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Sorting and Choice in English Secondary Schools

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Abstract

This paper focuses on one of the outcomes arising from England's choice based education system; the extent to which different types of pupils are sorted across schools. Pupil sorting will in turn impact on attainment outcomes, if there are peer group effects operating within schools. We consider three dimensions across which sorting may occur: ethnicity, income, and, for the first time using UK data, ability. We use a very large administrative dataset which contains linked histories of test scores for every pupil in England, as well as pupil level markers for ethnicity and low household income, and their home postcode (zip code). We first establish that choice is both feasible for and exercised by the majority of pupils in England. We then characterise and describe ability sorting and related it to feasibility of choice. We compare sorting across schools with sorting across neighbourhoods. We establish that post-residential school choice is an important component of the overall schooling decision. We show that there is a difference in the school-neighbourhood sorting relationship between areas that operate under different student-to-school assignment rules.

Keywords: choice, segregation, schools

JEL Classification: I2

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1 Introduction

The analysis of choice in education markets is currently enjoying a boom. In the US context, choice primarily means the use of voucher schemes. In the UK it refers to the operation of the quasi-market in education. There have been two main components in the debate: the impact of choice on improving outcomes through competitive pressure on all schools, and the impact of choice on the sorting or segregation of pupils across schools. This second issue is the focus of this paper. If there are important peer effects in schools, then sorting will influence both the efficiency and distribution of education outcomes. This issue is very complex, and has been mostly tackled to date using simulated theoretical models[1]. Hoxby (2003, p. 6) notes that the "most complicated effects of school choice are on student sorting – how students will allocate themselves among schools when allowed to choose schools more freely".

This paper provides some empirical evidence to complement the theoretical modelling. Using a universe dataset on all secondary school[2] pupils in England, including full test score histories, we characterise ability sorting in England. The dataset also includes geocodes for both schools and the pupils, so we can consider both school and neighbourhood sorting. There is clearly much we can do with this dataset, and this paper reports the first results from our research programme. We focus here on the role of the school assignment rule, and the degree of choice of schools available. Two assignment rules are used in different jurisdictions in England: neighbourhood schooling and elite schooling. In the former, the chief *de jure* criterion is distance from the school – pupils' default school is their nearest one.

[1] A discussion of this and existing empirical evidence is below.
[2] Secondary schools cover ages 11-16 or 11-18. Details on the data are below.

This is despite the Education Reform Act of 1988 introducing a limited concept of choice. In the latter elite or selective areas, pupils are selected into grammar schools on the basis of ability.

We first establish that choice is feasible for most pupils in England, and that it is exercised. That is, about half of all pupils in neighbourhood schooling jurisdictions do not in fact attend their nearest school. Second, we characterise the nature of ability sorting. We do this non-parametrically to exploit the richness and universality of our data, as well as calculating the usual segregation indices. We show that ability sorting in schools is, unsurprisingly, much greater in elite schooling jurisdictions. Conditioning on neighbourhood sorting, we show that post-residential sorting is positively correlated with the degree of choice available. Whilst this is contrary to the findings of Epple and Romano (2003), the nature of the English education market is sufficiently different from the one they studied to make a direct comparison misleading. Finally, we show that the school assignment rule influences neighbourhood ability sorting. Assigning pupils to schools on the basis of ability, rather than location, breaks the link between school and home, and allows different patterns of residential sorting.

The rest of the paper is structured as follows. Section 2 relates our analysis to the relevant literature, and Section 3 briefly discusses the structure of, and incentives created by, the English education market. Section 4 details our dataset and Section 5 presents our results. Section 6 provides a brief conclusion.

2 Modelling Choice

The economics literature on choice in education covers a broad range of methodologies, ranging from largely descriptive empirical work through theoretical

analysis and computable general equilibrium models. The collection edited by Hoxby (2003a) provides an excellent selection and overview of this research.

One of the central questions in this field is the impact of "choice" on educational outcomes, principally test scores. Choice, at least in the US context, often means the role of educational vouchers to allow particular groups to attend different schools. Petersen, Howell, Wolf and Campbell (2003) provide evidence on this question using data from experiments with randomised assignment of vouchers, and an overview is provided in Hoxby (2003c). Other surveys are in Ladd (2002), and Neal (2002). For the UK, Bradley, Crouchley, Millington and Taylor (2000) and Bradley and Taylor (2002) use cross-sectional variation in the extent of school choice to explore the role of the quasi-market in education operating since the reforms of 1988. As Hoxby (2003b) makes clear, there are two main forces operating to determine the outcome of increased choice. These are the competitive force working to increase effectiveness and productivity in schools, and the action of peer effects alongside differences in the allocation of students to schools. It is this latter issue that we focus on in this paper.

Hoxby (2003b) argues that comprehensive answers to the complex problem of choice and sorting require computable general equilibrium (CGE) models, estimates of structural parameters of demand and production functions, and a detailed characterisation of student sorting (pp. 6, 7). We aim to provide the last of these in this paper, using data for school students in England. Nechyba has a set of papers using simulated general equilibrium models of the choice process (for example, Nechyba, 1999, 2003a, 2003b) and also a summary of the work on income and ability sorting in Nechyba (2004). In the last of these, he discusses three different channels of sorting – decentralised sorting based on choice of residence, sorting out of the state

system altogether into private schools, and centralised sorting (tracking) within the public school system. Much of the work focuses on the first two of these. A number of results come out of this work, perhaps the most important being the relationship between school finance, the degree and nature of choice, and spatial residential segregation by income and ability. For example, in Nechyba (2003b), it is established that a pure public schooling system leads to more spatial segregation than a private system. In Nechyba (2003a) the role of private schools is examined further through simulations of different voucher systems within the model. In the presence of private schools, "residential segregation patterns within heterogeneous public school systems are then predicted to be quite different from school segregation patterns, with private school markets fostering *reduced* residential segregation by income and peer quality but *increased* school segregation along these same dimensions" (Nechyba, 2004, p. 24 [italics in original]). The relationship between vouchers and sorting depends on the voucher system design. Universal vouchers have an ambiguous relationship depending on the value of the voucher; targeted vouchers can decrease sorting. Similarly, Epple and co-authors have a set of papers looking at Tiebout sorting, formation of jurisdictions and sorting. Epple and Romano (2003) model three different student assignment regimes: neighbourhood schooling (a strict residence requirement for admission), school choice with no choice costs, and multi-jurisdictions Tiebout sorting. They show that different public policy regimes have dramatic impacts on the nature of sorting. Neighbourhood schooling leads to strong income stratification across neighbourhoods, with differences in school quality arising from peer group differences. Costless, frictionless choice equalises peer groups across schools. Epple and Romano argue that it is the residence requirement that is

fundamental to sorting rather than the single or multi-jurisdictions. Again, the differential sorting between schools and neighbourhoods is apparent.

Evidence from the US on sorting typically uses school- and district-level data. One important issue is that in the US, any dimension of school segregation is closely tied up with racial/ethnic segregation, and the pure effects of choice on sorting are difficult to disentangle. Clotfelter (1998) argues that (district) choice influences sorting, but Hoxby (2000) disagrees. Her focus is chiefly on controlling for the potentially confounding effect of sorting when trying to isolate the competitive effect of the degree of choice on productivity. She shows that the effect of the degree of choice on outcomes is largely unaffected by the inclusion or exclusion of measures of student heterogeneity across districts. On the other hand, the more schools that there are in a metro area, the greater the ethnic segregation. She concludes that student sorting is more relevant across schools within districts than across districts.

Close in spirit to the present paper is the work of Söderström and Uusitalo (2004), using student level data from Sweden. They compare student sorting along a number of dimensions before and after a significant reform to the school admission process in Stockholm. This reform switched from a predominantly residence-based admissions system to an explicitly ability-based system. Comparison of Stockholm and a neighbouring area without the reform enables them to run a difference-in-difference analysis on the impact of the reform on sorting. They find a significant increase in ability sorting in schools, but no change in residential sorting. They find the same result for ethnic and income sorting.

Thus while it is clear that the availability of choice and the degree of sorting are potentially important factors in school markets, there is not a great deal of evidence to complement the theoretical and CGE modelling.

3 The Secondary School System in England

The Education Reform Act of 1988 introduced a 'quasi-market' in education (Glennerster 1991). This system replaced the previous assignment of children to schools primarily on the basis of residence and the allocation of central government funding to schools by the local jurisdiction, local education authorities (LEAs)[3]. The 'quasi-market' had the following key features:

- Open enrolment: parents were given the right to choose the school they wanted their child to go to, though parents generally have to choose a school within the LEA in which they live.
- Overlapping catchment areas around schools, where catchment areas were based on geographical distance from the school.
- Both funding and management of schools was devolved to a more local level.
- Schools were funded on the basis of the number of pupils enrolled.
- Funding remained provided by central government, funded out of central government taxation.

These features remain to the present date. The intention was that per capita funding and parental choice would bring about competition between schools for

[3] Prior to 1988, LEAs – a tier of regional government in the UK – had considerable autonomy to allocate central government funding to schools and to decide educational policy in their area. A few LEAs retained a system of schools in which children were allocated on the basis on ability: to 'grammar' schools (for the more able) and secondary modern or comprehensive schools (for the less able), but most ran a system of non-selective schools. LEAs still exist, with considerably less autonomy. There are currently 150 LEAs, containing on average 119 primary schools (children aged 5-11) and 21 secondary schools (children aged 11-18).

pupils, which would raise educational outcomes (Glennerster 1991)[4]. In fact, residence does still matter in gaining admission to over-subscribed schools, although the importance of residence as an admissions criterion differs both across jurisdictions and across different school types. The system is inflexible in that the size of schools cannot be quickly increased or reduced.

Parental choice of school in this market is informed by two types of formal performance measure, and more informally through friends and general reputation. The first type are reports made on each school by a government agency (Ofsted) that makes in-depth site visits to each school at least once every six years. The second type of performance measure are the summary statistics on each school's performance, published annually in what are known as the school 'league tables'. These report a range of test score outcomes for the schools.

The structure of the market gives incentives for schools to attract more able pupils. Whilst the simple financial gain from attracting more able pupils is no different to that from attracting less able pupils[5], there are indirect gains. First, if peer group effects are important, schools with a high proportion of able children will achieve higher outcomes. Second, career concerns of head teachers mean that they may want to be associated with 'successful' schools. Third, more able children may be easier to teach for a given level of teacher input.

4. Data

For this analysis we use the Pupil Level Annual School Census (PLASC) dataset, a key administrative dataset which forms part of the National Pupil Database

[4] The quasi-market system differs from Tiebout choice in that it is not a system of local taxation and so not one of local determination of school funding or quality. Funding is raised by central government taxation and allocated to LEAs on the basis of pupil numbers.
[5] There is some additional funding for children identified as having special educational needs.

(NPD). PLASC covers all pupils in both primary and secondary schools in England, with approximately half a million pupils in each cohort. At pupil level, it provides complete linked histories of test scores plus some individual characteristics: gender and within-year age, ethnicity, eligibility for free school meals (FSM) (an indicator of low household income)[6] and special educational needs. Finally, and crucially for our analysis, we have the home postcode of every pupil in the dataset, enabling us to locate each pupil in relation to schools (and also to a range of administrative geographies). Pupils are linked to schools. At school level, there are a wide range of characteristics, including performance measures, geographical co-ordinates, school size, age range, religious denomination, funding status, gender mix and admissions policy.

Pupils take Key Stage 2 (KS2) tests at age 11 at the end of their primary school education. These are important tests for the schools as they are reported in the school 'league tables' discussed above. The pupils then move on to secondary schools to complete their education. We analyse the sorting of pupils into secondary schools on the basis of their KS2 scores.

In this analysis we (mostly) analyse state secondary schools in England, which pupils attend between the ages of 11 and 16 or 18, and omit private (fee-paying) schools. The main reason for this is that these schools are not required to take the Key Stage exams, and so only some report these data. In fact, for only around half of our cohort in private schools we have KS2 data. It seems unlikely that this will be a random sample of private schools, so the clearest strategy is to leave them all out. Also, it is not a big quantitative issue: around 7% of pupils in our cohort attend private schools. Nevertheless, these schools are of interest, and may be an important

[6] Eligibility for FSMs is essentially a measure of whether the family is entitled to social security benefits.

margin for choice in some places. We therefore present some evidence relating to them. We also omit special schools and other academic centres such as hospital schools and detention centres from our dataset.

One of the focuses of the paper is the two different pupil assignment rules used. A few Local Education Authorities (LEAs) have retained a system in which children are explicitly allocated to schools on the basis of test scores: to grammar schools (for the more able) and secondary moderns (for the less able); this is what we call the elite schooling assignment mechanism. In these LEAs, therefore, location is not a key part of the assignment mechanism. The majority of LEAs run a system in which pupils of all abilities attend what are known as comprehensive schools, and distance from the school is an important admission criterion; this is neighbourhood schooling. Given that overt selection by ability will have an impact on the sorting of pupils of different types across schools, part of our analysis focuses just on non-selective LEAs. We define a selective LEA as one in which more than 10% of pupils attend a grammar school.

We use the co-ordinates for each school to construct our measure of choice. Overlaying school locations with a complete road network, we construct drive-time zones (DTZs) around schools. In this paper we choose a 10-minute DTZ around every secondary school in England and count the number of schools within this area: this number of 'nearby' schools is our measure of the extent of choice in a local market. In future work, we will utilize the full variation at school level, but in this paper we aggregate this to LEA level for comparison with our measures of sorting and segregation.

We characterize student sorting across three different dimensions: ability, ethnicity and disadvantage. Segregation is a characteristic of an aggregate of units,

and we take the LEA as the aggregate, measuring segregation across both schools and electoral wards (neighbourhoods) within an LEA[7]. We take the neighbourhood basis for segregation as approximating where people want to live and compare that with the outcome of their school choice conditional on where they live. In US terms, these are like inter- and intra-district choice respectively.

We use the dissimilarity index, *D*, as our measure of segregation. This is the most widely used segregation index, following the foundational work of Duncan and Duncan (1955). Massey and Denton (1988) provide an extensive discussion and evaluation of different measures of segregation. The dissimilarity index is based on the idea of segregation as unevenness of the distribution of different types of students across units within the aggregate area. The more uneven the spread, the higher the degree of segregation. *D* ranges from 0 to 1, and can be interpreted as the fraction of students in the aggregate area that would need to move in order for there to be an even distribution of groups across units (schools or wards) in the area. Cutler, Glaeser and Vidgor (1999) quote Massey and Denton (1993) suggesting that values of 0 – 0.3 are considered to be low, 0.3 – 0.6 moderate, and 0.6 and above high.

5 Results

a) Feasibility and Exercise of Choice

We first establish that choice between different schools is feasible for most students in England. Choice can be exercised in two ways: in the dual choice of residential location and school, and in the choice of school given residence. The former will depend on the nature and location of jobs (among other things). Here we take the labour and housing markets as given and focus on the second. We ask the

[7] We have replicated some of this analysis at DTZ level. Results available from the authors.

question, do parents (or children) have a choice of school and do schools have potential children to choose between?

Using the ten minute drive-time zone (DTZ), Table 1 shows the distribution of the number of nearby schools for the whole country and split by area type, London, non-London Urban, and Rural areas. The results show that, on average, secondary schools in England have more than 6 schools within ten minutes drive of themselves. The modal category is between 1 and 5 schools and 14% have no close alternatives. The pattern across the three area types is as expected: in the densest area, London, the mean is 17, falling to 7 in non-London urban, and just over 1 in rural areas. Note that nearly half of schools in rural areas have no alternatives within ten minutes[8].

Of course, the feasibility of choice does not mean that it is taken up. We can use the geographic information in the dataset to address this directly. For each student, we determine the nearest school to their home address[9], and thus define whether they attend their nearest school. We present the mean proportion attending their nearest school and by different sub-areas. Table 2 shows that overall some 45% of children attend their nearest school. Thus just over half are "exercising choice" in the sense of not going to the closest school, given their place of residence. To be clear, an individual may be forced to go to a far-away school by the choices of others filling up her local school. In the context of a semi-closed and relatively inflexible system, not being at the nearest school may not be voluntary. The general equilibrium

[8] The use of a single time may underestimate the amount of choice in rural areas. Longer drive times for everything are the norm in rural areas, and the utility equivalent of a ten minute drive time in an urban area may be a longer distance in rural areas.

[9] This is using straight-line distances. We convert the postcode information to latitude and longitude, and then simply use Pythagoras's theorem to determine distances to each school. For three subsets we have checked this against road distances and found a correspondence of 85% in the two methods' designation of nearest school. We are pursuing this analysis in more depth in a companion paper to this.

implications of choice are complex in such an environment, and it is not possible to work back from the observed outcome to "who exercised choice".

That less than half of secondary school pupils in England attend their nearest school is a striking finding, however, and suggests that post-residential school choice is a very important component of the overall schooling decision. Again, the breakdown by area types is as expected: the proportion attending the nearest school is lowest in denser environments. Splitting the sample into selective and non-selective LEAs, in the latter more pupils go to their closest school. Since location is not a key part of the student assignment mechanism in selective LEAs this is not surprising.

b) Characterisation of Ability Sorting

Ability sorting is key to the nature and impact of peer group effects and hence to one of the main issues in the analysis of choice. We therefore focus on this in detail, and discuss other dimensions of segregation later. This is also facilitated by the fact that we can consider the whole ability distribution.

The results are presented graphically in the form of quantile profiles. We take the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} percentiles of the KS2 distribution in each school in an LEA. These are then graphed out, connecting the quantiles. Consider the top left panel of Figure 1, for Islington, a small LEA in London. Each vertical slice through the graph shows the distribution of KS2 scores for a school. All the schools in the LEA are portrayed, the schools ranked by mean KS2. Because the KS2 scores can take only a small number of values, the lines contain long flat segments. Using KS4 scores with much more variation produces the same patterns but with a greater degree of continuity.

The patterns are interpreted as follows. A flat set of quantile lines (as in Islington) shows very little ability sorting, as all schools have more or less the same

intake ability distribution. By contrast, a set of upward sloping lines indicates a high level of intake stratification, and the more steeply sloping the lines the greater the degree of stratification. An advantage of this graphical approach is that it allows the whole distribution to be considered, and differential sorting at the top or bottom of the intake ability distribution to be revealed.

Figure 1 presents the quantile graphs for a selection of LEAs, chosen on the basis of degree of location/urbanisation, and selection policy[10]. As noted, there appears to be very little ability sorting in Islington, a small (in terms of area) London LEA with no overt selection policy. In Islington, the highest (mean) intake (KS2 score) school has essentially the same ability distribution as the lowest. This is not just a feature of London. The final panel of Figure 1 is for Oxfordshire (which also is not selective). Here there is a little more stratification, but still the highest intake and the lowest intake school are not that different in terms of the ability distribution within the school. The situation in Barnet, a London LEA with some selective schools, is different. Whilst the bulk of schools in the middle are similar, there is a group at the top and a group at the bottom with very different intakes. In the top (highest mean intake) three schools, the 10th percentile of their ability is commensurate with the 90th percentile of bottom schools. The top two schools receive no or few students below 29 KS2 points, while the lowest four schools take very few above that score. Barnet has a small number of selective schools and their impact on the pattern is clear.

The patterns in the two very large metro areas of Birmingham and Manchester are rather different. Both exhibit gently upward sloping lines, but in the case of Manchester, these are generally smooth, showing a relatively continuous pattern of stratification. In Birmingham it is clear that there is a set of elite "academies" with

[10] The graphs for all LEAs are available from the authors.

very little intake of students below 25 points. These are Birmingham's selective schools. Manchester has no selective schools. The figures for Trafford, Buckinghamshire and Kent, which largely conform to the elite assignment rule, show very strongly the impact of selective schools. There is a clear dichotomisation of the distribution in each of these LEAs. It is interesting that the difference in the distributions is much greater at the bottom of the ability distribution than at the top. The high intake schools do have more high ability students, but the main distinction is that they take in no low ability students.

We can characterise the relationship between the degree of ability sorting and the feasibility of choice. We derive a summary statistic of the degree of sorting by regressing each pupil's KS2 score on the school mean KS2. We take the R^2 as the measure of sorting[11]. Very low sorting means that an individual pupil's score is uncorrelated with the school mean, implying a low R^2. High sorting implies high correlation of individual and school score and so a high R^2. We run this regression separately for each LEA to produce an LEA-level measure of sorting. Table 3 simply regresses this R^2 measure against the average number of schools that are reachable from a school in the LEA in a ten-minute drive, averaged over the LEA. The results are mildly supportive of a positive relationship in non-selective LEAs: more schools within a DTZ mean more sorting by ability. We return to this issue below.

We return briefly to the role of private schools. As noted above, we do not have data for all private schools. Figure 2 shows a modified version of the quantile graphs for 4 LEAs, including the data on the private schools we have data for. These are denoted by a vertical line joining the quantiles. The other addition to the figure is

[11] This is very closely related to the within/between variance ratio. While there may be statistical issues arising from the use of the R^2 from one regression as the dependent variable in another, we are simply using it here as an intuitive summary statistic. In fact, it correlates well with the standard *D* measure of segregation, which could be used instead.

an upper panel showing the size of the school (strictly, the size of our cohort in the school). The figure shows that private schools are typically at the top end of the intake distribution (eg Oxfordshire), but not always (eg Barnet). It shows that in all these LEAs, they are much smaller than state schools[12]. The inclusion of these schools changes the picture considerably for Oxfordshire (now looking much more segregated) and Manchester. The impact is less marked on Barnet and Birmingham. Overall, comparing the R^2 sorting statistic with and without the (partial) data on private schools shows that for most LEAs they are similar, with increased sorting in some (not least because numbers in these schools are so low). The rest of the paper reverts to exclusion of all private schools.

c) Characterisation of Multi-dimensional Sorting

We now consider different dimensions of student sorting. In particular, we are interested in how these are related. We measure segregation on dimensions of student disadvantage (entitlement to free school meals, FSM), of ethnic group, and of ability. To allow us to straightforwardly compare these, we create two dichotomous measures of ability: high ability (a student having a KS2 score above the 80th percentile), and low ability (a KS2 score below the 20th percentile). National level indices of segregation make little sense in this context, so we calculate the indices for each LEA separately, and then look at the distribution across LEAs, weighting by the LEA student population. Each measure is calculated for each LEA and the distribution refers to the distribution over LEAs, so the 75th percentile is to be interpreted as giving the value of the dissimilarity index, *D*, above which 25% of LEAs are to be found. Table 4 shows the means and some details of the distribution of the segregation measures.

[12] This is not an artefact of our partial data. We have all the data for each school, but not all schools.

The levels of ability and poverty segregation are generally not high. Three quarters of LEAs have ability and poverty segregation measures of 0.32 or below. Even at the extremes, segregation is not very high. The situation is very different for ethnic segregation, with high average values and very high values in some LEAs (see Burgess and Wilson (2003) for a more detailed analysis of ethnic segregation in England's schools).

Table 5 shows the summary correlation across LEAs of segregation on these different dimensions. Unsurprisingly, areas with relatively high segregation of low ability pupils also tend to have high segregation of high ability pupils. Given the link between low KS2 scores and family poverty (FSM), the correlation of segregation on these two dimensions is also as expected. The simple unconditional correlations between ethnic segregation and ability segregation are negative. This may be related to the fact that the populations of Black and South Asian ethnic origin groups are spread very unevenly across the country (Burgess and Wilson 2003).

d) Post-residential Choice and Sorting

One of the powerful aspects of our dataset is the ability to place students in their neighbourhood context. We can use the postcode data to assign each student to a ward (an electoral unit of around 5000 people on average, including approximately 600 10-17 year olds) within an LEA. This means that we can compare the spatial patterns of students in two different but related domains, their home and their school. Having located students in wards, we can analyse the distribution of ability (and other characteristics) across space. As far as we know, this is only possible using our dataset, and has not been examined before. This allows us to compute measures of sorting of students in the neighbourhoods where they (choose to) live as well as the

schools they choose to attend. This means we can document the relationship of spatial patterns of residence under different student-school matching rules.

Figure 3 graphs the school-based segregation measure (vertical axis) against the neighbourhood-based measure (horizontal axis). This gives us a picture of the impact of post-residential choice on the degree of sorting. These are for non-selective LEAs only. The first two panels examine high and low ability segregation, and the third income (FSM) segregation[13]. Focussing on the ability segregation results, it is striking that there is not a very close relationship between segregation in schools and segregation in neighbourhoods. The 45^{o} line shows that these non-selective LEAs split about evenly into those in which the student-school matching increases the segregation of high ability students, and those in which it attenuates it. There are, however, some LEAs where the school-based segregation is considerably higher than segregation at the neighbourhood level. We take this as evidence of post-residential segregation. The same pattern is observed for low ability student segregation and for income (FSM) segregation.

In Figure 4 we consider explicitly the impact of ability selection in the selective LEAs. The first panel shows all LEAs, the second panel selective and the third panel non-selective LEAs. As expected, it is clear that the selective LEAs exhibit very high levels of high-ability segregation in schools. But it is also clear that they do not, in general, have very high levels of neighbourhood segregation of ability. This illustrates the divorce of residence choice from school choice that arises in elite schooling areas.

In Figure 5 we explicitly compare the quantile graphs based on school and on neighbourhood. The top panels show Buckinghamshire (an elite schooling LEA) and

[13] Ethnic segregation is discussed in more detail in Burgess, Wilson and Lupton (2004).

the bottom panels Hertfordshire (the latter being a neighbourhood schooling LEA matched to the former using PS matching techniques; details available from the authors). There are a number of points to make. First, as noted before, the contrast in the schools' pattern between the two areas is very stark. Second, in Buckinghamshire, we do not see the same sorting pattern for neighbourhoods that we do for schools. This illustrates the divergence of school and neighbourhood sorting with an elite school assignment rule. Finally, we might expect to see greater residential sorting in the neighbourhood assignment rule LEA, but that is not obvious in this particular conparison.

This leads on to an analysis of the degree of choice and the concentration or dilution of residential segregation by the school matching process. It is clear, not least from the graphs above, that one cannot take residence as exogenous and think about school choice conditional on that. Choice of residence depends on the nature of the pupil assignment rule, with school and residence choice determined jointly. But it is also clear from our results above that post-residence school choice is a substantial part of the overall school choice process. It is worthwhile characterising the (partial equilibrium) nature of this process whilst being aware that the degree of school and neighbourhood segregation may be a factor in initial housing choice.

We take the ratio of the school-based segregation index to the neighbourhood-based segregation index as an indicator of this process. In Table 6 we regress this on our measure of school choice, the average number of schools that are reachable in a ten-minute drive from a school in the LEA, averaged over the LEA. We repeat this for all the dimensions of segregation considered, and separately for all LEAs and just non-selective (neighbourhood schooling) LEAs. We find a strong positive correlation between the extent of choice and the extent of school segregation, controlling for

residential segregation. We find this for all dimensions of segregation. The correlation is statistically significant in all the analyses and stronger among non-selective LEAs. In other words, in areas in which there are a bigger number of schools to choose between, school segregation is high relative to neighbourhood segregation. Quantitatively the effect is significant as well: a one standard deviation difference in the choice measure of 6.7 schools adds 0.13 to the high ability segregation measure, 0.17 to low ability segregation, and 0.23 to poverty segregation, relative to standard deviations of 0.175, 0.18 and 0.20 respectively. This can be described in two ways – greater choice means that parents can select their desired peer group more easily, conditional on where they live. Or, easier choice means that, given the desired school, parents have greater scope for living where they choose, and not necessarily right next to the school.

6 Conclusion

This paper has exploited a large administrative data set for England to examine the effects of choice on sorting of pupils across schools for 11-18 year olds. England has a system of generalised but differential choice. Parents have some choice of school, but this choice is constrained by availability of schools and education policy. So the observed outcome results from the interaction of demand and supply side selection, feasibility of choice and the assignment rule which governs the allocation of children to school (the last being selection on ability versus selection based on distance).

We first establish that choice of secondary school is both feasible for and exercised by the majority of pupils in England. Over half of pupils aged 11 do not go to their nearest secondary school. We characterise ability sorting and show that ability

sorting at school level is also correlated with sorting at school level by income and ethnicity. We then examine whether the feasibility of choice affects ability sorting and find a positive relationship. Sorting is greater where there is more choice: or put another way, markets in which there are more schools are markets in which there is more ability sorting.

School sorting might simply reflect neighbourhood sorting. We find there is ability sorting (as well as income and ethnicity sorting) by neighbourhood, but on average ability sorting at neighbourhood level is less than school sorting. Controlling for neighbourhood sorting i.e. focusing on post-residential choice, we find that differences in the school-neighbourhood sorting relationship are correlated with the assignment rule that allocates children to schools. The relationship between neighbourhood and school sorting is weaker where LEAs explicitly assign pupils to schools on the basis of ability, so allocation based on distance appears to bring about greater homogeneity of local neighbourhood. Finally, we bring these analyses together and examine the extent to which sorting by ability at LEA level is correlated with feasibility of choice, the assignment rule and income. We find statistical support for a role played by all these factors.

These data hold great promise in unravelling some of the complex patterns involved in creating peer groups in schools, and in particular the roles of the degree of school choice and the nature of the pupil assignment rule.

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Table 1 – Number of nearby schools

	Mean	Standard Deviation	0	1-5	6-10	11+	Observations
All	6.69	6.74	14.52	40.96	23.22	21.3	3127
London	17.19	7.39	0.48	3.14	13.29	83.09	414
Non London Urban	6.74	5.04	3.63	45.7	33.48	17.19	1873
Non London Rural	1.41	1.85	45.71	49.05	5.24	0	840

Nearby: within 10 minutes drive

Table 2 – Exercise of post-residential choice

	Percentage of students attending nearest school	Number of Students
All	44.59	524,609
London	24.09	66,348
Non London Urban	43.43	319,128
Non London Rural	57.01	139,133
Non Selective LEAs	46.66	458,522
Selective LEAs	30.22	66,087

Table 3 – Ability sorting and the feasibility of choice

Dependent Variable: R^2 measure of ability sorting

	(1) All LEAs	(2) Non-selective LEAs	(3) Selective LEAs
No. nearby schools	0.001	0.001	0.001
(LEA average)	(0.93)	(2.17)*	(0.14)
Constant	0.127	0.090	0.355
	(9.18)**	(12.26)**	(8.28)**
Observations	144	125	19
R-squared	0.01	0.04	0.00

Absolute value of t statistics in parentheses

* significant at 5%; ** significant at 1%

Table 4 – Segregation indices

Basis of Segregation	Mean	p10	p25	p50	p75	p90
High ability	0.293	0.175	0.205	0.253	0.321	0.469
Low ability	0.252	0.18	0.205	0.245	0.283	0.336
Disadvantage	0.29	0.2	0.246	0.293	0.327	0.369
Ethnic Group						
Black Caribbean	0.623	0.233	0.419	0.684	0.883	0.936
Black African	0.683	0.277	0.548	0.772	0.887	0.933
Black, other	0.654	0.344	0.532	0.689	0.847	0.916
Indian	0.585	0.345	0.462	0.601	0.726	0.831
Pakistani	0.684	0.426	0.582	0.72	0.837	0.917
Bangladeshi	0.707	0.427	0.615	0.748	0.861	0.932
Chinese	0.624	0.418	0.546	0.637	0.733	0.788
Other	0.504	0.323	0.386	0.503	0.625	0.707
Black	0.534	0.273	0.394	0.526	0.668	0.806
South Asian	0.554	0.369	0.458	0.585	0.662	0.715

Table 5 – Correlation of segregation indices

	Black	South Asian	Low ability	High ability	Disadvantage
Black	1				
South Asian	0.374	1			
Low ability	-0.145	-0.06	1		
High ability	-0.142	-0.1	0.791	1	
Disadvantage	0.014	0.077	0.587	0.395	1

Table 6 – Relationship between school/neighbourhood ratio and school choice

Dependent variable: Ratio of school-based to neighbourhood-based segregation measure of the indicated variable:

All LEAs	(1)	(2)	(3)	(4)	(5)
	High Ability	**Low ability**	**Disadvantage**	**Black students**	**South Asian Students**
No. nearby schools	0.020	0.026	0.034	0.024	0.020
(LEA average)	(2.14)*	(4.59)**	(9.58)**	(7.13)**	(7.11)**
Constant	1.155	0.962	0.743	0.725	0.768
	(12.01)**	(16.30)**	(19.82)**	(20.24)**	(26.25)**
Observations	144	144	144	142	143
R-squared	0.03	0.13	0.39	0.27	0.26
Non-selective LEAs only					
No. nearby schools	0.021	0.027	0.036	0.025	0.019
(LEA average)	(5.27)**	(6.20)**	(10.08)**	(7.15)**	(7.02)**
Constant	0.905	0.864	0.710	0.720	0.761
	(20.62)**	(18.17)**	(18.64)**	(19.19)**	(26.51)**
Observations	125	125	125	123	124
R-squared	0.18	0.24	0.45	0.30	0.29

Absolute value of t statistics in parentheses
* significant at 5%; ** significant at 1%

Figure 1 – Ability sorting across specific LEAs

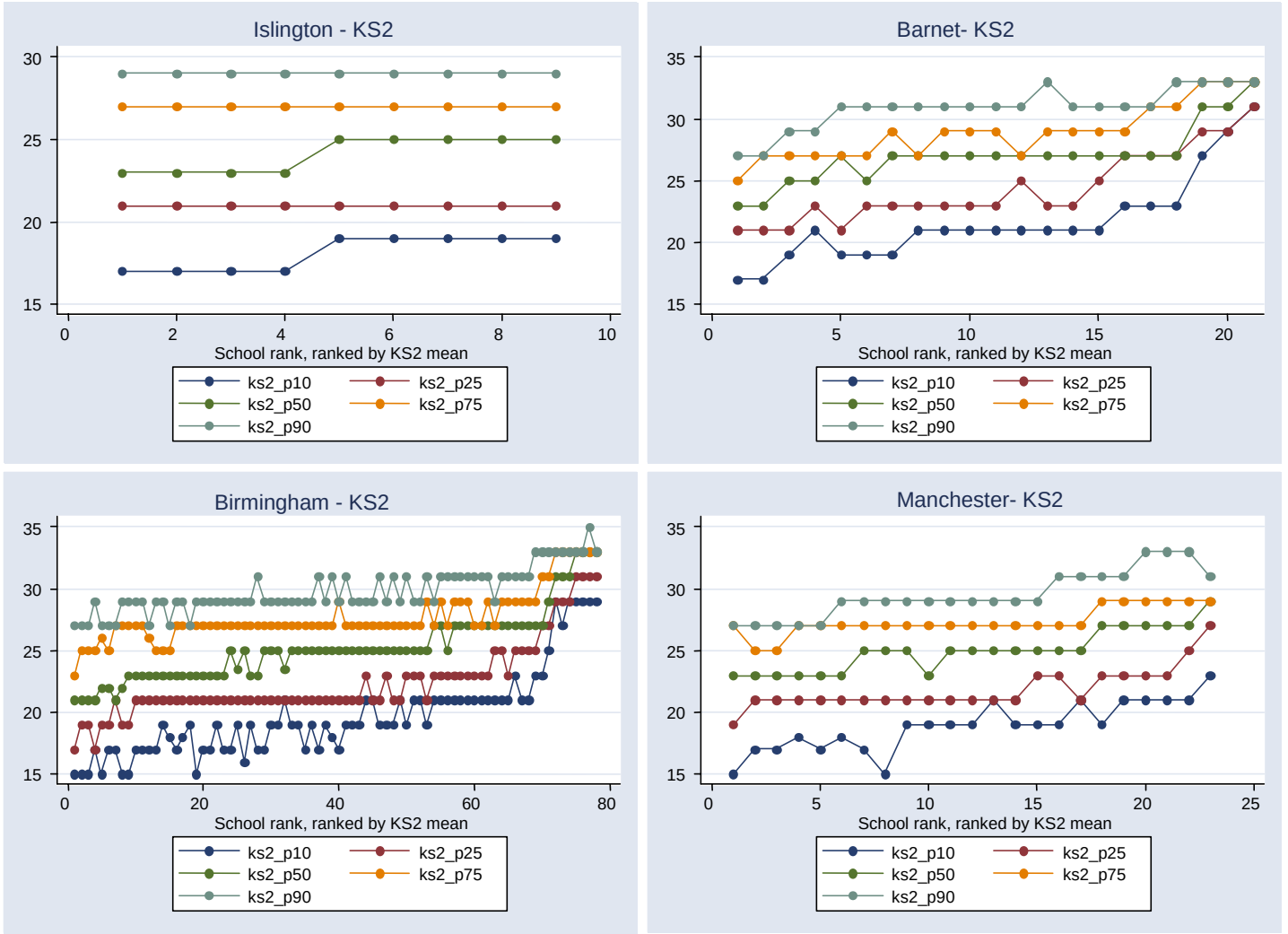


Figure 1 Continued

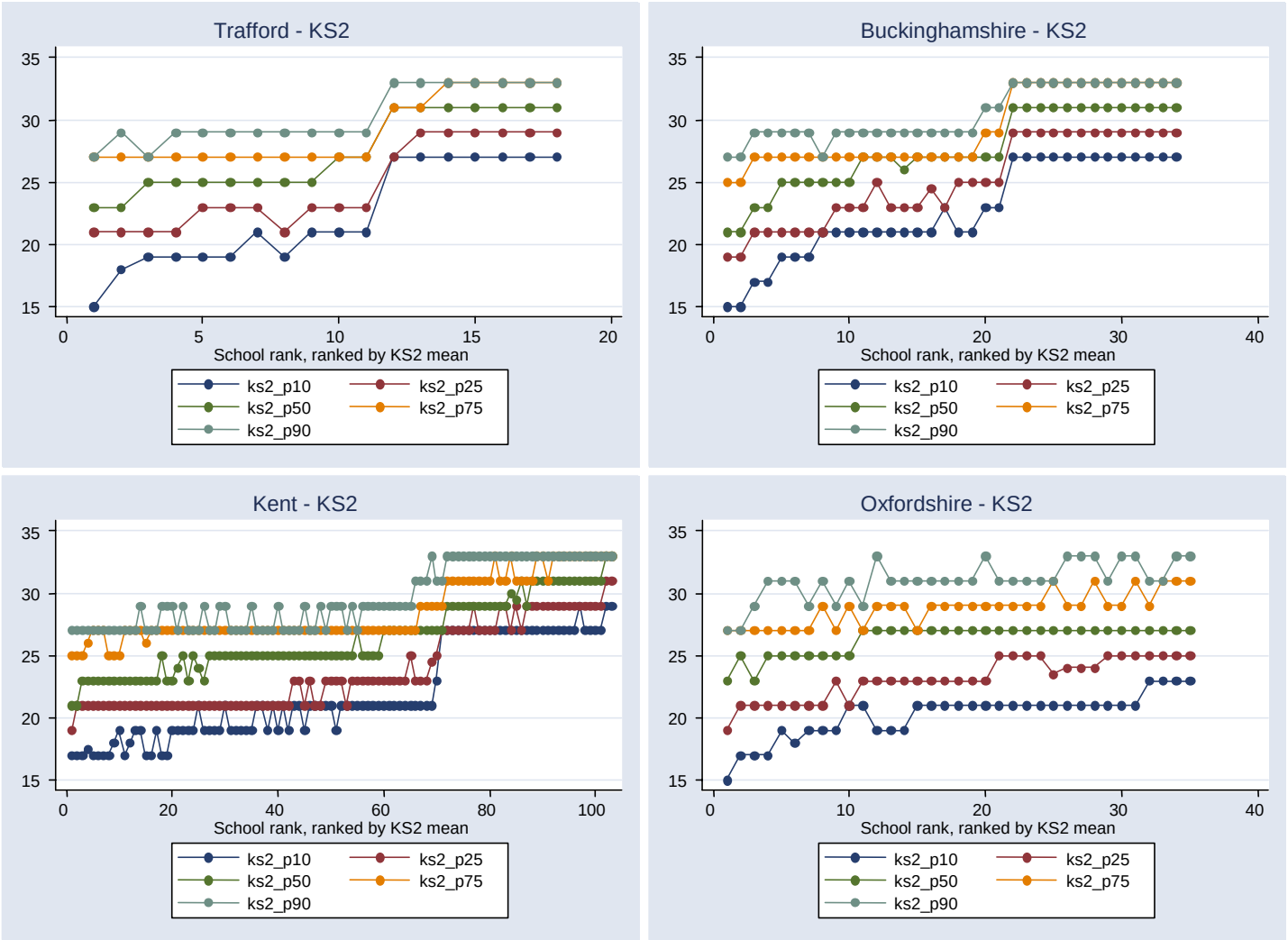
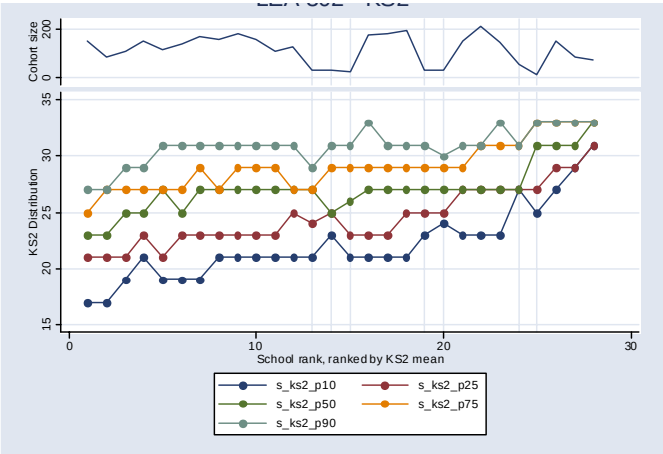
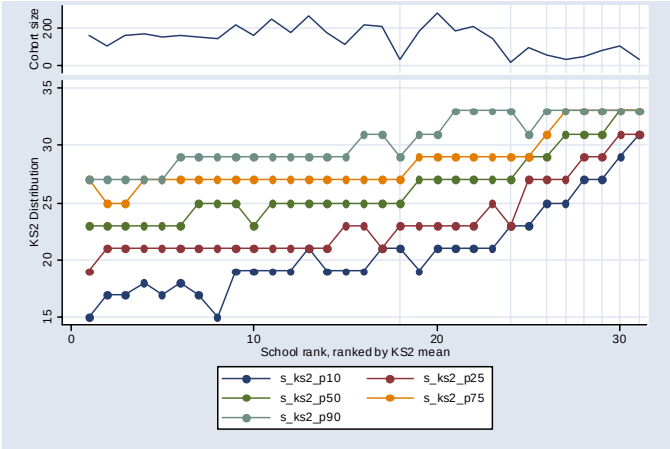


Figure 2: Ability Sorting including Private Schools

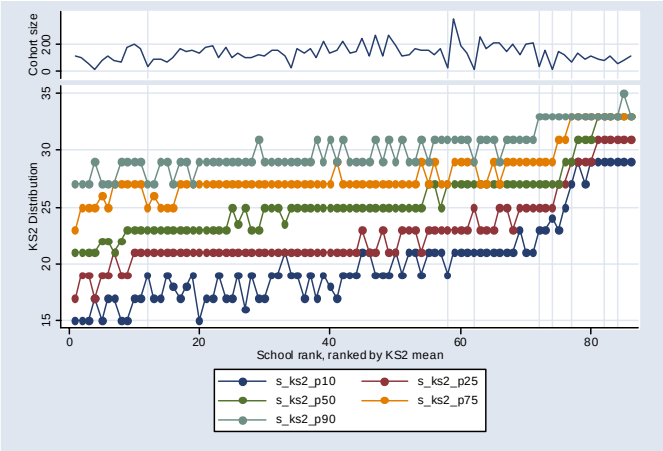
Barnet



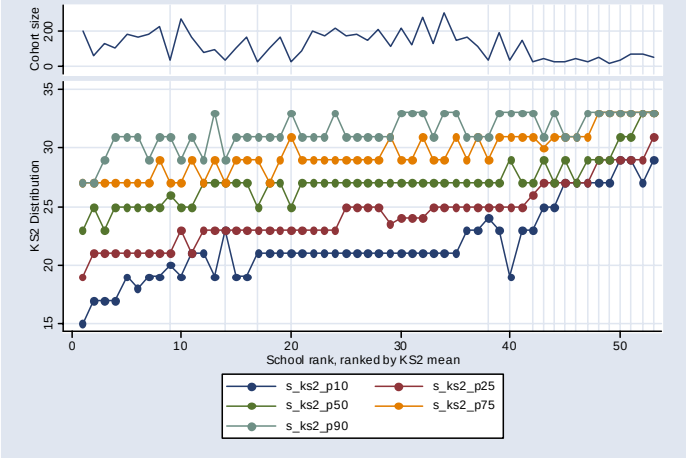
Manchester



Birmingham

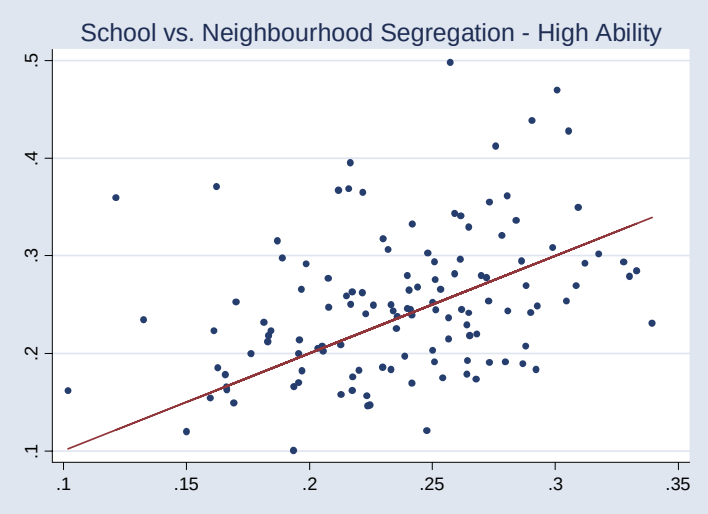


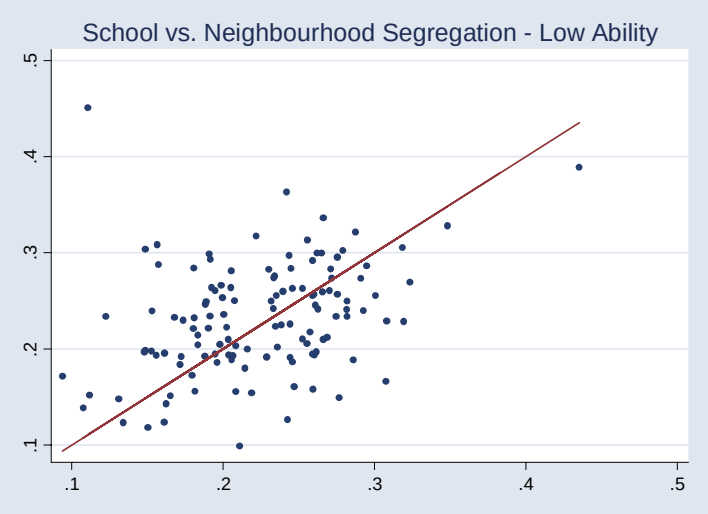
Oxfordshire



The upper panel of each Figure shows the size of the cohort in each school. The vertical lines indicate that that school is a private school.

Figure 3 – School and neighbourhood segregation along different dimensions





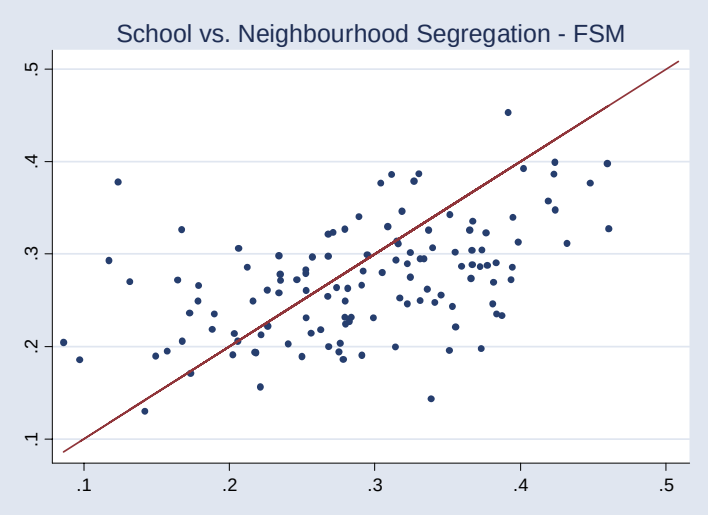


Figure 4 – School versus neighbourhood segregation: high ability

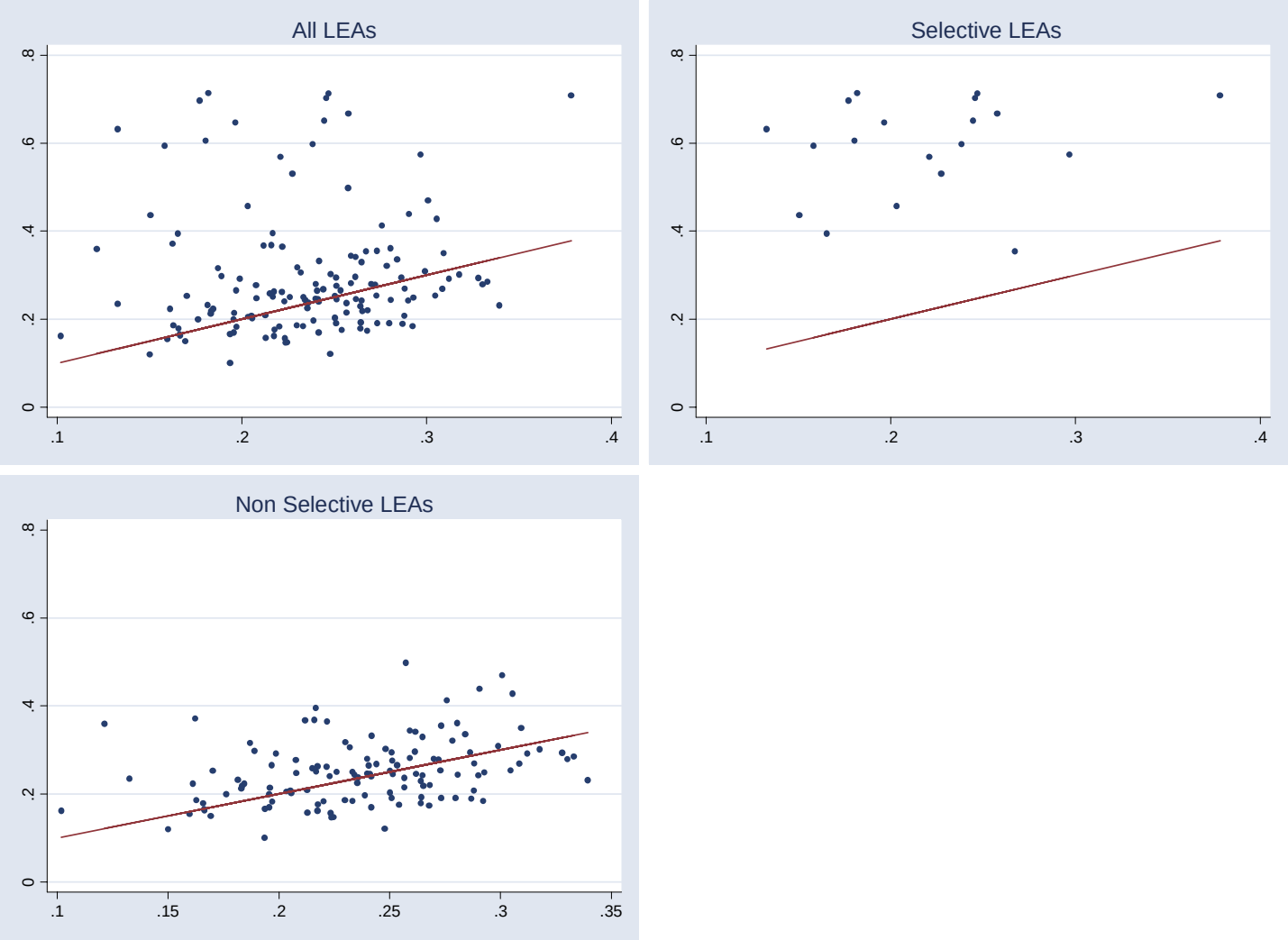


Figure 5: School and Neighbourhood Sorting – Elite and Neighbourhood Schooling

Buckinghamshire is an Elite (Selective) Schooling LEA, Hertfordshire an otherwise-similar neighbourhood (non-selective) LEA

School-based

Neighbourhood-based