I (DON'T) LIKE THE WAY YOU MOVE:

THE DISRUPTIVE EFFECTS OF RESIDENTIAL TURNOVER ON STUDENT ATTAINMENT

Stephen Gibbons*, Olmo Silva** and Felix Weinhardt***

-- Preliminary and incomplete --

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Author for correspondence:
Olmo Silva,
Department of Geography and Environment,
London School of Economics,
Houghton Street, WC2A 2AE, London, UK.
Tel.: 0044 20 7955 6036
Email: o.silva@lse.ac.uk

* Department of Geography and Environment, Centre for Economic Performance and Spatial Economics Research Centre, London School of Economics; and IZA, Bonn.

** Department of Geography and Environment, Centre for Economic Performance and Spatial Economics Research Centre, London School of Economics; and IZA, Bonn.

*** Centre for Economic Performance and Spatial Economics Research Centre, London School of Economics; and IZA, Bonn.

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Abstract:

Economists naturally believe that residential mobility is good from an individual's perspective, as well as for labour markets more generally. Little attention has however been paid towards the potential negative externalities that could arise from of high levels of mobility. Recent work has shown that there are disruptive and significantly negative effects on pupils in schools that experience high levels of turnover. This paper is the first to test for negative externalities at the neighbourhood level, which could arise because of disruption, the break-up of strong neighbourhood ties and social disorganisation. Using detailed census data we show that students who do not move experience negative effects on test score value added between age 11 and age 14 from high levels of neighbourhood turnover. This has important implications for the way economists generally think about the benefits from residential mobility.

Keywords: Education, neighbourhood, mobility, turnover, social capital.

JEL Classifications: C21; I20, R23.

1. Introduction

As economists, we are inclined to regard geographical mobility of people as a good thing, with high rates of mobility important for well-functioning and efficient markets. Geographical mobility of people offers opportunities for individual investment in human capital and adjustment to geographical changes in economic structure (Greenwood, 2007; Sjaasted, 1962). In contrast, researchers from other disciplines such as sociology and urban studies have emphasised that movements of people can, at the same time as generating benefits, impose considerable personal and external (social) costs in terms of human capital development. These external costs might fall on other members of a person's family, on their friends, their neighbours or community.

Sutherland (1924) was among the first to suggest that higher levels of neighbourhood turnover break down strong ties among local residents, trigger 'social disorganization' and increase criminality. His initial insights stimulated a long line of related theoretical and empirical work in sociology; see among others Shaw and Mackay (1969) and Sampson and Byron Groves (1989). With the urban study field, Jacobs (1961) was prominent in suggesting that neighbourhood turbulence can negatively affect children's well-being and learning. Similarly, residential mobility features as an important barrier to the accumulation of personal human capital in theories of 'social capital' (the antithesis of social disorganisation), because the 'social relations that constitute social capital are broken at each move' (Coleman 1988, p.S113). This frequent fracturing in social relations in high mobility neighbourhoods presumably affects everyone in the community, not just those who move, leading to social as well as private costs.

These sociological concepts of social disorganisation and social capital (and related concepts of social cohesion and collective efficacy) have filtered down to thinking in our field through the economics of social interactions, peer groups and neighbourhood effects. However, theoretical work in this area in economics has focussed on the influence of group members' behaviour and characteristics on the outcomes of other members of the group, rather than on the influence of the rate of turnover of group members. Likewise, empirical work has largely focussed on measuring the effects of neighbourhood and peer group composition on individual outcomes. There is ample work of this type on the role of poverty, levels of education, ethnicity and numerous other neighbourhood characteristics, the best of which tends to suggest that neighbourhood composition is not very relevant for schooling performance, labour market outcomes and other indicators of 'economic self-sufficiency' (Sanbonmatsu et al., 2012; Gibbons et al., 2013). However, to the best of our knowledge, no previous work has looked at the specific causal influence of residential turnover. This is an important omission given the explicit role of community stability in the theories of social disorganization and social capital, and their counterparts in the economics of social interactions.

Our research fills this gap by studying to what extent the educational achievement of children is affected by the residential turnover of their neighbours. Given its focus on residential mobility, our work clearly slots in and contributes to the empirical literature on 'neighbourhood effects'. However, by estimating the external effects of neighbourhood turnover, we move the attention to important – but as yet ignored – questions about the social costs of mobility.

In order to investigate these issues, we use administrative data on the educational record of over 1.5 million school children in England tracking the educational progress of four cohorts as they transit from the end of primary to the middle of secondary schooling. Our data contains information on pupils' test scores, schools attended at different grades, background characteristics and detailed information on place of residence, which allows us to calculate changes in home address. We use these data to estimate the effect of neighbourhood residential turnover amongst children of similar age on a child's own educational progress in tests between ages 11 and 14. Our empirical strategy involves regression analysis with a high dimensional set of neighbourhood, school and cohort effects to control for unobserved factors that simultaneously affect turnover rates and student achievement. We also limit our estimation sample to students who stay in the same neighbourhood between ages and 11 and 14. This allows us to identify the effect of movers on stayers – i.e. the effect of externalities associated with mobility – while controlling for the effect of individual own mobility.

Even in highly saturated specifications with a full range of fixed effects and covariates, we find that neighbourhood turnover negatively affects educational progress. A twelve percentage point increase in annual turnover (about one standard deviation) causes a 0.6% of a standard deviation reduction in test score gains between ages 11 and 14. This effect is relatively small when scaled against other factors that have sometimes been shown to affect student progress, such as teacher quality or class sizes. However, this estimate stems from mobility over the first three years of secondary education, and pupils spend up to 11 years in compulsory education. Thus the cumulated effect of mobility over the course of a child's education could more substantial and up to three times larger considering the full span of compulsory schooling. Note also that this effect is not caused by turnover in schools or by changes in neighbourhood composition, which, in sharp contrast, we showed to have zero impact in previous work (Gibbons et al., 2013). The effects we estimate are solidly linked to residential turnover, providing some support for traditional sociological ideas that fragile community ties lead to unfavourable individual outcomes.

Besides providing a novel twist to the growing research on 'neighbourhood effects', our work contributes to the literature on mobility and individual outcomes. Much of this evidence concerns the private costs and benefits of mobility, i.e. the effects of mobility on the movers, rather than its externalities. A number of papers have found lower social capital amongst those undertaking more frequent residential moves (e.g. Pribesh and Downey, 1999), although experimental evidence suggests this relationship may be due to negative selection, with those least able to form social ties being more likely to move (Pettit and McLanahan, 2006). Hilber (2010) looked at the effects of home-ownership on social capital, a factor closely linked to lower rates of residential turnover. His evidence shows that home ownership increases individual involvement in community activities, echoing previous evidence in Di Pasquale and Glaeser (1999). There is also evidence showing that children who move frequently (changing residence and/or school) have worse outcomes on various dimensions – including educational attainment (Coleman, 1988; Haganet et al., 1996; Hanushek et al., 2004). However, other studies have found beneficial long-run effects (Hango, 2006) – though the direction of causality is open to question and selection effects can potentially explain these differential outcomes (Pribesh and Downey, 1999). Work aimed at identifying the causal neighbourhood effects of turnover – i.e. the external impact – is instead almost non-existent. Empirical work on 'social disorganisation' has established conditional correlations between neighbourhood turnover and crime in several different contexts, but has not got very far in establishing causality. A small literature exists on the external effects of turnover of children in schools, finding that higher rates of mobility have significant adverse effects on other children's subsequent achievement, both in the US (Hanushek et al. 2004) and England (Gibbons and Telhaj 2011). However, this approach has not been taken to investigating the social cost of neighbourhood turnover. Our work constitutes the first attempt at identifying the causal externality effect of neighbourhood mobility on students' outcomes.

The paper is structured as follows. Section 2 describes our data sources and the general institutional context. Section 3 sets out the empirical specification and the identifying assumptions. Section 4 describes the results and Section 5 (preliminary) concludes.

2. Context and Data

Our analysis is based on state-school students in England during the first three years of their secondary education. Compulsory primary education in England runs from age 5 (grade 0) to age 11 (grade 6), while compulsory secondary education runs from age 12 (grade 7) through to age 16 (grade 11). During our study period, students in England took a series of compulsory national assessments at age 7 (grade 2/Key Stage 1/KS1), at age 11 (grade 6/Key Stage 2/KS2) and age 14 (grade 9/Key Stage 3/KS3). At age 16, students take their end-of-compulsory education qualifications (GCSEs and equivalents). However, due to data limitations, in our study we do not analyse data on students beyond KS3.

School admission is closely, but not exactly, linked to place of residence. The exact details vary by school, school district (Local Education Authority, LEA) and have changed over time. However, the general picture for the period of our analysis was that admission to state schools at both the primary and secondary phase was based on principles of parental choice, although in practice parents' 'freedom to choose' is constrained by the fact that popular schools become over-subscribed. When this occurs, various criteria are used to prioritise students, usually favouring those who live nearby, those with special educational needs, or those with siblings in the school. Certain types of school can prioritise students according to other criteria – e.g. religion (faith-schools) or specific aptitudes (music and other specialist schools). A small proportion of state secondary schools select on prior achievement (Grammar schools), but students in these schools are excluded from our analysis. In general, for non-faith 'community' schools, parents apply to schools via the local authority, while for faith schools application is often made directly to the school. As result of these features of the admissions system, there is not a one-to-one link between place of residence and school attended, and neighbouring children may attend many different schools. These details are important for our analysis of the effects of residential turnover amongst similar age peers as it means that high residential turnover does not necessarily imply high school turnover, and vice versa.

Our main data source is administrative data on students in England at the beginning of their secondary school careers taken from the National Pupil Database (NPD). We use records from the NPD for four cohorts of students taking their KS3 assessments in 2005, 2006, 2007 and 2008, sitting for their KS2 tests three years earlier in 2002, 2003, 2004 and 2005, and taking KS1 exams in 1998, 1999, 2000 and 2001. The NPD provides various pieces of information on the students including test scores in English, Mathematics and Science at KS2 and KS3; assessments in English and Maths at KS1; background characteristics, including gender, eligibility for free meals, special educational needs and ethnicity; schools attended and their characteristics; and postcode of residence. Using the latter detail, we assign pupils to Census Output Areas (OAs) which constitute small neighbourhoods hosting on average 125 households and approximately 5 children of the same age.

Our main estimation focuses on a sub-set of these students, namely those who stay in the same residential neighbourhood – defined by the Census Output Area (OA) – over the years between their KS2 tests and KS3 tests. More precisely, the stayers are defined as students whose home address is recorded in the same OA in the year they take their KS2 tests and in year they take their KS3 tests, and in the two intervening years. For the remaining students in the NPD who move over the KS2- to -KS3 period, we still have complete information on place of residence, characteristics and test scores. We use these students to construct neighbourhood turnover rates specific to each cohort, as well as changes in the neighbourhood composition between KS2 and KS3 driven by this residential mobility. Neighbourhood-by-cohort turnover rates are built from the inflow and outflow of same-age students in a given cohort (i.e. students taking their KS3 tests in a given year), within each student's residential census OA and aggregated over the three years between KS2 and KS3 tests. More specifically, for each cohort, the OA outflow is added to the inflow over these three years and divided by the number of pupils in the OA at time of the KS2 tests to create a turnover rate. In some robustness checks, we also look at the effects of inflow and outflow rates separately. Note that we restrict the sample to individuals with non-missing information in all periods of our investigation, so that variation in neighbourhood mobility and neighbourhood characteristics is not driven by students dropping in and out of our sample, but only by residential changes.

Other information on housing prices and demographic characteristics is merged in with this pupil level data using the residential postcodes and OAs. These data sources provide us with information on more than 1.2 million students who stay in the same residential neighbourhood between ages 11 and 14. The next section discusses the empirical specifications used for estimation of the effects of neighbourhood turnover on these students' achievements.

3. Empirical specification

The aim of our empirical work is to estimate the external effect of neighbourhood mobility on students' educational attainment during secondary schooling. Estimating this relationship requires controlling for a number of potential pupil-level, school-level and neighbourhood-level unobservables that might be correlated with both pupils' outcomes and neighbourhood turnover. To formalize our discussion, we assume a simple linear educational value-added in which educational progress (test score gains) between KS2 and KS3 for student *i*, living in neighbourhood *n*, belonging to cohort *c*, and attending schools *s2* at KS2 and *s3* at KS3 depends on residential turnover in the student's home neighbourhood in the years between their KS2 and KS3 assessments (mob_{nc}). Furthermore, pupil value-added is affected by student, neighbourhood and school characteristics that are observed in our data (x_{incs}), as well as a combination of unobserved factors at the individual, neighbourhood, school and cohort level. These are potentially correlated with neighbourhood turnover and we allow them to affect test score progression very flexibly through a function *f(.)*. Finally, pupil value-added is affect by a random error term (ε_i) uncorrelated with all other factors.

Putting this all together, our empirical model takes the following form:[1]

$$(KS3-KS2)_i = mob_{nc}\beta + x'_{incs}\lambda + f\left(\sigma_i, \nu_n, \tau_c, \upsilon_{s2}, \upsilon_{s3}\right) + \varepsilon_i \qquad (1)$$

[1] Appendix I provides more details about the analytics leading to this model specification.

In our empirical application, we estimate Equation (1) on the subset of students who do not move neighbourhood between KS2 and KS3, so *n* is fixed for a given student *i*. This restriction means that individual student's own mobility between KS2 and KS3 does not enter into Equation (1). This allows us to focus on the external effects of turnover on stayers. Note that cohort *c* defines a group of students that are in the same school grade at the same point in time, and each cohort is effectively identified by the year when students took their KS3 tests (either 2005 or 2006 or 2007 or 2008). Since there is no grade repetition in England, these students are and remain in the same one-year age cohort throughout the period. In Equation (1), $KS3-KS2_i$ is the gain in individual student test scores averaged across English, Mathematics and Science between Key Stage 2 and Key Stage 3. In the empirical analysis, these test scores are standardised by converting to percentiles within the national student distribution for cohort *c*.

The focus of our interest is on the estimation of β, which we would like to interpret as the expected change in students' test score gains caused by an exogenous change in neighbourhood residential turnover during the years between the two sets of tests. The fundamental challenge to consistent estimation of β is that neighbourhood-cohort turnover mob_{nc} is likely to be correlated with the unobserved determinants of these test score gains in *f(.)*. This correlation occurs because residential mobility and student achievement are affected by similar unobserved factors, and students that differ in unobservable ways will sort into high and low turnover neighbourhoods. For example, mobility could be generally higher in areas populated by low-income/socioeconomic groups, with higher rates of job and family separation, and with a high incidence of short term rental housing. Residential sorting would imply that these factors also characterise a student's own family situation and hence have direct effects on student's achievement. Furthermore, as discussed in Section 2, England has a system of geographically constrained school choice, so residential turnover could also be related to local school quality (e.g. teaching quality, resources, and composition) through the school-choice processes. This implies that turnover in the neighbourhood might be correlated with turnover in schools – which has been shown to have direct effects on pupil achievement (Hanushek and Rivkin, 2004; Gibbons and Telhaj, 2011). Note that school-related effects are particularly pertinent in our context, because we study the period from KS2 to KS3 when students move between primary and secondary school, so there is considerable school-choice related mobility.

Our identification strategy exploits the detail and size of our data – coupled with institutional features of schooling in England – to control for the unobserved factors in *f(.)* as far as is feasible through a variety of neighbourhood, cohort, primary- and secondary-school fixed effects. In particular, the data allow us to include OA neighbourhood effects because we have multiple cohorts. In this case identification comes from the variation in neighbourhood-by-cohort turnover between cohorts. Furthermore, school or school-by-cohort fixed effects can also be included in our specification because, as explained in Section 2, there is not a one-to-one mapping between the neighbourhood where a child lives and the school they attend. Pupils of the same age and living in the same OA attend, on average, two to three different secondary schools. Secondary schools usually attract pupils from more than 60 OAs. This institutional feature allows us to control for primary or secondary school-by-cohort effects and primary-by-secondary-by-cohort effects. On the other hand, it is infeasible to include individual fixed effects directly, because we only observe the KS2-KS3 change in test scores once for each student. However, controlling for neighbourhood fixed effects eliminates unobserved individual effects α_i assuming that the composition of the neighbourhood in terms of mean α_i does not change between cohorts over our period of study, i.e. i.e. $E[\alpha_i|n,c] = E[\alpha_i|n,c+1]$ for all c. Given our focus on stayers (and some balancing regressions we will present later) this assumption does not seem untenable.

In addition to these fixed effects, some specifications include a selection of conditioning variables in x_{incs} drawn from what we observe in our data. Individual characteristics include gender, KS1 (age-7) attainments, free school meal entitlement and special education needs. These characteristics are recorded in the year a student takes their KS2 tests and are treated as fixed/predetermined. We also control for variation in neighbourhood characteristics by including neighbourhood-by-cohort changes in the means of the individual students' characteristics between KS2 and KS3. These measures are computed including moving individuals who effectively drive the neighbourhood changes in these predetermined measures. In some specification we further append the initial levels of the neighbourhood characteristics to account for any correlation between cohort-specific turnover and the cohort-on-cohort variation in the initial characteristics of residential areas. Finally, in most specifications we include neighbourhood-by-cohort turnover rates for three-year lagged cohorts – i.e. turnover of primary school children who took their KS2 assessments in

2005, 2006, 2007 and 2008 (and will take their KS3 assessments in 2008, 2009, 2010 and 2011). These primary-schooling neighbourhood-by-cohort turnover rates are constructed in an analogous way to the KS2-to-KS3 mobility rates described in Section 2, but aggregating the flows of children moving into and out of each OA over the four years prior to KS2 in 2005, 2006, 2007 and 2008. We use this variable to capture the effect of neighbourhood shocks not accounted for by the inclusion of neighbourhood effects in our differentiated model that might drive both test score progression and turnover.[2]

Our identifying assumption in estimating Equation (1) is that the year-to-year changes in neighbourhood, cohort-specific residential turnover are uncorrelated with the unobserved determinants of student achievement, once we condition on a highly exhaustive set of neighbourhood, school and cohort effects. We assess our identifying assumptions by examining sensitivity of the estimates of β to different combinations of these fixed effects and covariates. Moreover, we present 'balancing' tests that show that observable neighbourhood-by-cohort and individual characteristics are uncorrelated with neighbourhood turnover once we condition on appropriate neighbourhood fixed effects. Finally, we present some falsification tests where we replace our mobility measure with proxies calculated over primary school pupils or based on pupils who are either one year older or one year younger than the students under analysis. This extensive battery of tests suggests that our results are not spurious but causally linked to pupil value added.

4. Results

4.1. Descriptive Statistics

Descriptive statistics for our estimation sample of residential stayers are presented in Table 1. The sample has 1.2 million students evenly spaced over four cohorts and living in around 133,000 OAs. The top panel of the table tabulates individual characteristics. The percentiles of the KS2 and KS3 test scores are based on the full set of stayers and movers, and have a mean of 50.5 and standard deviation of 29 by construction.

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[2] Note that the control variable set includes school characteristics such as the size of the school attended at the beginning of secondary school (in grade 7) and school-type dummies (also referring to the school attended in grade 7 and including: Community, Voluntary Aided, Voluntary Controlled, Foundation, CTC and Academy) when school effects are not included. The exact details of each specification are set out in the Results section.

The value-added in the full dataset has a mean of zero. The descriptive statistics in Table 1 show that the sample of stayers is broadly representative of the overall national sample (also compare figures in Gibbons et al., 2013, Appendix Table 1), though stayers have marginally lower KS2 achievements (by 0.46 percentiles), higher KS3 achievements (by 0.64 percentiles) and hence a slightly higher value added (by 1.11 percentiles). Evidently, movers have lower educational progress than stayers, which is consistent with the literature that shows that frequent home moves are associated with lower educational achievements. However, we do not go any further here in trying to establish the causality in this relationship.

Panel B presents descriptive statistics for the neighbourhoods of residence. These show that the average rate of annual turnover between KS2 and KS3 (grade 6 to grade 9) is 14.5%, split between 6.4% outward mobility and 8.1% inward mobility. On average approximately 5.3 pupils of the same age live in the same census OA neighbourhood. Turnover amongst primary school children, from grade 3 to KS2 (grade 6) is slightly larger at 20.4%. The fact that residential mobility is higher in primary school years has been previously documented in the UK (see Machin et al., 2006). The table also shows the change in neighbourhood composition for the stayers' sample. There is little overall change in the neighbourhood means of KS1 scores, or FSM, SEN and male proportions. Given that during this period there were no evident national trends in these variables, this suggests neighbourhoods with stayers are not changing in ways that are significantly different from those of neighbourhoods without any stayers.

Figure 1 uses histograms to display the extent of variation in KS2-to-KS3 neighbourhood turnover in the stayers' sample. The top-left plot shows that, although nearly 20% of the neighbourhood-by-cohort observations experience no mobility, there is a substantial amount of variation overall. The remaining plots show the distribution of the residuals from regressions of mobility rates on the various sets of fixed effects employed in the main regression analysis below. These plots show that there is considerable variation in neighbourhood-by-cohort turnover rates even when we control for either secondary school-by-cohort fixed effects (top right) or primary-by-secondary-by-cohort fixed effects (bottom left), or neighbourhood fixed effects (bottom right). The numbers in the notes to the figure show that the standard deviation in turnover rates changes little as we control for school-by-cohort effects, from 0.128 down to 0.110. The within-neighbourhood standard deviation of turnover rates is only slightly lower at 0.098. This shows that approximately 60% of the neighbourhood-by-cohort turnover variation occurs within the same neighbourhood and over time.

4.2. *Main findings from the regression analysis*

Our main set of results is presented in Table 2. The table reports regression coefficients and standard errors. Columns (1), (3), (5) and (7) do not include any control variables, whereas Column (2), (4), (6) and (8) include individuals' own characteristics as well as school information, changes in neighbourhood composition and primary-school-pupil mobility. More details are provided in the notes to the Table. Note that we allow for some spatial and temporal autocorrelation and heteroskedasticity in the error term of students living within the same OA, and report standard errors that clustered at this level.

The first set of estimates in Columns (1) and (2) present regression results that link pupils' value added to neighbourhood turnover between KS2 and KS3. We find that higher levels of neighbourhood turnover have a negative, significant and sizeable association with pupil test score progression. A one standard deviation change in turnover is associated to about 4% of a standard deviation change in value added. However, these regressions to do not control for the effect of school-by-cohort and neighbourhood unobserved factors on test-score progression, and thus are likely to be a biased estimate of the externality effect of neighbourhood mobility.

Column (3) and (4) append to our specifications primary-by-secondary-by-cohort effects. These account for any correlation between neighbourhood turnover in the years between KS2 and KS3 and school factors – such as composition, resources and mobility – that pupils experience upon transition from primary to secondary school and might affect their educational progress. Accounting for these unobservables reduces our estimates by a factor of five. We now find that the association between value added and neighbourhood turnover is around -0.78, or a standardized effect of 0.6%. Importantly, adding individual and neighbourhood controls to these specifications does not substantially changes our results (compare Columns (3) and (4)). This suggests that changes in neighbourhood turnover are balanced with respect to these additional controls once we account for school-by-cohort effects.

Column (5) and (6) replace primary-by-secondary-by-cohort effects with neighbourhood effects and thus rely on the cohort-on-cohort variation in turnover. Our results still show a negative and significant association between pupil test score progression and neighbourhood mobility, implying that one standard deviation increase in neighbourhood mobility reduces pupil value added by 0.4% of a standard deviation. Although this seems small effect, pupils spend 5 years in secondary education, and up to 11 years in compulsory education. So the cumulated effect of average annual mobility over the course of their education could substantially larger (up to nearly three times). When we further add secondary school-by-cohort effects to our specifications as in Columns (7) and (8), our estimate is only slightly reduced to around -0.37 and stays significant.[3] This still represents approximately a 0.35% of a standard deviation change in pupil value-added vis-à-vis a one standard deviation change in turnover. Note that, across Columns (5) to (8), adding controls for individual and neighbourhood observables does not substantially affect our findings. This reinforces our claim that turnover in the residential areas is balanced with respect to pupil and neighbourhood characteristics once neighbourhood and school unobservables have been accounted for, and suggests that our estimates pin down the causal external effect of neighbourhood mobility. In the next section, we present more evidence to support this statement.

4.3. Balancing, robustness checks and further results

In Table 3 we tabulate the balancing properties of our proxy for neighbourhood turnover. In particular, in Panel A, we regress our neighbourhood-by-cohort mobility measure on pupil baseline characteristics. Next, in Panel B, we study the relationship between cohort-specific measures of secondary school quality and neighbourhood turnover. These include average KS1 and average KS2 test scores at the school where students start their secondary education, i.e. measured in grade 7; the standard deviation of KS2 test scores at the beginning of secondary school; and secondary school size (also recorded in grade 7). Finally, in Panel C, we study the link between neighbourhood turnover and other proxies for neighbourhood quality not

[3]Including primary-by-secondary-by-cohort dummies and neighbourhood effects proved computationally unfeasible, so our specification only include secondary-by-cohort and neighbourhood effects. Regressions that only include secondary school-by-cohort dummies yields results close to those presented in Columns (3) and (4) of Table 2 and including primary-by-secondary-by-cohort dummies.

included in the specifications of Table 2. These include: the cohort-specific number of schools opening and schools closing within 5km of a pupil's residence; the percentage of pupils attaining the governmental target of five GCSEs exams (age-16) at the A* to C level averaged across all schools attended by pupils living in the neighbourhood; the absence rate (including both authorized and unauthorized absences) of secondary schools attended by pupils living in the neighbourhood; and the finally average price of houses sold in the OA of a pupil's residence corrected for difference in the composition of the housing transactions using hedonic regressions on basic house characteristics.[4] Column (1) of the table presents regressions that only control for cohort effects. Column (2) instead includes neighbourhood effects and thus relies on the same variation used in Columns (5) and (6) of Table 2 to estimate the effect of neighbourhood turnover.

The estimates in Column (1) of Table 3 show that there is a significant and sizeable association between neighbourhood mobility and a host of individual, school and neighbourhood attributes. The sign of these relations suggests that areas with higher levels of turnover are inhabited by more disadvantaged pupils who attend more disadvantaged schools, and that these neighbourhoods command lower prices. However, once we include neighbourhood effects as in Column (2), all the coefficients shrink substantially and most of them (11 out of 13) become statistically insignificant. This suggests that the variation we use to estimate the external effect of mobility on pupils' value added in unlikely to be related to other individual, school and neighbourhood aspect and that the estimate we discussed above present a well-identified external effect of neighbourhood mobility on pupil value added.

To further validate this intuition, we perform an extensive set of falsification and robustness checks. These are presented in Table 4. To start with, in Column (1), we relate student value added to neighbourhood mobility calculated using primary school children (and unconditional on the mobility of secondary schools students). This test shows no significant association between pupil test score progression and neighbourhood mobility.[5] Next, in Column (2) of the table, we include our usual mobility measure

[4] These characteristics include housing type (detached, semi-detached, terrace, flat, bungalow), year and month of transaction, legal status (freehold or leasehold) and new/resale property. This information is obtained from the Land Registry administrative dataset that covers all property sold and purchased in England.

[5] Note that we include this variable as a control in the specifications in the even columns in Table 2, where our focus is on KS2-to-KS3 turnover. Even then, we do not detect any significant association between primary school turnover and value added (conditional on secondary school turnover).

alongside neighbourhood turnover proxies computed using pupils who are one year younger and pupils who are one year older than the cohort in consideration. We find that the size and significance of the relationship between pupil value added and own-cohort mobility remain unaffected and similar to the one presented in Column (6) of Table 2. Conversely, we find no evidence that mobility of older or younger pupils has a negative effect.[6] All in all, the first two columns of Table 4 strongly suggest that it is only the turnover of students of the same age that affects value added and not other neighbourhood unobservable factors driving at the same time the residential mobility and pupil achievements.

One possible concern with the value-added specifications presented in Table 2 is that they restrict pupil KS2 lagged test scores to have full persistence on current KS3 outcomes. This might be problematic if *(i)* neighbourhood turnover is related to some transitory shocks that positively affect the performance of all pupils in the neighbourhood; *(ii)* this shock drives some pupils to leave the neighbourhood while other remain and then 'mean-revert' to lower levels of attainment (in relative terms) by the time they reach KS3. If this was the case, estimating a restricted value-added specification would attribute the effect of transient shocks and mean-reversion to neighbourhood mobility. In order to address this concern, in Column (3) of Table 4 we estimate an unrestricted value added model where we instrument the lagged dependent variable – i.e. KS2 test scores – using earlier KS1 (age-7) test scores. This approach yields a larger negative estimate of the effect of neighbourhood mobility at approximately -0.43.

Next, in Column (4) and (5) of the table, we consider separately the effect on inwards and outwards mobility. Both are found to have a negative and significant size of a very similar magnitude. Interestingly, inwards mobility has a somewhat larger and more precisely estimated effect than outwards mobility. This shows that our findings are not picking up a spurious effect driven by neighbourhood shocks and unobserved trends (e.g. gentrification) that drive the 'best' households out of certain areas and leave them populated only with pupil on negative value-added trajectories.

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[6] The correlation between mobility in the current cohort and turnover among younger and older pupils is low and always below 0.20. This is because our neighbourhoods are small and there is a substantial amount of year-on-year variation in mobility rates.

Columns (6) and (7) append additional controls to our specifications. Column (6) includes the initial levels of the neighbourhood composition measured at the time of KS2 on top of the changes in neighbourhood characteristics between KS2 and KS3 (the latter being driven by pupil mobility). This does not affect our findings. Column (7) adds dummies for pupils' own ethnic groups (8 categories) as well as averages of the incidence of different ethnicities at the time of KS2 and their changes between KS2 and KS3. This also does not affect our findings. Finally, Column (8) drops the 30% smallest neighbourhoods with less than 4 pupils. This restriction does not affect our conclusions so far: neighbourhood turnover is negatively and significantly associated with pupils' test score progression between KS2 and KS3.

In a set of unreported results, we also studied whether the effect of turnover is non-linear by including quadratic and cubic terms of our mobility measure. We failed to find any significant pattern. We also studied whether mobility between KS2 and grade 7 has a differential effect from mobility between grade 7 and grade 8, and turnover between grade 8 and KS3. We found that the joint effect of these three proxies was significant and negative, and that a test for the three effects to be the same clearly accepted the null. Finally, we appended to a specification equivalent to the one reported in Column (6) of Table 2 a mobility measure based on residential changes calculated over larger neighbourhood measures, namely Lower-Level Super Output Areas (LSOAs). These contain typically contain 4 to 6 OAs (and so between 20 and 30 pupils of the same age). We found that mobility measures calculated over these wider neighbourhoods were not significantly associated with pupil value added. Conversely, the relationship between turnover at the OA level and KS2-to-KS3 value added remained significant, negative and of a magnitude similar to the one discussed so far.

4.4. Heterogeneity by individual and area characteristics

In Tables 5 and 6, we investigate whether our results differ for pupils with different background characteristics (Table 5) or living in areas with different characteristics (Table 6). The results in Columns (1a)-(1b) to (2a)-(2b) of Table 5 indicate that mobility has a larger detrimental effect for boys relative to girls, and for pupils on free school meals. However, these differences are not significant at conventional levels, while tests for the joint significance of the coefficients on the pairs (e.g. boys and girls) rejects the null of no effects. Columns (3a)-(3b) show that pupil without special-education needs lose out more than pupils with strong educational disadvantages, but this difference is once again not significant. The opposite picture emerges from Columns (4a)-(4b) which show that pupils with early test scores in the bottom half of the distribution are more negatively affected by neighbourhood mobility than pupils in the top half. However, we find that once again this difference is not statistically significant.

Table 6 presents more patterns of heterogeneity. In Columns (1a)-(1b) we investigate whether the negative effect of mobility is more pronounced in areas with a high concentration of social tenants (above the median of the national distribution) than in areas with a lower concentration. Although the point estimates confirm this conjecture, the difference in the two effects is not significant. Next, in Columns (2a)-(2b), we study whether turnover has a more detrimental effect in areas with low homeownership rates (below the national median) than in areas with a higher incidence of owner-occupation. Our results show that while both estimates are negative, the impact of turnover is much larger and more significant in areas with few homeowners. The difference in the point estimates for the two groups is statistically significant at approximately the 5% level (the p-value on the equality test is 0.0530). Note that this finding is not driven by the fact that turbulence is a feature of low homeownership neighbourhoods since both types of areas are characterised by similar levels of mobility (approximately 13% and 16% in high and low homeownership areas, respectively). This result, coupled with the findings of the strand of research that shows that homeownership promotes investment in social capital (Hilber, 2010), suggests that social ties might help mitigating the disruptive effects of neighbourhood turnover.

Next, in Columns (3a)-(3b) and (4a)-(4b), we investigate whether our effects vary depending on the neighbourhood incidence of lone parents and adults with poor educational qualification. Our results show that the negative effect of turnover is substantially larger in areas with many lone parents and few people with education at least at level 4 (degree or equivalent) – and in the order of -0.67/-0.69 – than in areas with more qualified individual and fewer lone parents – at -0.10/-0.13. These differences are statistically significant at the 5% level or better. This evidence also suggests that areas with stronger family ties and higher educational attainments are capable of dampening the negative effect of neighbourhood mobility.

Columns (5a)-(5b) investigate the heterogeneity of our results along the dimension of neighbourhood school quality. More precisely, we rank locally accessible schools – i.e. those attended by pupils living in the OA – by whether their percentage of pupils achieving the age-16 target of 5 or more ‘good’ A*-C GCSEs is above or below the national median. Our evidence shows that pupils living in areas with better schools are less affected by neighbourhood turnover than those in areas with poor performing schools, and that the difference is significant. Given that the variable we use to identify better schools is likely to be more strongly related to family background than school effectiveness – i.e. it is more associated to school intake than school value added – this finding confirms our previous finding that areas with allegedly more social ties are able to mitigate the negative effects of neighbourhood turnover.

Finally, Columns (6a)-(6b) investigate whether our effects are different for areas with high and low house prices. To carry out this comparison, we first correct house price information by using hedonic methods that account for differences in the characteristics of the houses transacted in different areas. These characteristics include housing type (detached, semi-detached, terrace, flat, bungalow), year and month of transaction, legal status (freehold or leasehold) and new/resale property. This information is obtained from the Land Registry administrative dataset that covers all property sold and purchased in England. Our findings show that neighbourhood mobility has a more negative effect in areas with house prices below the national median than above. However, the difference between the two point estimates is not significant, while the two effects are jointly significant at better than the 1% level.

4.5. Heterogeneity by types of mobility

To conclude this section, in Table 7 we investigate whether different types of mobility have different effects on pupil test score value added. In Panels A we study the differential impact of mobility that entails changing the Local Education Authority (LEA) where a pupil lives or not, while in Panel B we break down the mobility indicator across pupils who move in the bottom 25% of the distance distribution, the top 25% of the distance distribution, and the remaining central part of the distribution. Hanushek et al. (2004) argue that moves that entail a school district change and a substantial distance are those more likely to be associated with Tiebout-relocation of families looking for better schooling and local public goods (Tiebout, 1956). Our point estimates suggest that mobility associated to an LEA change is less negative than mobility within the same LA. However, this difference is not significant. Moreover, both estimates are negative and jointly significant. Similarly, the estimates in Panel B show that the most disruptive type of mobility is the one associated with distances in the middle part of the relocation span distribution (between 400 metres and 4km, with a median of 1.2km). The negative effect of mobility associated with the longest or shortest moves is less precisely estimated, although the point estimates are always negative and a battery to tests for the pair-wise and three-way differences always rejects the hypothesis of significant heterogeneity.

Finally, in Panels C and D, we split our mobility indicators according to whether the underlying moves imply a neighbourhood improvement or worsening. In Panel C, we focus on changes in the proportion of students achieving the national target of 5 A*-C GCSE at age 16 (at the end of secondary schooling) in the local schools – i.e. those attended by the stayers in that neighbourhood. In Panel D, we focus on changes in average house prices after accounting for the composition of the local housing stock using hedonic regressions. The patterns suggest that moves that entail a worsening of the neighbourhood characteristics are more significantly and negatively associated to the value added of the stayers. Conversely, neighbourhood mobility that is associated to either the top 25% improvements in end-of-secondary-school attainments or to the top 25% increases in house prices are less negatively associated to KS2-to-KS3 value added. However, all point estimates are clearly negative and tests for the significance of the differences between the various estimates clearly reject the null. Once more, this suggests that types of mobility more likely associated with Tiebout-type relocations do not have less detrimental effect on the value added of pupils who do not move.

The regressions in Panel C and D discussed here above do not control for whether people moving up or down the neighbourhood quality distribution – i.e. engaging in mobility that entails an improvement in GCSEs in the top 25% of the quality changes distribution – move to and from ‘good’ or ‘bad’ neighbourhoods overall – e.g. areas in the top or bottom 25% of the GCSEs quality distribution. Note however that our mobility measure is a proxy for total turnover, so it captures both people moving into and out of neighbourhoods. As a result areas with high levels of turnover driven by people moving up (or down) the neighbourhood quality distribution will be characterised by both people moving out and people moving in in ways that improve (or worsen) on their current area. This implies the correlation between average neighbourhood quality and mobility needs not to be positive for Tiebout-type moves and negative for mobility that implies worsening neighbourhood quality. In fact, we find that the correlation between average GCSE at schools available from a given neighbourhood and turnover driven by people that experience a top-25% increase in average GCSEs is negative at -0.04. This is becomes -0.13 and -0.08 when we consider people moving in the middle 50% and bottom 25% of the distribution of the changes in the average local-school GCSEs. Consistently, if we look at average GCSEs of neighbourhoods that are characterised by high or low Tiebout-type and non-Tiebout type turnover, we find very similar figures. The average percentage of pupils in local schools attaining the 5 A*-C GCSEs target is 51.6% and 54.4% in areas with an incidence of people moving in ways that entail a top 25% change in the GCSE distribution which is above/below the median of the distribution of this type of move. If we focus on mobility implying a bottom 25% change in the GCSE distribution, these figures become 51.4% and 54.5% for areas respectively above/below the median for this type of move. In short, neighbourhoods with a high incidence of Tiebout-type moves do not differ substantially from other neighbourhoods. This is not surprising given that our turnover measure means, roughly speaking, that for every person moving from a 'bad' origin to a 'good' destination to attain an improvement in neighbourhood quality there will be someone moving in and leaving a worse area to obtain a neighbourhood quality increase. All neighbourhoods are therefore both 'good' and 'bad' origins and destinations because turnover sums both outwards and inwards mobility and breaks down the simplistic link between average quality and type of move.

Nevertheless, we re-ran the analysis in Panel C and D of Table 7 further controlling for an interaction between turnover and whether the area is above/below the median of the average 5 A*-C GCSE distribution or above/below the median of the average hedonic house price distribution. Stated differently, we combined the specification of Table 6, Columns (5a)-(5b) with that of Panel C of Table 7 (for GCSEs), and the specification of Table 6, Columns (6a)-(6b) with that of Panel C of Table 7 (for house prices). This robustness check did not affect our conclusions. For example, we still found that areas with end-of-secondary school attainments above the median of the GCSE distribution were less negatively affected by turnover than areas with lower average achievements (consistent with Columns (5a)-(5b) of Table 6).

Furthermore, the effect of mobility was always negative irrespective of whether this entails a variation in the top 25%, bottom 25% or middle 50% of the GCSE change distribution, though this effect was more marked and significant for the middle part.[7] All in all, we confirm our previous conclusion: high level of turnover have a negative effect on the value-added of the stayers – irrespective of whether these represent Tiebout-type forms of mobility or not.

5. Concluding remarks

Our results clearly suggest that individuals engaging in mobility and changing their residential neighbourhood between age 11 and age 14 impose a negative externality on students who do not move. This negative effect is stronger for vulnerable pupils residing in more deprived areas. Moreover, the effect seems to be more pronounced when the moves entail a worsening of the neighbourhood characteristics. However, moves that are more arguably linked to Tiebout-choice – such as those associated with improvements in test scores or increases in house prices – do not have a positive effect on the outcomes of the stayers. This suggests that, although residential mobility might be good from an individual's perspective as well as for labour markets more generally, it might entail negative externalities on immobile individuals in communities that experience high rates of turnover.

[7] Given that these results do not substantially differ from the results in Table 7, they are not tabulated to conserve space. However, they are available upon request.

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Appendix I: More details on the empirical model

The empirical model of Equation (1) is based on an underlying assumption that levels of achievement are cumulative and depend on personal, neighbourhood and school characteristics. Residential turnover in a student's home neighbourhood is the focus of interest in our study.

To formalize our exposition, suppose that a student's achievement at a KS_t tests – where t is equivalent to an education phase – is determined by neighbourhood turnover in neighbourhood n during phase t (mob_{nt}), personal characteristics $\sigma_{i,t}$, neighbourhood characteristics $\nu_{n,t}$ and school characteristics $\upsilon_{s,t}$. Note that we allow for the following features in our model: *(i)* individual and neighbourhood characteristics have phase-specific effect on test scores; *(ii)* school effects enter as a moving average, with interactions between primary and secondary schooling, so that schools in the previous phase and current phase affect current achievement. The rationale for this formulation can be described as follows: when pupils move across educational stages and, most likely, move to a different school, changes in school resources, teachers, peers and mobility will affect their performance. So both current, past and an interaction of past-and-current school effects can affect pupil performance. This set-up gives rise to the following expressions:

$$
\begin{aligned}
KS_{i,t} &= KS_{i,t-1} + mob_{n,t}\beta + \sigma_{i,t} + \nu_{n,t} + \upsilon_{s,t} + \upsilon_{s,t-1} + \upsilon_{s,t}\upsilon_{s,t-1} + \varepsilon_{it} \\
KS_{i,t+1} &= KS_{i,t} + mob_{n,t+1}\beta + \sigma_{i,t+1} + \nu_{n,t+1} + \upsilon_{s,t+1} + \upsilon_{s,t} + \upsilon_{s,t+1}\upsilon_{s,t} + \varepsilon_{it+1} \qquad (2) \\
KS_{i,t+1} - KS_{i,t} &= mob_{n,t+1}\beta + \sigma_{i,t+1} + \nu_{n,t+1} + \upsilon_{s,t+1} + \upsilon_{s,t} + \upsilon_{s,t+1}\upsilon_{s,t} + \varepsilon_{it+1}
\end{aligned}
$$

Considering only the set of pupils who do not change neighbourhoods, this becomes:

$$KS_{i,t+1} - KS_{i,t} = mob_{n,t+1}\beta + \sigma_{i,t+1} + \nu_{n} + \upsilon_{s,t+1} + \upsilon_{s,t} + \upsilon_{s,t+1}\upsilon_{s,t} + \varepsilon_{it+1}$$

Note that in this expression, individual and neighbourhood that affect baseline attainments – i.e. $KS_{i,t}$ – have dropped out implying that 'ability' and 'sorting' that affect early test scores and neighbourhood choice of household that do not move have been controlled for by the value-added specification. However, this expression still contains individual and neighbourhood effects that will drive pupils' test score progression alongside current and lagged school effects and their interaction.

In our data, we are able to observe multiple cohorts – denoted by c – of children from the same neighbourhoods and schools, leading to the following expression:

$$KS_{ic,t+1} - KS_{ic,t} = mob_{nc,t+1}\beta + \sigma_{ic,t+1} + \tau_{c,t} + \nu_{nc} + \upsilon_{sc,t+1} + \upsilon_{sc,t} + \upsilon_{sc,t+1}\upsilon_{sc,t} + \varepsilon_{ict+1} \qquad (3)$$

Where all variables now have a cohort-specific component and $\tau_{c,t}$ is a phase-by-cohort effect. We estimate Equation (3) using observable student, neighbourhood and school characteristics, and various permutations of school, neighbourhood and cohort fixed effects to capture the various observable and unobservable components that affect pupils' test score progression. School-by-cohort fixed effects can be estimated from students in a given cohort attending a given school. Primary-by-secondary-by-cohort effects can be estimated using pupils in a given cohort and transiting from primary to secondary school. Finally, neighbourhood fixed effects can be estimated from children from different cohorts living in the same neighbourhood. Note that school-by-cohort fixed effects can be included in our specification at the same time as neighbourhood effects because there is not a one-to-one mapping between the neighbourhood where children live and the primary or secondary school they attend. Moreover, there is quite a substantial reshuffling of pupils across schools when they moving from the primary to the secondary phase. On average, pupils in secondary schools meet 80% new peers – i.e. students that do not come from the same primary – and secondary schools are much bigger attracting pupils from a large number of primaries. This implies we can estimate effectively secondary-by-primary-by-cohort effects.

Among all these observable and unobservable factors, neighbourhood fixed effects are crucial given that neighbourhood turnover rates are likely to be determined and correlated with unobserved neighbourhood characteristics of other types – e.g. housing tenure and long-run demographic patterns – that can affect pupil educational progress. Neighbourhood fixed effects also allow us to control for sample selection of individuals into neighbourhoods on the basis of neighbourhood characteristics that affect pupil value added, since neighbourhood characteristics also control for $E[\sigma_i \mid n]$.

Tables

Table 1: Descriptive statistics of the main dataset

Variable	Mean	Standard Deviation
Panel A: Students' characteristics, stayers only		
KS2 percentiles, average English, Maths and Science	50.037	25.249
KS3 percentiles, average English, Maths and Science	51.143	25.837
KS2 to KS3 value-added	1.106	13.590
KS1 score, average English and Maths	15.108	3.617
Student is FSM eligible	0.158	0.364
Student is SEN	0.213	0.410
Student is Male	0.508	0.499
Secondary school size (in grade 7)	1084.3	384.77
Panel B: Mobility and other characteristics of neighbourhoods		
Annual rate of mobility in n'hood (grade 6 to 9)	0.145	0.128
Annual rate of mobility in n'hood, outward (grade 6 to 9)	0.064	0.068
Annual rate mobility in n'hood, inward (grade 6 to 9)	0.081	0.093
Primary school annual rate of total mobility in n'hood (grade 3 to 6)	0.204	0.194
KS1 score, average English and Maths – Change grade 6 to 9	-0.031	1.446
Share FSM – Change grade 6 to 9	0.005	0.145
Share SEN – Change grade 6 to 9	0.002	0.165
Share Male – Change grade 6 to 9	0.002	0.165
Number of students in neighbourhood, Grade 6	5.343	2.565
Number of students in neighbourhood, Grade 9	5.331	2.585

Note: Descriptive statistics refer to students who do not change OA of residence in any period between grade 6 and 9 in the non-selective part of the education system. Number of 'stayers': approximately 1,210,000 (evenly distributed over three cohorts). Number of Output Areas: approximately 133,000. KS1 refers to the average test score in Reading, Writing and Mathematics at the Key Stage 1 exams (at age 7); FSM: free school meal eligibility; SEN: special education needs (with and without statements). Secondary school type attended in grade 7: 66.7% Community; 14.8% Voluntary Aided; 3.1% Voluntary Controlled; 14.5% Foundation; 0.3% Technology College; 0.4% City Academy.

Table 2: Neighbourhood mobility: the effect on students' achievements

	Dependent Variable is value-added between KS2 and KS3							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Neighbourhood mobility – KS2-KS3	-3.914 (0.115)***	-3.670 (0.114)***	-0.787 (0.103)***	-0.783 (0.103)***	-0.432 (0.142)***	-0.423 (0.141)***	-0.378 (0.136)***	-0.369 (0.135)***
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Second. × primary × cohort FX	No	No	No	No	No	No	Yes	Yes
Second. × primary × cohort FX	No	No	Yes	Yes	No	No	No	No
Neighbourhood FX	No	No	No	No	Yes	Yes	Yes	Yes
Changes in neighbours' characteristics + primary mobility	No	Yes	No	Yes	No	Yes	No	Yes

Note: Table reports coefficients and standard errors clustered at the OA level in round parenthesis. Number of observations ~1,210,000 in ~123,000 Output Areas. All regressions include cohort dummies. Controls include: student own KS1 test scores; student is FMSE; student is SEN; student is male; school size (refers to school attended in grade 7); school type dummies (refers to school attended in grade 7 and includes: Community, Voluntary Aided, Voluntary Controlled, Foundation, CTC and Academy). Neighbourhood mobility is the annual rate of mobility in neighbourhood between grade 6 to 9 considering both outwards and inwards relocations. Changes in neighbourhood characteristics include changes between grade 6 and grade 9 in: KS1 scores; FSME eligibility; SEN status; gender. Secondary by cohort effects: ~12,300 groups (refer to school at grade 7 when students enter secondary education). Secondary by primary by cohort school effects: ~185,000 groups. Neighbourhood (OA) effects: ~133,000 groups. ***: 1% significant or better.

Table 3: Balancing properties of neighbourhood mobility

	Treatment is: Neighbourhood mobility – Grade 6 to grade 9	
	(1)	(2)
Dependent Variable is:	Unconditional	Neighbourhood FX
Panel A: Pupil level characteristics		
KS1 score,	-1.630	0.069
average English and Maths	(0.012)***	(0.036)*
Student is	0.200	-0.004
FSM eligible	(0.004)***	(0.003)
Student is	0.094	-0.004
SEN	(0.003)***	(0.004)
Student is	-0.003	-0.002
Male	(0.004)	(0.005)
Panel B: Attended school characteristics		
Grade 7 school average KS1 score	-0.919	-0.007
(English and Maths)	(0.014)***	(0.008)
Grade 7 school average KS2 score	-7.272	0.004
(English, Maths and Science)	(0.102)***	(0.064)
Grade 7 school std. dev. KS2 score	-0.055	0.004
(English, Maths and Science)	(0.0195)	(0.019)
Secondary school size (in Grade 7)	-27.54	5.4501
	(5.069)***	(2.634)**
Panel C: Neighbourhood and accessible school characteristics		
Number of schools opening within 5km	0.072	-0.007
of pupil's residence	(0.006)***	(0.008)
Number of schools closing within 5km	0.146	-0.005
of pupil's residence	(0.012)***	(0.015)
Percentage students achieving 5 A*-C	-14.74	-0.099
GCSEs – accessible schools	(0.214)***	(0.076)
Percentage days absent –	1.646	0.016
accessible schools	(0.026)	(0.012)
House prices (hedonic) –	-74772.5	416.2
Output Area of residence	(1150.2)***	(491.8)

Note: Table reports coefficients and standard errors clustered at the OA level in round parenthesis from regressions of one of the dependent variables (first column) on neighbourhood mobility and year dummies. Regressions run at the individual level. Number of observations: approximately 1,210,000. Column (1) does not include any additional control. Column (2) include neighbourhood (OA) fixed effects. Neighbourhood (OA) effects: ~133,000 groups. ***: 1% significant or better; **: at least 5% significant; *: at least 10% significant. Panel B refers to the characteristics of schools attended by students who do not move in grade 7 (first grade of secondary school). Percentage of students achieving 5 A*-C GCSEs and percentage of days absent are averaged across the set of secondary schools that stayers attend from a given neighbourhood (Output Area). House price (hedonic) are corrected for housing characteristics and averaged at the Output Area level.

Table 4: Neighbourhood mobility and students' achievements – Falsification and robustness checks

	Specification refers to/includes:							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Primary school mobility	Other cohorts' mobility	KS3 control for KS2 – IV	Inward mobility only	Outward mobility only	Add levels of n'hood controls	Add ethnicity controls	Drop 30% smallest n'hoods
Neighbourhood mobility	0.019 (0.094)	-0.379 (0.152)**	-0.428 (0.129)***	-0.520 (0.188)***	-0.462 (0.263)*	-0.423 (0.141)***	-0.421 (0.141)***	-0.450 (0.236)*
N'hood mobility, 1-year older cohort		0.090 (0.112)						
N'hood mobility, 1 year younger cohort		0.114 (0.126)						

Note: Table reports coefficients and standard errors clustered at the neighbourhood (OA) level in round parenthesis. ***: 1% significant or better; **: at least 5% significant; *: at least 10% significant. All regressions include cohort dummies; student own KS1 test scores; student is FMSE; student is SEN; student is male; school size; school type dummies; changes in neighbourhood characteristics between grade 6 and grade 9; primary school mobility rates (except for Column (1) where this is the only mobility measure); neighbourhood (OA) effects. Column (1) uses only mobility rates based rates on moves of primary school children between Grade 3 and KS2/Grade 6 for the same time windows used to construct neighbourhood mobility between Grade 6 and 9. Column (2) add only mobility rates based rates on moves of pupils one year younger and one year older than pupils in the main sample (calculated for the same time windows). Column (3) estimates a lagged dependent variable specification instrumenting KS2 percentiles with teacher-assessed KS2 test levels. KS2 estimate in second stage: 0.886 (s.e.: 0.001). Column (4) and (5) focus on inward only and outward only mobility rates, respectively. Column (6) adds average neighbourhood characteristics measured in Grade 6 (i.e. KS1 scores; FSME eligibility; SEN status; gender). Column (7) adds controls for individual ethnicity (8 categories) and changes in neighbourhood ethnic percentages between Grade 6 and Grade 9 (8 categories). Column (8) drops the 30% smallest neighbourhoods (with less than 4 pupils. Number of observations ~1,210,000 in ~133,000 OAs, except for Column (8) where the number of observations is ~820,000 in ~91,000 OAs.

Table 5: Heterogeneity in the effect of neighbourhood mobility – By pupil background characteristics

	Dependent Variable/Timing is: KS3-KS2 value-added/Grade 6 to 9							
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
	Male student	Female student	FSM Student	Non-FSM Student	SEN Student	Non-SEN Student	Low KS1 Student	High KS1 Student
N'hood mobility – Grade 6 to 9	-0.545 (0.174)***	-0.297 (0.177)*	-0.690 (0.292)**	-0.368 (0.149)**	-0.269 (0.231)	-0.467 (0.154)***	-0.451 (0.172)***	-0.398 (0.185)**
P-value: equality	*0.2410*		*0.2897*		*0.4237*		*0.3096*	
P-value: joint significance	*0.0054*		*0.0069*		*0.0092*		*0.0073*	

Note: Table reports coefficients and standard errors clustered at the neighbourhood (OA) level in round parenthesis. ***: 1% significant or better; **: at least 5% significant; *: at least 10% significant. All regressions include cohort dummies; student own KS1 test scores; student is FMSE; student is SEN; student is male; school size; school type dummies; changes in neighbourhood characteristics between grade 6 and grade 9; primary school mobility rates; neighbourhood (OA) effects. Results obtained from regressions pooling all students and interacting individual characteristic specified in the heading with neighbourhood mobility. Number of observations ~1,210,000 in ~133,000 OAs.

Table 6: Heterogeneity in the effect of neighbourhood mobility – By pupil neighbourhood characteristics

	Dependent Variable/Timing is: KS3-KS2 value-added/Grade 6 to 9											
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
	High Social Tenants	Low Social Tenants	Low Home Ownership	High Home Ownership	High Lone Parents	Low Lone Parents	Low High Qual.	High High Qual.	Low 5 A*-C GCSEs	High 5 A*-C GCSEs	Low House Prices	High House Prices
N'hood mobility – Grade 6 to 9	-0.557 (0.198)***	-0.271 (0.198)	-0.674 (0.197)***	-0.132 (0.200)	-0.689 (0.194)***	-0.102 (0.204)	-0.667 (0.193)***	-0.127 (0.205)	-0.663 (0.200)***	-0.097 (0.208)	-0.562 (0.199)***	-0.242 (0.212)
P-value: equality	*0.3074*		*0.0530*		*0.0364*		*0.0543*		*0.0493*		*0.2702*	
P-value: joint Significance	*0.0078*		*0.0024*		*0.0016*		*0.0022*		*0.0037*		*0.0096*	

Note: Table reports coefficients and standard errors clustered at the neighbourhood (OA) level in round parenthesis. ***: 1% significant or better; **: at least 5% significant; *: at least 10% significant. All regressions include cohort dummies; student own KS1 test scores; student is FMSE; student is SEN; student is male; school size; school type dummies; changes in neighbourhood characteristics between grade 6 and grade 9; primary school mobility rates; neighbourhood (OA) effects. Results obtained from regressions pooling all students and interacting neighbourhood characteristic specified in the heading with neighbourhood mobility. Number of observations ~1,210,000 in ~133,000 OAs. High and low social tenants (Columns 1a and 1b): above or below the median of the distribution of the share of households in the OA who rent from the council, from a housing association or from a social landlord (0.092). High and low home ownership rate (Columns 2a and 2b): above or below the median of the distribution of the shares of households in the OA who are homeowners (0.774). High and low lone parents (Columns 3a and 3b): above or below the median of the distribution of the shares of households in the OA who are headed by a single parent (0.059). High or low high qualifications (Columns 4a and 4b): above or below the median of the share of households in the OA whose head has educational qualifications at Level 4 or 5 (0.142). Low or high 5 A*-C GCSEs (Columns 5a and 5b): above or below the median of the percentage of students achieving the A*-C GCSEs target at accessible schools on average across the years (53.17%). Accessible schools are those attended by the stayers from a given neighbourhood (OA). Low or high house prices (Columns 6a and 6b): above or below the median of the house prices in the neighbourhood on average across the years (£123843). House prices corrected for housing characteristics using hedonic regressions.

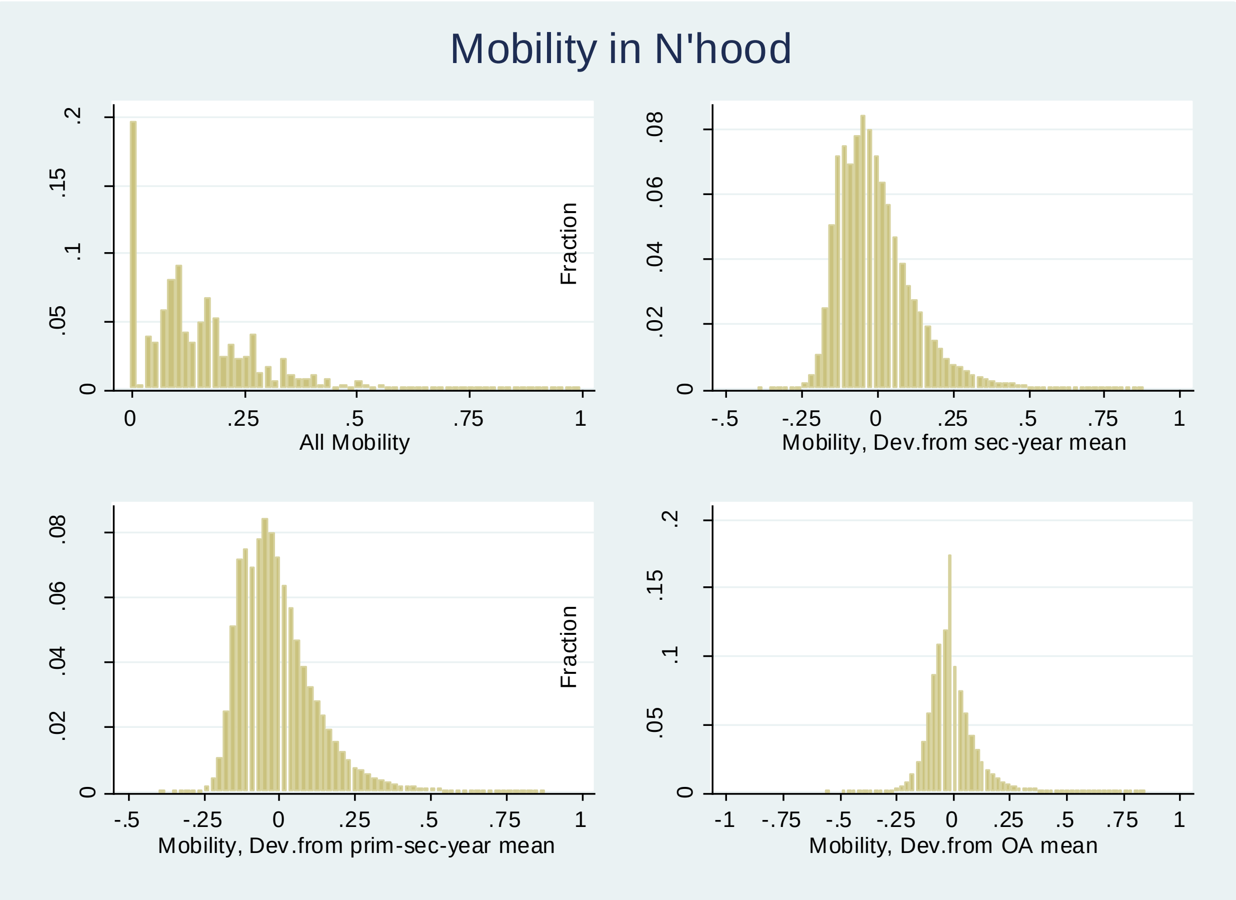
Table 7: Heterogeneity in the effect of neighbourhood mobility – By different mobility types

		Dependent Variable/Timing is: KS3-KS2 value-added/Grade 6 to 9					
Panel B: LA crossing		*Panel B: Distance*		*Panel C: School quality GCSE*		*Panel D: House prices*	
Same LA	-0.485 (0.156)***	Bot. 25% Distance	-0.441 (0.283)	Bot. 25% Δ(A*-C GCSE)	-0.405 (0.333)	Bot. 25% Δ(house prices)	-0.849 (0.342)**
Change LA	-0.133 (0.336)	Mid 50% Distance	-0.594 (0.202)***	Mid 50% Δ(A*-C GCSE)	-0.455 (0.208)**	Mid 50% Δ(house prices)	-0.294 (0.230)
		Top 25% Distance	-0.057 (0.285)	Top 25% Δ(A*-C GCSE)	-0.344 (0.328)	Top 25% Δ(house prices)	-0.200 (0.339)
P-value: equality	*0.3439*		*0.3131*		*0.9583*		*0.3488*
P-value: joint significance	*0.0072*		*0.0105*		*0.0499*		*0.0339*

Note: Table reports coefficients and standard errors clustered at the neighbourhood (OA) level in round parenthesis. ***: at least 1% significant; **: at least 5% significant. All regressions include cohort dummies; student own KS1 test scores; student is FMSE; student is SEN; student is male; school size; school type dummies; changes in neighbourhood characteristics between grade 6 and grade 9; primary school mobility rates; neighbourhood (OA) effects. Results obtained from regressions simultaneously including mobility computed rates for subgroup of pupils engaging in different types of moves. Approximately 11.9% of the moves are within an LA and 2.6% across LA boundaries. Distance thresholds as follows: bottom 25% ~400 to 800 metres; top 25% ~4000 to 6500 metres. Panel C ranks neighbourhoods by the average fraction of pupils achieving A*-C GCSEs in the schools attended by the stayers. Thresholds for the changes in A*-C GCSE as follows: bottom 25% ~-7.5 to -6.8 percentage points; top 25% ~8.7 to 9.4 percentage points. Panel D ranks neighbourhoods by the average house prices corrected for housing characteristics using hedonic regressions. Thresholds for the changes in house prices as follows: bottom 25% ~-£15,700 to -£13,000; top 25% ~£19,000 to £22,800. Number of observations ~1,210,000 in ~133,000 OAs.

Figures:

Figure 1: Variation in the neighbourhood



Note: Descriptive statistics of neighbourhood mobility: mean 0.145; std.dev. 0.128. Descriptive statistics of deviations from secondary school-by-cohort mean: mean 0.000; std.dev. 0.123. Descriptive statistics of deviations from primary-by-secondary-by-cohort mean: mean 0.000; std.dev. 0.110. Descriptive statistics of deviations from neighbourhood (OA) mean: mean 0.000; std.dev. 0.093.