma + S_n\psi + \mu_n + \varepsilon_{in}$

Here, Y_{in} is a school performance measure of individual i who lives in neighbourhood n. X_i denotes a vector of individual and family characteristics that influence school performance, like ability or the education of the mother, and Sn denotes school quality. X_n is vector of neighbourhood characteristics that also influence school performance. I follow Moffitt (2001:60) in denoting this vector with the letter X, in order to stress that these neighbourhood characteristics, similar to S_n, are potentially correlated to the own characteristics that have an influence on the pupil's school performance. That is, variables like the ability of children in the neighbourhood or the level of education in the neighbourhood are likely to be important here, too. X_n hence denotes averages of, say, ability of other people in the neighbourhood, excluding individual i. This quality of the neighbourhood is the "treatment" variable and that the estimation of γ is the main interest. Finally, note that the unobserved error term has two components. First, there is ε_{in} which is white noise. However, the second component μ_n captures neighbourhood specific unobservable variables that are potentially correlated with X_n. With $E[\mu_n X_n] \neq 0$ OLS produces biased estimates. Again using Manski's (1993:533) wording this is the "correlated effect". The main difficulty in measuring neighbourhood effects is to exclude this "correlated effect". The problem is that people sort into their neighbourhoods. Therefore, own outcomes, such as school performance, can be correlated with neighbours' outcomes even without any interaction effect .

Controlling for the "correlated effect" should be more feasible in a time-series framework. Consider the following specification, where Δ denotes changes between the (two) tests that are used to calculate the dependent variable:

2. $\Delta Y_{in} = \Delta\alpha + \Delta X_i\beta + \Delta X_n\gamma + \Delta S_n\psi + \Delta\mu_n + \phi_{in}$

This is the typical change-in-change specification that can be used to assess how changes in neighbourhood quality impact on changes in school per-

[1] Another problem is the so-called "reflection problem", which states that neighborhood quality can be endogenous if pupils lived together for a while. Since I focus on pupils who move this will not be further discussed here

formances[2]. Using value added or controlling for previous test scores on the individual level is certainly preferable to using a singular test scores as dependent variable. If test scores are not diluted by measurement error, then this setting controls for time-invariant test score and sorting related family characteristics, but also for constant individual ability and school quality.

The biggest problem for neighbourhood level studies in the time-series context is that neighbourhoods do not change much over time. In fact, Charles Booth's London poverty maps from 1889 highly correlate with contemporary neighbourhood level measures of social deprivation. As a result, neighbourhood effects studies that focus on the identification problem have almost exclusively analysed situations where people move. The problem is hence to identify situations where a move, which goes along with a change in neighbourhood quality, is truly exogenous.

A variety of approaches have been developed to overcome the sorting problem. First, there is the strategy to find instruments that are related to neighbourhood quality but not to sorting. Cutler and Glaeser (1997), for example, use variations in physical features like number of rivers as instrument for segregation. More recently, Goux and Maurin (2007) use the date of birth of neighbouring pupils, which is a determinant of educational success in France, to instrument for "neighbourhood quality". Overall, these studies tend to find significant negative neighbourhood effects.

Secondly, some studies focus on institutional factors that affect the sorting mechanism itself: Goux and Maurin (2007), for example, also argue that people in social housing are not free to choose the neighbourhood they live in, at least compared to everyone else. They think that assignment to social housing in France is random as waiting lists are very long and choice limited. Hence, they follow that social housing neighbourhood membership is exogenous and that the use of standard OLS-regressions is justified in order to estimate the contextual neighbourhood effect. However, they fail to control for differences in school qualities. If school quality is negatively correlated with social housing neighbourhoods, then this effect is mistaken as the neighbourhood effect. At least in the UK, "there is a systematic deficit in quality" [of schools] "precisely in the areas where a high-quality education in needed most." Lupton (2005:590). Hence, the "strong contextual effects" (2007:3) that Goux and Maurin find could simply be caused by differences in school qualities across neighbourhoods. Gibbons (2002) is another study that uses the idea that social tenants cannot sort into their neighbourhood and that the "neighbourhood status of any socially housed tenant is unrelated to their family resources" (p. 27). Even after controlling for school quality, Gibbons finds small but significant effects on the probability of gaining A-levels for social housing tenants in the 1970s. Another study by Brian Jacob (2004) uses public housing demolitions in Chicago as exogenous source of variation. He finds that pupils affected by the demolitions did not do any better or worse compared to their public housing peers. However, these pupils

[2]Error terms should be clustered at treatment level to avoid invalid t-statistics as demonstrated by Bertrand (et al. 2004).

also moved to neighbourhoods and schools very similar to the ones they had to leave. Hence, while Jacob identifies a situation where the decision to move seems exogenous, it does not create variation in the neighbourhood quality indicators. Therefore, he concludes that while he can say little about neighbourhood effects the relocation as such did not seem to have negatively affected school results. To summarize, studies that have an institutional identification strategy tend to find at best small negative effects.

Thirdly, fixed effects are used to control for sorting: Aaronson (1998) tries to identify neighbourhood effect in a time-series context by looking at differences between siblings. He finds small negative effects on school outcomes looking at families who move so that their siblings have different exposures to different neighbourhoods. The idea is that family characteristics proxy for unobservable characteristics that cause sorting. Looking at differences between siblings should then control for all family related observable and unobservable characteristics. However, timing is a problem here. The identifying assumption is that all family characteristics stay constant over time. This is questionable as the decision to move could very well be endogenous to unobserved changes in family characteristics. In particular, the decision to move must not be correlated with $\Delta\mu_n$ in equation (2), which denotes changes in unobservable like sorting preferences. Since residential relocation is rather the exception than the rule, it is difficult to argue that the reasons that people (suddenly) decide to move are uncorrelated to other changes in other factors that can influence children's school results. Attributing differences in educational success between siblings to differences in neighbourhoods can hence produce misleading results. Note that this is a general problem of the siblings-family fixed effects-approach. One the one hand, you have to compare children with a considerable age difference in order to maximise variation in the neighbourhood quality the children are exposed to, on the other hand choosing a larger time frame makes the assumption that family characteristics stay constant over the whole period even more problematic.

Finally, in order to find truly exogenous variation in neighbourhood quality, much attention has been paid to quasi-experimental voucher-schemes that allow people to relocate into better neighbourhoods. The best known recent example is the "Moving to Opportunity experiment". In the context of academic achievements (Sanbonmatsu et al. 2006) the findings are that there are no significant effects on school performances. In the experiment some families were randomly given vouchers that allowed them to move out of public housing into much better neighbourhoods with much better schools. The idea is that if neighbourhood effects exist, school performances of the children who moved should improve. However, the effect estimated is not the actual neighbourhood effect, but the effect of being given a voucher. The main problem is that not every family that was given a voucher in the Moving to opportunity experiment actually decided to move into a better neighbourhood. Basically, you cannot force families with vouchers to move. Hence, there is endogenous selection that can potentially bias the results. If families with vouchers who chose to stay differ to families with vouchers who chose to move, then we cannot simply attribute differences

in outcomes between families with voucher and families without voucher to differences in neighbourhood qualities. Hence, unobservable characteristics that differ between families with vouchers who moved and did not move could be mistaken for the neighbourhood effect.

To summarize, there are four main approaches: Some studies use instruments for neighbourhood quality, others focus on particular institutional settings that could randomise movements, a third group tries to control for unobservables with fixed effects and finally there are social experiments. As outlined, none of the existing studies is unproblematic and the basic problem to find the right comparison group remains.

Somewhat surprisingly, to my knowledge, Aaronson (1998) remains the only study to use the timing of a neighbourhood change to distinguish treatment from non-treatment groups. The approach developed by this study is a combination of ideas from Aaronson (1998) and an institutional story Gibbons (2002, Goux and Maurin (2007)) , which I discuss in the next section.

3 Identification

In order to find variation in neighbourhood quality that is exogenous, i.e. independent of own characteristics, this study focuses on people who move into social housing at different times. The rational is that social housing space is limited in most areas of England and people who successfully applied have very little influence on the specific micro-neighbourhood where they get a place. Regan (et al. 2001, executive summary, no page numbers) conclude in their qualitative study on housing choice and affordability in Reading and Darlington that "Moving within social housing was curtailed by allocation procedures and a lack of opportunity to move or swap properties". One of their interviewees in Reading, who rents from a social landlord complained: "Most of the people I know who have been offered flats or houses or anything have no choice... it is that or nothing" (2001:22). Quantitative evidence confirms that mobility within the social rented sector is extremely low (Hills, 2007a:109). Also, the significant reductions in social housing stock due the "right to buy" scheme introduced by Margaret Thatcher caused waiting lists to increase over the past decades[3]. There are currently nine million social housing renters and 4.5 million people on the waiting lists (Turley 2009).

To find exogenous variation in neighbourhood quality I exploit this fact that people who apply for social housing in England are not directly allocated a place but have to remain on waiting lists for quite a while. To ensure that waiting times are sufficiently long, I only include councils where at least 5% of the population have been on a waiting list in 2007 (Figure 3 shows these areas). This idea is that families on the waiting lists who first applied at different times should –on average- be very similar in their characteristics. That is, the timing of the move (not necessarily the decision to move itself, nor the

[3] More than 1.5m homes have been sold off since the scheme was introduced in the 1980s (Source: Communities and Local Government, official statistics).

wish to get into council housing) should now be exogenous. Pupils of parents who applied to social housing at different times should share similar observable and unobservable characteristics but have different "exposure"-times to a social housing neighbourhood as generated through the precise time of when they got a place offered. Note that this identification assumption is met even if people could influence the neighbourhood they move into. Hence, we only have to assume that the average characteristics of the people on the waiting lists and institutional factors (like discrimination) do not change over the study period. If this is the case, then Xn varies independently.

Figures 4 and 5 show that pupils who moved into social housing at different times are balanced with regard to their individual characteristics and treatments. In Table 4 I test if early movers differ from late movers into social housing more formally using a probit model and the observable pupil characteristics. Indeed, none of the individual observable characteristics shows a significant association to the likelihood of moving before rather than after the Ks3 test. In particular, there is no association to Ks2 scores. Note this holds even without using school fixed effects, something that I will be able to do in my analysis.

Following the route taken by Grogger (1995), who looks at differences in earnings for people who were imprisoned at different periods of times, I hence compare pupils who moved into social housing after taking the first, but before taking the second test, to pupils who moved into social housing after taking the second test. Formally, this reads:

$$
\begin{aligned}
3.\ Y_{i,t=05} = {} & \alpha + \gamma_1 D_{SH,T=03-05} + \theta_1 D_{t=03-05} + \theta_2 D_{SH,t=03-07} \\
& + \beta_1 Y_{i,t=02} + \beta_2 D_{changed\_school,t=03-05} \\
& + \beta_3 D_{\#years\_fsme\_eligible,t=03-05} \\
& + \beta_4 D^2_{(\#years\_fsme\_eligible,t=03-05)} + \beta_5 D_{male=1} \\
& + \psi(school\_pupil\_teacher\_ratio)_{t=03} + ethnicity\_controls\Delta\mu \\
& + \phi_{in}
\end{aligned}
$$

The dependent variable is the percentalised Ks3 test score. The first dummy variables equals one for pupils who moved into social housing between 2003 and 2005, that is before taking the Ks3 test. The second dummy equals one for all pupils who moved before the test, independent of the neighbourhood they moved into. This is to capture any potential effect of moving itself. The third dummy equals one for all pupils who moved into social housing between 2003 and 2007. $Y_{i,t=02}$ denotes the individual's Ks2 result at the end of primary school in 2002[4]. The other variables are self-explanatory. Note that the pupil-teacher ratio at school drops out once school fixed effects are included.

[4]Note that there is very limited scope for a "reflection problem" at the school level since the average pupil meets about 87% new peers at the start of secondary school (Lavy et al., 2009).

To summarize, specification (3) is a "lagged dependent variable difference-in-difference" specification. Including previous Ks2 test scores should capture the influence of all time-invariant characteristics. The first difference is then to compare people who moved into social housing at different times, before and after the Ks3 test. This is an additional safety net to ensure that I compare like with like. Finally, a potential effect of "just moving" is differenced away comparing these pupils to other pupils who move between non-social housing neighbourhoods. This also takes out any potential time-varying age-effect since all pupils have the same age in each year independent of the group they belong to. Hence, specification (3) should allow estimating the pure effect of moving into a social housing neighbourhood, which is captured by γ_1.

For comparative purposes I also ran regressions on non-movers and on movers, not controlling for belonging to the social housing group. The next section gives information on the institutional setting and presents the data.

4 Data and Background

The English school system is organised around four key stages, in which learning progress is assessed on the national level. Of interest for this study are the end of Key-stage 2 (Ks2) assessment at the end of primary/junior school, and the Key-stage 3 (Ks3) assessment, which assesses pupils' progress in the first three years of compulsory secondary school education (figure 1). The Ks2 assessment is at the age of 10/11, while the Ks3 is carried out at the age of 13/14. I focus on joint measures across the core subjects and use the average point performance. After creating percentiles of the Ks2 and Ks3 scores respectively, individual results between the two tests are directly comparable.

Since the 1996 Education Act each school in England and Wales is required to report census information to the Department for Children, Schools and Families (DCSF), formerly the Department of Education and Skills (DfES). From 2001 onwards this Pupil Level Annual School Census (PLASC) includes detailed pupil-level information, like the pupils' postcode of residence, information of ethnic background and the status regarding eligibility of free school meals (fsme)[5]. I use six consecutive years of the PLASC and track a cohort of individual pupils from their last year in Primary/Junior school in 2002 until 2007, when they were in their fifth year of secondary education.

Since I am interested in pupils who change their neighbourhoods over these years the next thing that I have to do is to identify everyone whose residential location changed over the years. In order to do this, I use the National Statistics Postcode Directory, until 2002 called All Fields Postcode Directory, which is maintained by the Office for National Statistics and matches all 2.3 million postcodes of the UK to their corresponding Output Area (OA) of the 2001 Census.

[5] People eligible for fsme are likely to receive Income Benefits, Job-seeker allowances and single parents with a dependent child. (Hobbs & Vignoles, 2007b). This variable is a proxy for the lowest income groups.

After this process, I am left with a sample of 505,465 pupils. All these pupils progressed to their fifth year of secondary education in the school year 2007, when they were aged 15/16. All of them completed the Ks2-assessment at the end of the academic year 01/02 and all of them completed the Ks3-assessment after their first three years of secondary education in the first half of 2005. Test results and information on the schools they attended is available[6], as well as their neighbourhood of residence measured on the Census 2001 "Output Area" (OA) level and changes of this on an annual basis. I am using the OA level, which is the smallest level of geography used by the Census. The average output area contains about 125 households, which is a reasonable definition of "neighbourhood". In particular, this scale is detailed enough to avoid the downward-bias that can occur in the calculation of neighbourhood effects if the level of aggregation is very large, as Goux and Maurin (2007) point out.

The next step is to identify those pupils who move. It turns out that of these 505.465 pupils about one third changes their residential OA at least once between 2002 and 2007. About 10% of the sample moved more than once.

Unfortunately, the PLASC does not contain any information on housing tenure. Hence, the next and crucial step is to identify who lives in a social housing neighbourhood and who does not. I do this using neighbourhood information from the 2001 Census of Population. The 2001 Census of Population is the most recent survey of all people and households living in England and Wales that is carried out every decade. A wide range of socio-economic variables was collected and made available at various levels of geographical aggregation[7]. I extract OA information on the total number of households that rent from the council (local authority) or a registered social landlord or housing association, the male unemployment rate, the level of education and the level of car ownership. While the latter variables are used as neighbourhood controls in some of my regressions, I use the former to calculate the percentage of households living in social housing for each OA. If for example 80% of all households in a particular OA live in social housing, then it is very likely that a pupil who lives in that OA also lives in social housing. Figure 2 shows a histogram of this percentage on the OA level for the year 2002. As we can see, only a minority of OAs has a large percentage of social housing households. There is hence a trade-off between sample size and accuracy of identifying who moves into social housing and who does not. The timing of movers into 100% social housing neighbourhoods must be exogenous, whereas movers into 0% social housing neighbourhoods are never constrained by social housing waiting lists on the other extreme. I decided to use 70% as the threshold level because neighbourhood quality variables such as the unemployment rate or qualification levels are very similar across 70%+ social housing neighbourhoods. In particular, Key-stage 2 scores of pupils in neighbourhoods with 70% of households living in social housing are literally

[6] I merged in the annual school census a.nd Edubase dataset, too. More information on these datasets: http://www.edubase.gov.uk/, http://www.teachernet.gov.uk/management/ims/datacollections/sc2008/

[7] For details visit the office for national statistics: http://www.statistics.gov.uk/census2001/about_census.asp

identical to pupils' scores in 90%+ neighbourhoods[8]. Therefore, everyone living in an OA with 70% or more households being in social housing is treated as living in a social housing neighbourhood, and all others are not. Of course, the choice of any threshold remains arbitrary to some extend. However, since postcode level data on social housing is not available there is no alternative. Using this threshold, by tracking OA-changes over the years it is now possible to identify those who moved out of an area with less than 70% of social tenants into an area with 70% or more households living in social housing. It is also known that mobility within the social housing sector is close to zero (Hills, 2007a:109). Hence I focus in my analysis on pupils who moved into an OA with more than 70% of households in social housing and stayed. From now on I will refer to this as "moving into a social housing neighbourhood".

Table 1 shows the movement patterns by year and neighbourhood. As we see, a total of 1.789 pupils moved into social housing neighbourhoods between 2003 and 2007. Moves were much more frequent in the period 02/03, both between non-social housing and into social housing neighbourhoods. The high numbers of pupils moving between 2002 and 2003 is likely to be a result of the primary to secondary school transition between these years. This is why my focus lies on movers between 2003 and 2007, that is the period within two years before and two years after the Key Stage 3 test.

Tables 2 and 3 give summary statistics of pupils who moved once. Table 3 illustrate the poor quality of the neighbourhoods and the underperformance of pupils who moved into social housing neighbourhoods. These children on average belong to the 37th percentile in their Ks2 score which clearly shows that they were underperforming even before they moved. The corresponding percentiles for non-social housing neighbourhood movers is the 48th. Figures 4a-4c show that this holds independent of the year of move. That is, pupils who moved into social housing neighbourhoods in the two years before taking the Ks3 test are literally identical to those moving into social housing neighbourhoods in the two years after taking the Ks3 test.

We can also see from the tables that neighbourhood quality indicators like unemployment rates or population density are much higher for pupils moving into social housing, while car ownership and qualification rates are much lower. Again, all pupils who moved into social housing experienced identical large negative changes in neighbourhood quality, independent of the year they moved. Non-social housing movers, on the other hand, moved between similar neighbourhoods.

In the next section I present my results.

[8] The average total English, Mathematics and Science Ks2- percentile score for pupils who lived in areas where over 70%, but less than 90% of households are social housing scored 118.97. On the average, pupils living in 90%+ neighbourhoods scored 123.19, while pupils in a less than 70% social housing environment scored 157.02.

5 Results

Table 5 presents a summary of the results of seven different regressions that link school performance to social housing neighborhoods. Regressions in table 6 do not focus on identification and simply correlate Ks3 results to the areas where the pupils lived in when they took the test in the year 2005. Tables 7 replicates the regressions from table 6 focusing on pupils who moved. I additionally control for belonging to the social housing mover group in Tables 7 columns (c) and (d). Table 7c shows the results for the specification (3) as outlined in the section on identification above, and Table 7d adds school fixed effects.

Tables 6 clearly show the negative correlation between living in a social housing neighborhood and Ks3 test results. Without controls, pupils in social housing neighborhoods score more than 15 percentiles lower than their peers (Table 6a). It is hence not surprising that this underperformance has been linked to neighbourhood quality in the past. However, this association reduces to 3 percentile points once a rich set of controls including Ks2 results are added (Table 6b). Once school fixed effects are added, this association reduces to 1.6 percentile points which suggests that social housing neighbourhoods have on average worse schools than non-social housing neighbourhoods. Whilst this is still a significant association, variables such as the number of years of free school meal eligibility –an income proxy- is much more important in determining school improvements.

However, recall that all these results are pure cross-sectional comparisons between pupils who live in social housing and non-social housing neighbourhoods at the time of the test. As discussed in the review of the literature, we expect that unobserved correlated effects bias these results. In particular we might capture effects of individual characteristics and school quality. The latter threat is excluded in table 6c by including school fixed effects. Here, pupils who live in social housing neighbourhoods are compared to pupils in non-social housing neighbourhoods who go the same school[9]. Hence, to summarize the results from this first specification: we see large and negative associations between neighbourhood quality and school results. These associations are reduced once we control for a rich set of background characteristics including previous test scores but remains strongly significant. However, we know that these results are likely to capture unobserved correlated effects and can hence not be interpreted as a pure neighbourhood effect.

Tables 7 replicates the specifications from table 6 using pupils who moved into social housing neighbourhoods to identify the neighbourhood effect. The findings in columns (a) and (b) are very similar to columns (a) and (b) from table 6. Without controls, for example, these pupils score about 13 percentile points lower than their peers in the Ks3. If anything, the associations between moving into a social housing neighbourhood and the test results are somewhat weaker compared to those who always lived in social housing. This is not surprising in a sense that pupils who moved into social housing neighbourhoods in the

[9] I also tried using area fixed effects but they make no difference once school fixed effects are used.

two years before the test had a lower exposure to the neighbourhood compared to pupils who always have lived there. Overall, however, the results are very similar to table 6, column (a) and (b) which suggests that pupils who move into social housing are not very different to pupils who have always lived in social housing at least as far as test scores are concerned. Again, there seems to be a robust negative association between moving into social housing neighbourhoods before the test and test results.

Finally, I also control for "moving into social housing" in the regressions displayed in table 7, colums (c) and (d). Here, the association between moving into a social housing neighbourhood before the test becomes positive. This means that although pupils who moved into a social housing neighbourhood before the Ks3 test underachieved, they underachieved less then their peers who moved into a similar neighbourhood after the Ks3 test. The effect becomes significant at the 5% level once school fixed effects are added. This strongly suggests that the previous negative associations between moving into social housing neighbourhoods were driven by unobservable characteristics common among the pupils who moved into social housing neighbourhoods at some point.

6 Discussion and Conclusions

This study exploits random differences in exposure times to social housing neighbourhoods that are a by-produce of the long waiting lists in high demand areas in England. These neighbourhoods belong the worst neighbourhoods in England in terms of socio-economic indicators like the unemployment level, car ownership rates and qualification levels. Nevertheless, this study finds that pupils benefitted from moving into these neighbourhoods earlier. After all, why should anyone want to get a social housing place if negative "aggregate effects" are to be expected? Under this light, the results of specification (3) are everything but surprising.

However, we have to be careful when interpreting this positive finding from table 7, columns (c) and (d). The existence of (small) negative neighbourhood effects cannot be ruled out. Indeed, it is possible that while true neighbourhood effects are negative, pupils experience a larger positive effect from moving into social housing. Although people who are living in social housing are above-average dissatisfied with their living conditions (Hills, 2007a:97), I cannot exclude the possibility that the quality of living space (for example, in terms of overcrowding) for those moving into social housing actually improved compared to whatever (temporary) accommodation they were living in whilst being on the waiting list. There could be an additional unobserved income effect due to the lower rental payments in social housing, even though I control for fsme-statuses. However, recall that answering these questions is not the focus of this study. What this study does is estimating a reduced form specifications, in which it is impossible to identify if the results, assuming for now that they are robust, measure effects of social housing neighbourhoods or of social housing membership or of the two. Rather, this study demonstrated the difficulties of measuring

(social housing) neighbourhood effects. All but my final specifications find significant negative associations between social housing neighbourhoods and school performances. The negative association only disappeared in my final and most robust specification that looks at differences-in-differences for early and late social housing movers, exploiting the randomness in the precise timing of the move that is caused by long social housing waiting lists. This suggests that all previous specifications fail to control for correlated unobserved characteristics. While my final reduced form specification does not allow differentiating social housing-specific from more general neighbourhood effects, it certainly highlights the appropriateness of the method. The application of this method must not remain limited to the social housing context but can be used in all situations where supply restrictions in a specific neighbourhood introduce randomness into the timing of residential moves.

There remains an important issue regarding the robustness of my findings. Future research should control for the measurement error in my social-housing neighbourhood identification. Following Angrist and Krueger (1995) and their split-sample IV estimation for returns to schooling, one half of the sample could be used to predict social housing membership (on the OA level) based on area characteristics. The fitted values of this first stage could then be used in a second stage of a TSLS regression using the other half of the sample. Simultaneously, once data for more PLASC-years becomes available, more cohorts (for example pupils aged 10 in 2003) could be added to the study to make up for the resulting reductions in sample size.

If my results are confirmed, then they have serious implications for the current UK social housing policy. The current government is in favour of mixed-income neighbourhoods and dispersed construction of social housing in order to avoid social stigmatisation or ghettoization of whole estates, basically: negative neighbourhood effects (Hills 2007a:179). Holmes (2006) concludes his report on the Mixed Income Communities Program of the Joseph Rowntree Foundation by judging the majority of their developments as a success, stating that these neighborhoods "[...] had become pleasant places to live, learn and work." (Key findings, no page number). Remarkably, this study showed that pupils benefited even from moving into a high-density, low-income, low qualification and highly concentrated social housing neighbourhood. These areas are certainly less 'pleasant places to live, learn and work', but there was still a small positive impact on the school progress of the 10-14 year olds. While everyone would certainly prefer to live in a mixed-income neighbourhood rather than in a high-density, low-income social housing 'hot-spot', we have to acknowledge that building low quality and high density is cheaper than dispersing social housing tenants into mixed-income neighbourhoods[10]. In times of severe shortages of social housing and limited resources for new constructions there is hence a trade-off between maximising the number of people who can be offered a place and maximising the neighbourhood quality of these places. This study demonstrated

[10] Apart from this it is unclear to me how mixed income neighbourhoods can be an equilibrium outcome in presence of sorting prefernces that produced the segregation that we observe nowadays.

that the opportunity costs of focussing on the latter might be large.

7 Bibliography

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Figures and Tables, Contents

Figure 1: The English School System

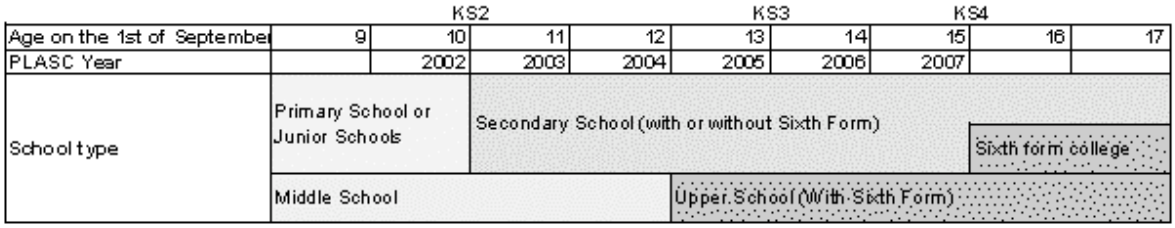


Figure 2: Histogram: % of households in social housing, by Output Area in England in 2002

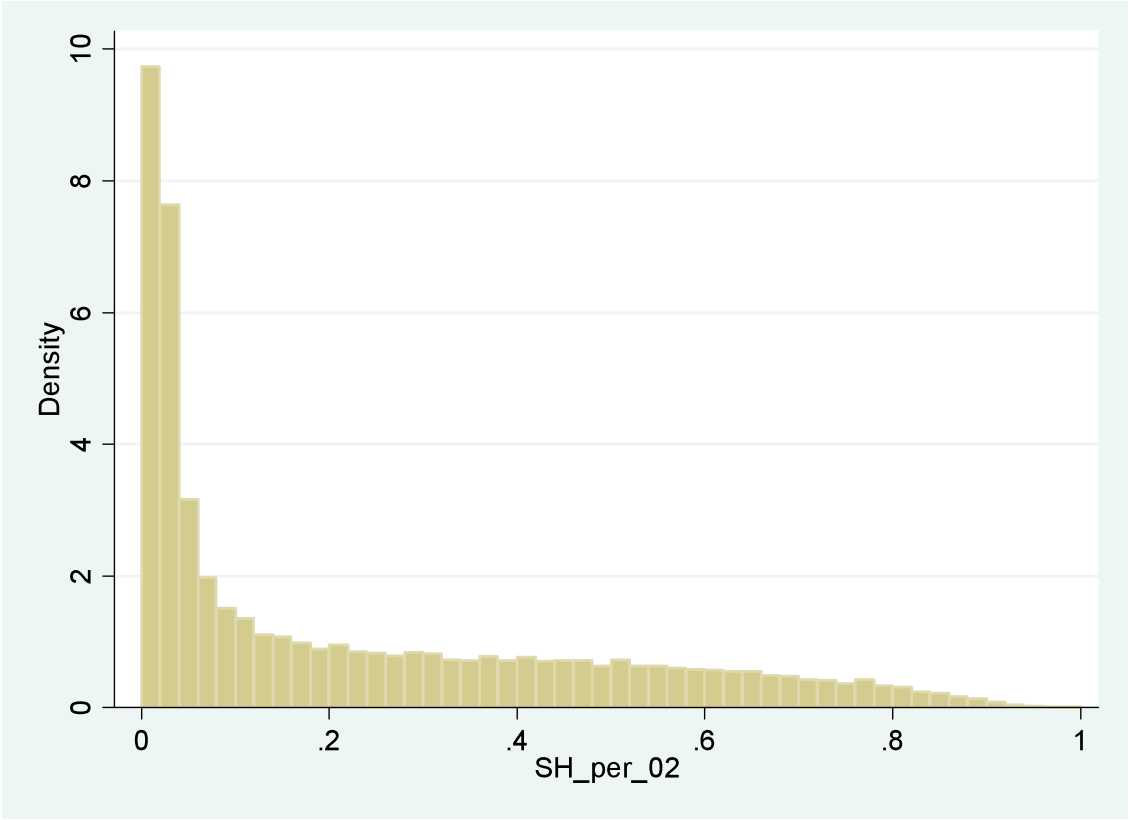
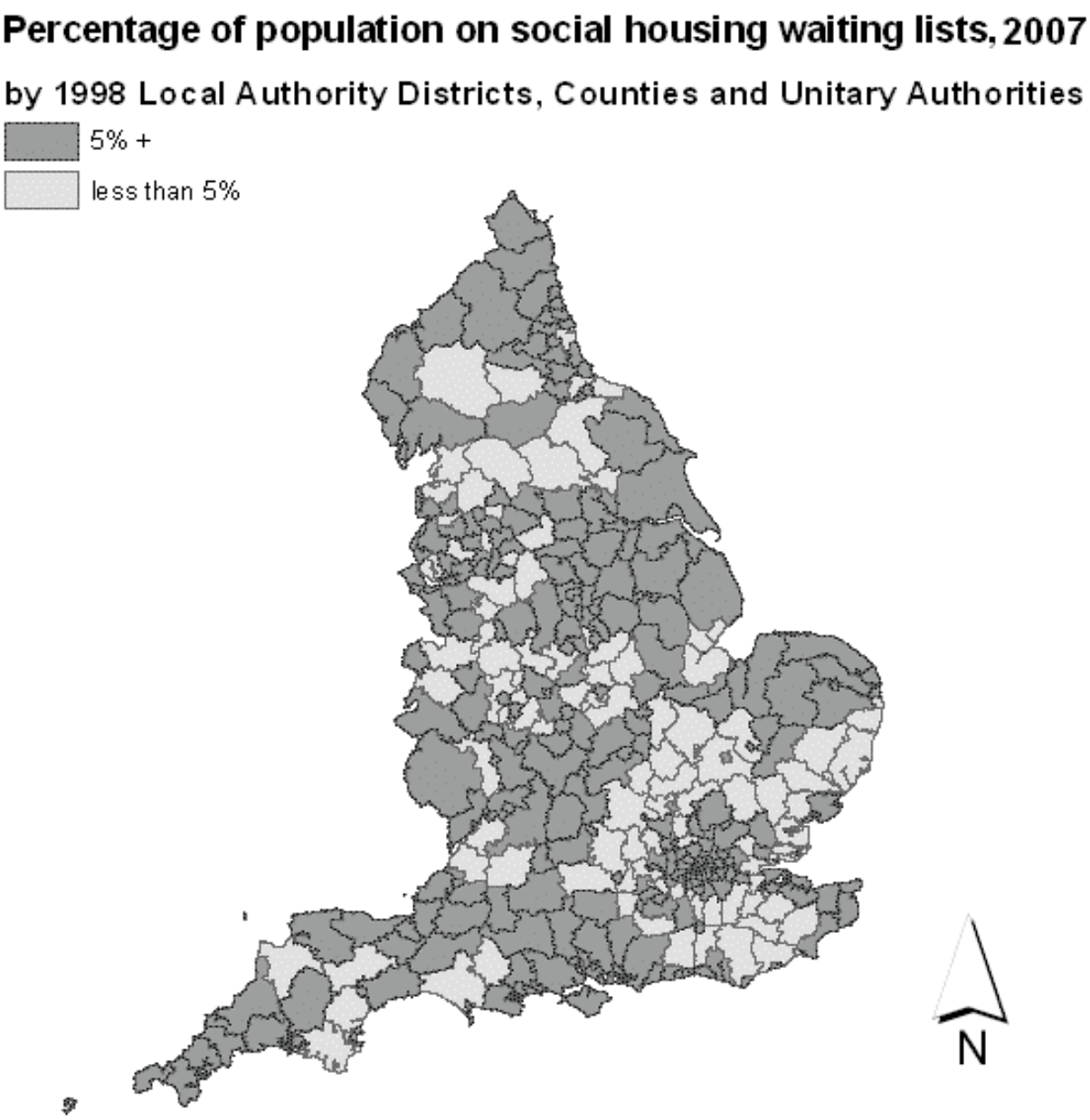


Figure 3:



Data Sources: Department for Communities and Local Government, "shapefile" from UKBORDERS.

Using a spatial match in ARC-GIS I identified all Census 2001 Output Areas with their centre in a local authority with less than 5% of the population on a waiting list and excluded pupils living in, moving from or moving to one of these OAs from the analysis.

Figure 4a: Balancing I

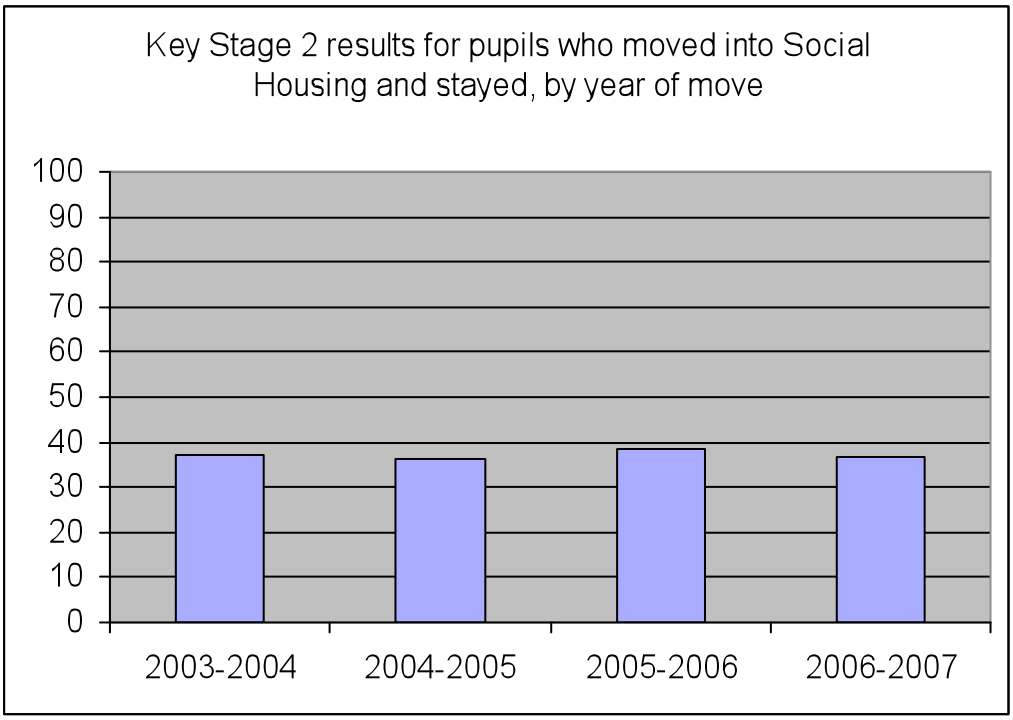


Figure 4b: Balancing II

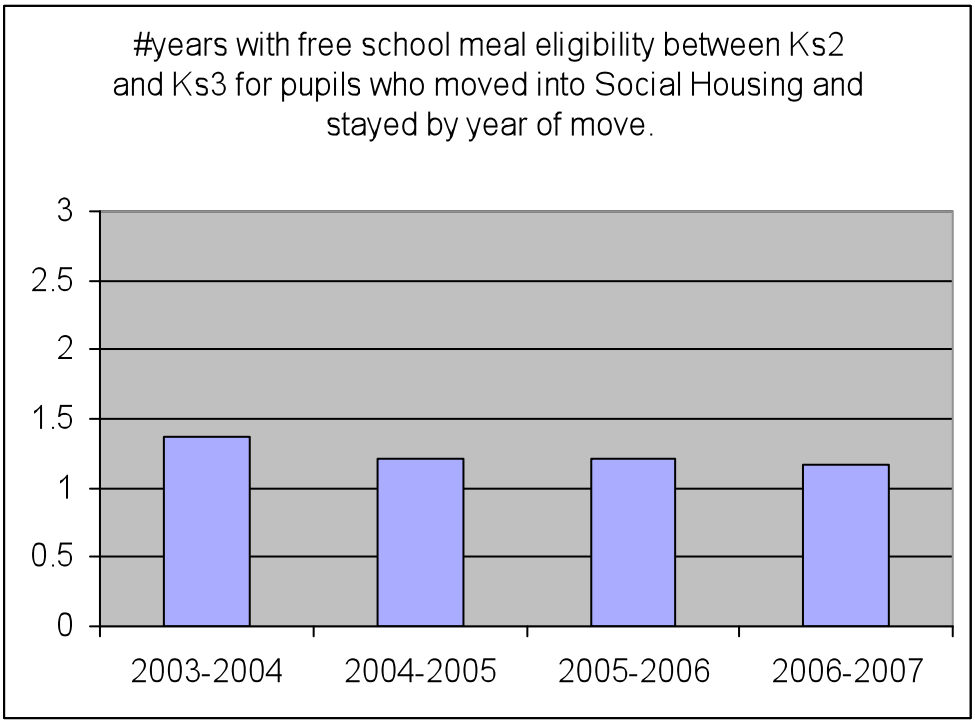


Figure 4c: Balancing III

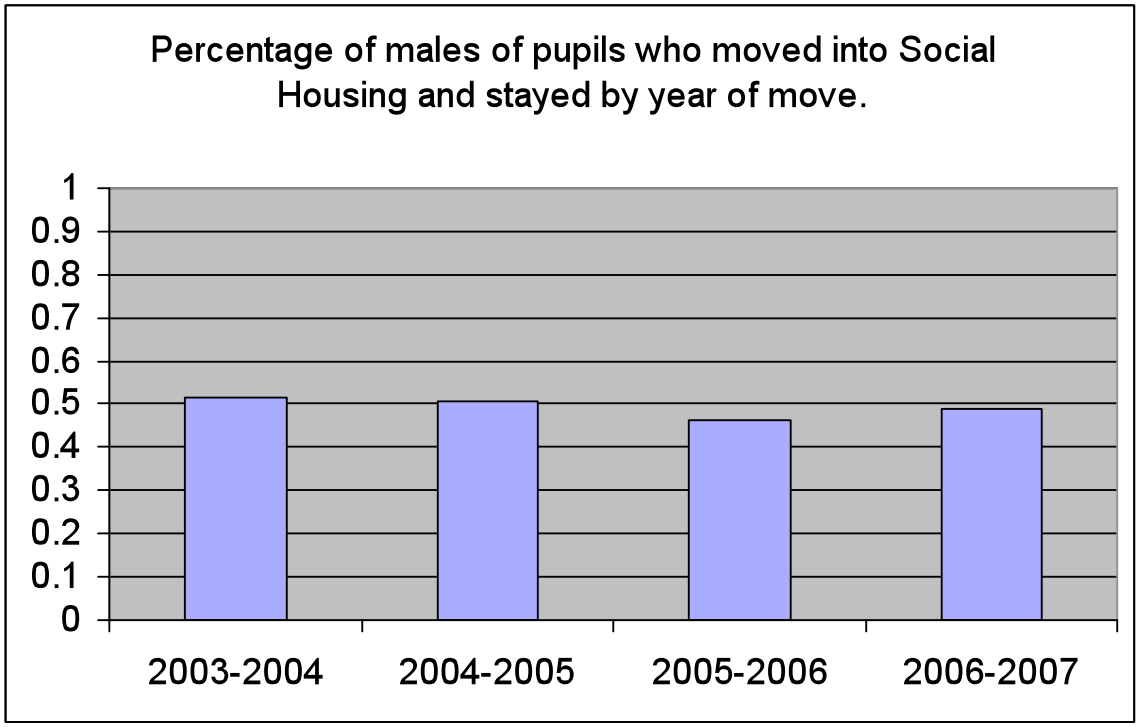


Figure 5a: Balancing of treatment I

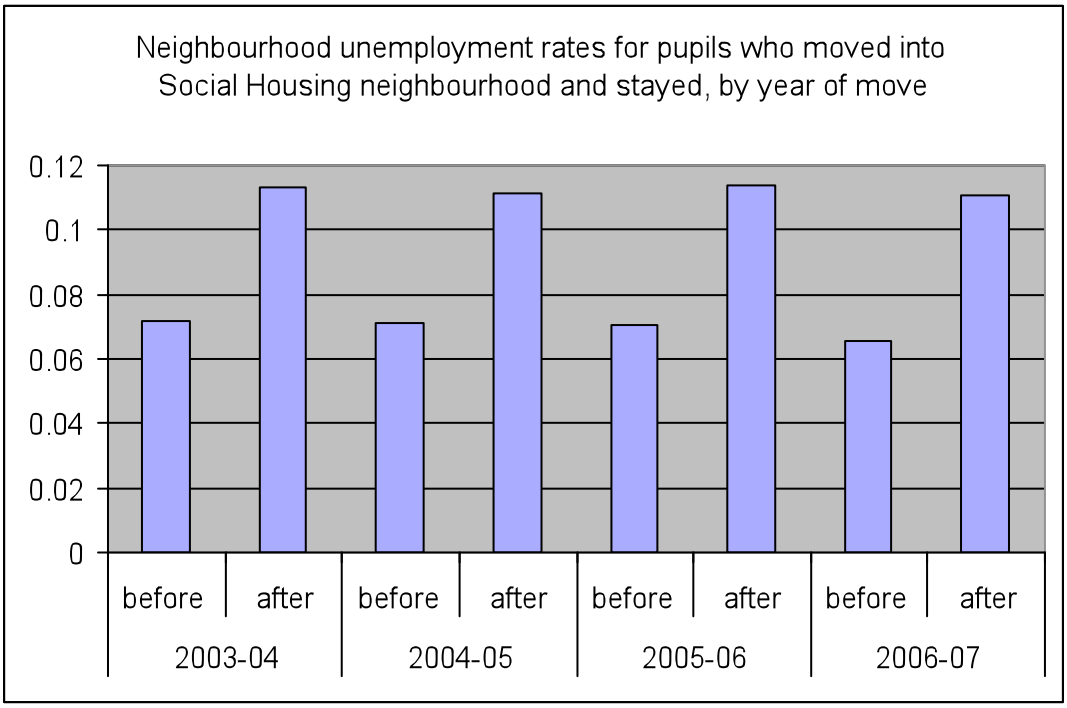


Figure 5b: Balancing of treatment II

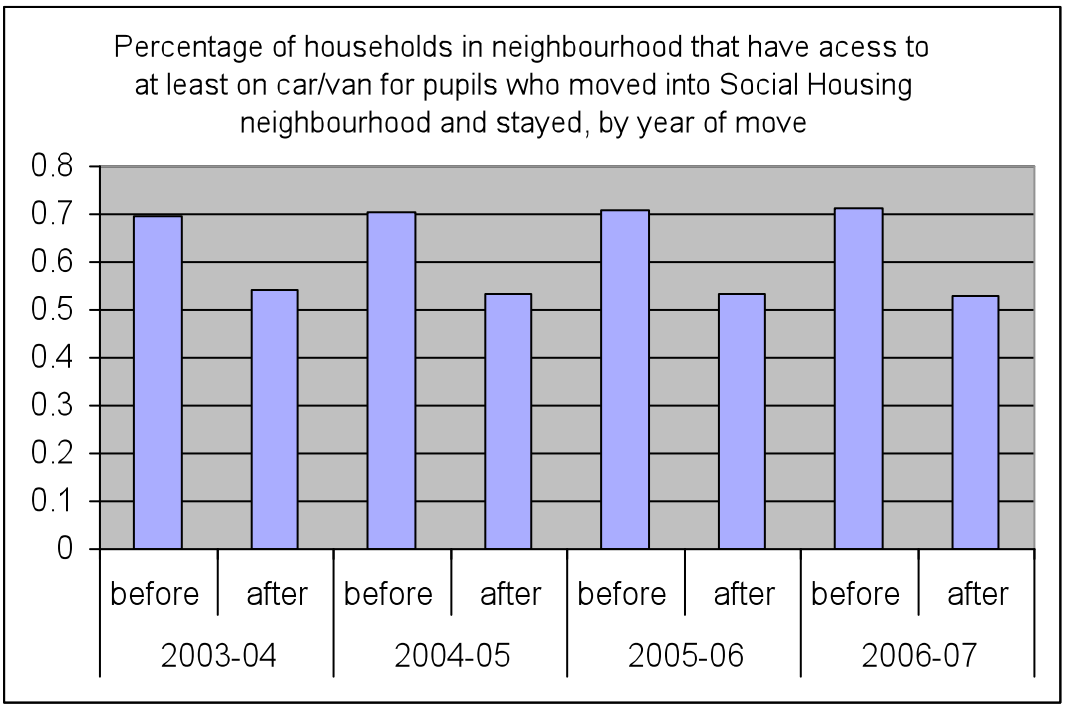


Figure 5c: Balancing of treatment III

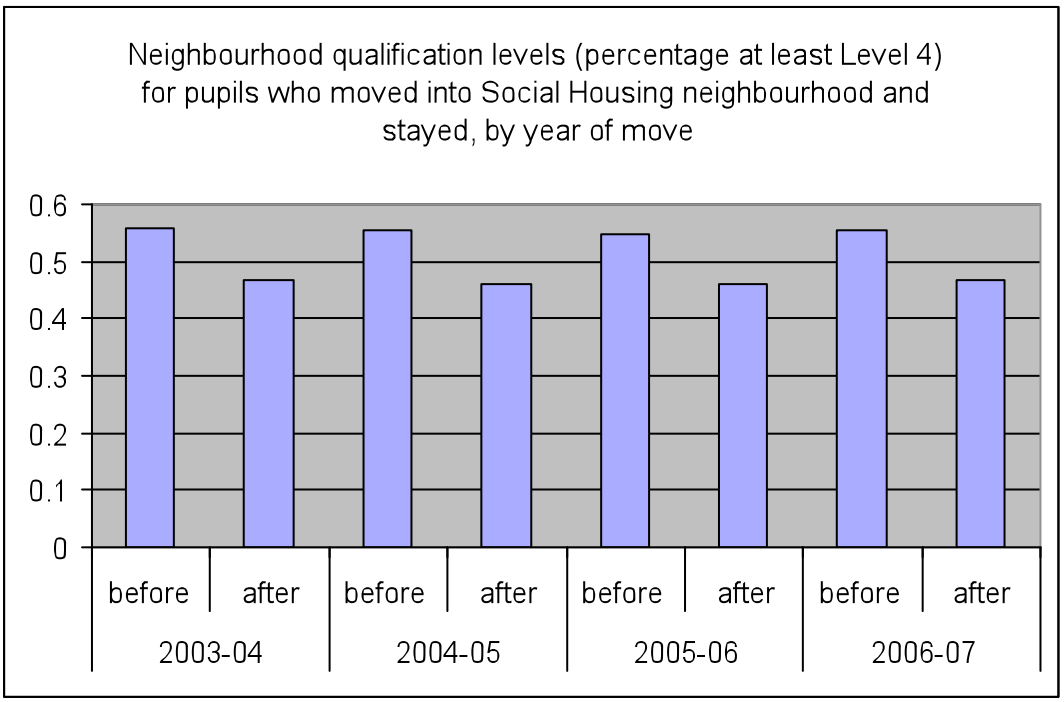


Table 1: Number of pupils who moved once between 2003 and 2007 by neighbourhood

	Moved into SH neighbourhood	Moved, but not into SH neighbourhood
2003-2004	534	14402
2004-2005	404	13258
2005-2006	381	10730
2006-2007	470	12997

Notes: Only pupils who always lived in Local Authority with more than 5% of population on Social Housing waiting list.

Table 2a: Summary statistics for pupils who did not live in a social housing neighbourhood in 2005 (KS3)

Variable description	Obs.	Mean	Std. Dev.	Min.	Max.
Key Stage 2 Score	348836	50.498	28.673	1.000	100
Key Stage 3 Score	348836	49.824	26.537	1.000	100
Changed secondary school before KS3	348836	0.128	0.334	0	1
Changed school and also moved	348836	0.058	0.233	0	1
Number of moves	348836	0.506	0.807	0	5
Number of years eligible for free school meals, 02-05	348836	0.440	0.969	0	3
Gender (male=1)	348836	0.503	0.500	0	1
Teacher to pupil ratio in first secondary school	348836	16.034	1.951	0.870	0.118
Ethnicity-White British Isles	348836	0.837	0.370	0	1
Ethnicity-Other White	348836	0.017	0.128	0	1
Ethnicity-Asian	348836	0.061	0.240	0	1
Ethnicity-Black or Chinese	348836	0.029	0.167	0	1
Ethnicity-Mixed	348836	0.003	0.053	0	1
Ethnicity-Other	348836	0.023	0.149	0	1
Ethnicity-Unknown	348836	0.007	0.081	0	1
Percentage of households in neighbourhood with access to car or van	348836	0.840	0.140	0.187	1
Neighbourhood unemployment rate	348836	0.043	0.035	0	0.360
Neighbourhood population density (people/m2)	348836	50.359	41.941	0.015	2086
Percentage in neighbourhood with Level 4+ qualification (further degree)	348836	0.622	0.187	0.167	1

Notes: Key stage scores are percentiles computed on the whole cohort. Only pupils who always lived in Local Authority with more than 5% of population on Social Housing waiting list.

Table 2b: Summary statistics for pupils who moved between non-social housing neighbourhoods (2003-2007).

Variable description	Obs.	Mean	Std. Dev.	Min.	Max.
Key Stage 2 Score	51387	47.954	28.339	1	100
Key Stage 3 Score	51387	46.950	26.209	1	100
Changed secondary school before KS3	51387	0.194	0.395	0	1
Changed school and also moved	51387	0.147	0.354	0	1
Number of moves	51387	1	0	1	1
Number of years eligible for free school meals, 02-05	51386	0.531	1.039	0	3
Gender (male=1)	51387	0.498	0.500	0	1
Teacher to pupil ratio in first secondary school	51378	16.080	2.010	7.867	0.118
Ethnicity-White British Isles	51387	0.820	0.384	0	1
Ethnicity-Other White	51387	0.018	0.132	0	1
Ethnicity-Asian	51387	0.062	0.240	0	1
Ethnicity-Black or Chinese	51387	0.038	0.191	0	1
Ethnicity-Mixed	51387	0.003	0.051	0	1
Ethnicity-Other	51387	0.025	0.158	0	1
Ethnicity-Unknown	51387	0.008	0.091	0	1
Percentage of households in neighbourhood with access to car or van	51387	0.825	0.154	0.094	1
Neighbourhood unemployment rate	51387	0.047	0.039	0	0.345
Neighbourhood population density	51387	52.162	50.546	0.015	1874
Percentage in neighbourhood with Level 4+ qualification (further degree)	51387	0.615	0.131	0.1756	1

Notes: Key stage scores are percentiles computed on the whole cohort. Only pupils who always lived in Local Authority with more than 5% of population on Social Housing waiting list and moved once between 2003 and 2007.

Table 3a: Summary statistics for pupils who lived in a social housing neighbourhood in 2005 (KS3)

Variable description	Obs.	Mean	Std. Dev.	Min.	Max.
Key Stage 2 Score	20285	37.298	26.661	1	100
Key Stage 3 Score	20285	34.580	23.943	1	100
Changed secondary school before KS3	20285	0.111	0.314	0	1
Changed school and also moved	20285	0.052	0.223	0	1
Number of moves	20285	0.573	0.849	0	5
Number of years eligible for free school meals, 02-05	20285	1.410	1.334	0	3
Gender (male=1)	20285	0.492	0.50	0	1
Teacher to pupil ratio in first secondary school	20283	15.954	2.182	.870	0.118
Ethnicity-White British Isles	20285	0.694	0.461	0	1
Ethnicity-Other White	20285	0.032	0.175	0	1
Ethnicity-Asian	20285	0.061	0.240	0	1
Ethnicity-Black or Chinese	20285	0.126	0.331	0	1
Ethnicity-Mixed	20285	0.005	0.072	0	1
Ethnicity-Other	20285	0.039	0.195	0	1
Ethnicity-Unknown	20285	0.020	0.139	0	1
Percentage of households in neighbourhood with access to car or van	20285	0.523	.121	0.094	0.973
Neighbourhood unemployment rate	20285	0.111	0.047	0	0.372
Neighbourhood population density	20285	110.458	135.292	0.487	2602
Percentage in neighbourhood with Level 4+ qualification (further degree)	20285	0.477	0. 109	0.163	0.893

Notes: Key stage scores are percentiles computed on the whole cohort. Only pupils who always lived in Local Authority with more than 5% of population on Social Housing waiting list.

Table 3b: Summary statistics for pupils who moved into a social housing neighbourhood between 2002 and 2007.

Variable description	Obs.	Mean	Std. Dev.	Min.	Max.
Key Stage 2 Score	1789	37.139	26.333	1	100
Key Stage 3 Score	1789	34.028	23.473	1	99
Changed secondary school before KS3	1789	0.182	0.386	0	1
Changed school and also moved	1789	0.134	0.341	0	1
Number of moves	1789	1	0	1	1
Number of years eligible for free school meals, 02-05	1789	1.245	1.313	0	3
Gender (male=1)	1789	0.496	0.500	0	1
Teacher to pupil ratio in first secondary school	1789	16.026	2.182	7.870	0.667
Ethnicity-White British Isles	1789	0.763	0.425	0	1
Ethnicity-Other White	1789	0.028	0.165	0	1
Ethnicity-Asian	1789	0.050	0.219	0	1
Ethnicity-Black or Chinese	1789	0.086	0.280	0	1
Ethnicity-Mixed	1789	0.002	0.047	0	1
Ethnicity-Other	1789	0.039	0.194	0	1
Ethnicity-Unknown	1789	0.014	0.117	0	1
Percentage of households in neighbourhood with access to car or van	1789	0.620	0.164	0.209	1
Neighbourhood unemployment rate	1789	0.091	0.051	0	0.289
Neighbourhood population density	1789	75.744	70.033	.130	1244
Percentage in neighbourhood with Level 4+ qualification (further degree)	1789	0.505	0.124	.170	0.973

Notes: Key stage scores are percentiles computed on the whole cohort. Only pupils who always lived in Local Authority with more than 5% of population on Social Housing waiting list and moved once between 2003 and 2007.

Table 4: Balancing on individual characteristics: pupils who moved into Social Housing neighbour-hoods in the two years before the Key Stage 3 test vs. in the two years after

	Table 6a
Key Stage 2 score	-0.0025
	(-0.22)
Number of years fsme eligible 02-05	0.0392
	(1.68)
Gender (male==1)	0.091
	(1.52)
Ethnicity-White British Isles	0.0727
	(0.33)
Ethnicity-Other White	-0.162
	(0.29)
Ethnicity-Asian	0.159
	(0.26)
Ethnicity-Black or Chinese	-0.054
	(-0.22)
Ethnicity-Mixed	0.102
	(0.27)
Ethnicity-Other	0.191
	(034)
Ethnicity-Unknown	(omitted)
Pupil to teacher ratio (2003)	-0.0061
	(0.01)
School FX	No

Notes: Dependent variable equals one if pupil moved before KS3 in sample where everyone moved once and into Social Housing, hence either before or after KS3. Obs: 1785. Probit regression. Only pupils who always lived in Local Authority with more than 5% of population on Social Housing waiting list.

Table 5: Summary of outcomes (tables 6a to tables 7d).

	Table 6a	Table 6b	Table 6c	Table 7a	Table 7b	Table 7c	Table 7d
Effect of living in SH neighbourhood before the KS3 test	-15.52 (0.18)**	-3.05 (0.11)**	-1.59 (0.10)**	-	-	-	-
Effect of moving into SH neighbourhood before the KS3 test	-	-	-	-12.63 (0.82)**	-2.02 (0.48)**	0.94 (0.56)$^{+}$	1.27 (0.53)*
Controls	No	Yes	Yes	No	Yes	Yes	Yes
School FX	No	No	Yes	No	No	No	Yes
Controlling for "moving into social housing"	No	No	No	No	No	Yes	Yes

** sig. at 1%, * sig. at 5%, $^{+}$sig. at 10%. Only pupils who always lived in Local Authority with at least 5% of the population on a Social Housing waiting list in 2007.

Table 6: Key Stage 3 performance living in a social housing neighbourhood

	(a)	(b)	(c)
Lived in a social housing neighbourhood for at least one year in 2003-2005	-15.52 (0.18)**	-3.05 (0.11)**	-1.59 (0.10)**
Key Stage 2 score	-	0.77 (0.001)**	0.747 (0.001)**
Changed secondary school 03-05	-	1.024 (0.102)**	-2.06 (0.154)**
Number of moves	-	-0.758 (0.031)**	0.911 (0.15)**
Number of years fsme eligible 02-05	-	-4.760 (0.12)**	-3.40 (0.11)**
(Number of years fsme eligible 02-05)squared	-	0.945 (0.04)**	0.689 (0.04)**
Gender (male==1)	-	-1.425 (0.05)**	-1.277 (0.045)**
Pupil to teacher ratio (2003)	-	-0.275 (0.013)**	(absorbed)
Ethnicity-Unknown	No	Yes	Yes
School FX	No	No	Yes

Notes: Over 369000 obs., errors clustered at treatment level. Only pupils who always lived in Local Authority with more than 5% of population on Social Housing waiting list. ** sig. at 1%, * sig. at 5%, $^{+}$sig. at 10%.

Table 7: The effect of moving into a social housing neighbourhood

	(a)	(b)	(c)	(d)
Moved once and into social housing neighbourhood between 2003-2005	-12.63 (0.82)**	-2.018 (0.48)**	0.95 (0.55)$^{+}$	1.26 (0.53)*
Moved once between 2003-2005 but between non-social housing neighbourhoods	-1.68 (0.17)**	0.237 (0.089)**	0.021 (0.09)*	0.17 (0.084)*
Moving into social housing 2003-2007	-	-	-2.98 (0.29)**	-1.94 (0.28)**
Key Stage 2 score	-	0.773 (0.001)**	0.773 (0.001)**	0.747 (0.001)**
Changed secondary school 03-05	-	1.056 (0.103)**	1.052 (0.103)**	0.834 (0.15)**
Number of moves	-	-0.803 (0.313)**	-0.789 (0.031)**	-0.68 (0.03)**
Number of years fsme eligible 02-05	-	-5.03 (0.117)**	-5.01 (0.117)**	-3.48 (0.112)**
(Number of years fsme eligible 02-05)squared	-	0.99 (0.04)**	0.985 (0.04)**	0.70 (0.039)**
Gender (male==1)	-	-1.42 (0.045)**	-1.42 (0.045)**	-1.27 (0.045)**
Pupil to teacher ratio (2003)	-	-0.273 (0.013)**	-0.273 (0.013)**	(absorbed)
Ethnicity-Unknown	No	Yes	Yes	Yes
School FX	No	No	No	Yes

Notes: over 369000 obs, errors clustered at treatment level. Only pupils who moved from and into Local Authority with more than 5% of population on Social Housing waiting list. ** sig. at 1%, * sig. at 5%, $^{+}$sig. at 10%.