Modelling school catchments, choices and ethnic segregation: a geocomputational approach

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1. Introduction

Recent papers from the Centre for Market and Public Organisation (CMPO), University of Bristol, England (e.g., Burgess & Wilson 2005; Burgess, Wilson & Lupton 2005; Johnston et al. 2004, 2006; Johnston, Burgess & Wilson 2005), have modelled ethnic segregation between state schools in England and Wales. Because patterns of ethnic segregation observed for schools simply may reflect residential geographies, so measures of school-level segregation are compared with measures of segregation for the pupils' residential localities. The general conclusion is that school-level segregation matches or exceeds neighbourhood levels of segregation.

An interpretation of this finding is that choice in the 'education market' allows parents to school their children in more distinct ethno-cultural groupings than a representative selection from ethnically diverse neighbourhoods would generate. If this interpretation is correct (and it may not be), then recent Government proposals to further school choice may undermine the potential to promote multicultural tolerance and 'mixing' within student intakes. Essentially this is the "orthodox view" described by Noden (2000) (after Gewirtz et al. 1995; Waslander & Thrupp 1995), albeit now with an ethnic dimension: "this orthodoxy suggests that quasi-markets present further advantages to already advantaged families and that, consequently, such market reforms will lead to increased social segregation in schools" (op. Cit. pp. 371-2).

The aforementioned body of research focuses on the demand side of the education market, insofar as demand is expressed by the schools pupils attend (not actually just a matter of choice: see below). Conditioning on characteristics of pupils and of schools, generally it is assumed that parents will prefer to send their child(ren) to the nearest school to their home. What the research lacks, however, is explicit consideration of the geography of supply: the proximity of schools to each other and the extent to which they compete with each other for the same spaces of recruitment. Implicit friction of distance and 'least cost' assumptions are not tenable if school catchment areas overlap substantially and frequently: if they exhibit a geographical patterning that is not incorporated within the model but would likely alter the likelihood of attending a nearest school. As Gibson and Asthana (2000 p.304) remind us: "the geography which matters is the local … and the scale of analysis should be commensurate with the local markets within which schools actually operate."

2. Modelling the 'core catchment' areas of schools

State schools in England and Wales do not have set catchment areas; rather, parents are invited to express a preference as to which school they would like their child to attend. Yet, no school has unlimited capacity, therefore parental choice is constrained, ultimately by admissions criteria which may include whether a sibling attends the school, religious affiliation, gender and – critically – proximity to the school.

Consequently, any school is likely to have a spatially clustered admissions geography; this particularly is the case for primary schools. Schools may not have de jure catchment areas but they do have de facto ones and these can be revealed by mapping the Pupil Level Annual School Census returns (PLASC) micro-data, released for research by the Department for Education and Skills (DfES).

Figure 1 shows the admissions geography for one primary school in Birmingham: each circle (&) represents a postcode within which one or more pupils attending the school reside. Superimposed upon the geography (as a hatched line) is what here is termed as the 'core catchment area' of the school: it is the area within which 50% of the pupils attending the school reside.

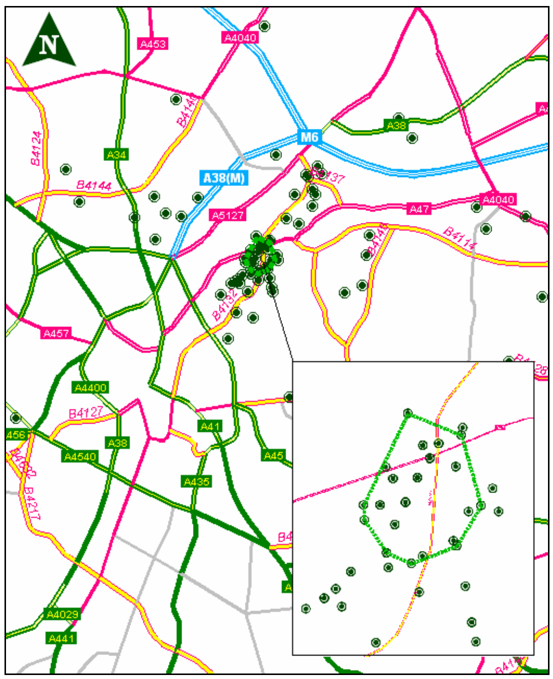

Figure 1. The 'core catchment' area of a primary school in Birmingham, England (containing 50% of the pupils that attend the school)

There are many ways of defining a core catchment area. Even agreeing the 50% criterion, the school concerned has 200 pupils, meaning there are 200! ÷ (100! × 100!) ways of selecting half. The core catchment shown in Figure 1 has been determined using the following algorithm:

1. Position a rectangle at the (median *x*, median *y*) residential grid reference, calculated for the set of all home postcodes for pupils attending the school: a geographical centroid.

2. Allow the rectangle to grow in one of the N, NE, E, SE, S, SW, W, NW directions, choosing that which returns the greatest prevalence of pupils attending the school (i.e.

maximise n1 / n2 where n1 is the number of pupils in the search area that attend the school and n2 is all pupils in the search area).

3. Repeat stage 2 until 50% of the school's pupils have been included in the catchment.

A further constraint is that postcodes with point location more than 1.5 × interquartile range in any of the eight search directions are excluded from the core catchment areas. The result is to produce a compact and unbroken catchment area representing the clustered residential geography of half the pupils attending the school.

Having done it for one, core catchments can be calculated for each of the remaining 321 primary schools in Birmingham. The catchments are found to overlap. Consider the pupil identified with the ; symbol in Figure 2. They are within and do attend the school of Figure 1. But they are also within the core catchment areas of two other primary schools. It may be argued that the apparent local choice set, C_i, of pupil i at location (x_i, y_i) has three elements (three schools to choose from), of which the school i attends – j_i – is in this case a member: $j_i \in C_i$.

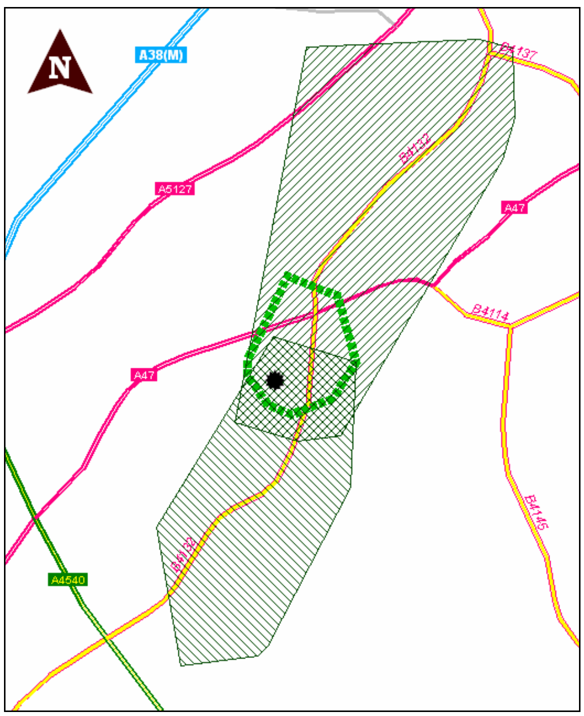

Figure 2. An example of overlapping catchment areas.
The pupil appears to have had the choice of three schools to attend.

On average, the size of the choice set (#C) is 1.81 (mean) or 2 (median) for primary school pupils in Birmingham. The interquartile range is from 1 to 2; the maximum is 6; the minimum is 0 because not all pupils that attend a primary school will reside within a core catchment area (then, C_i: $\varnothing$ – it is a null set – true of 9912 of 104306 pupils; 9.50%).

Other pupils will reside in one or more core catchment areas ($\#C_i \geq 1$) but not attend those schools: $j \notin C_i$ (true of 42008; 40.3%). This latter group of pupils are of particular interest because in regard to their schooling they are 'violating' a friction of distance /

least cost argument. Defining as being near to a pupil any primary school that has a core catchment that includes the pupil's residential postcode, it appears that Black Caribbean pupils are more likely to travel further than they need do to attend primary schools than do, for example, Bangladeshi pupils – Figure 3 (and this remains true when formally modelled within a multilevel framework conditioning on characteristics of the pupils and of schools).

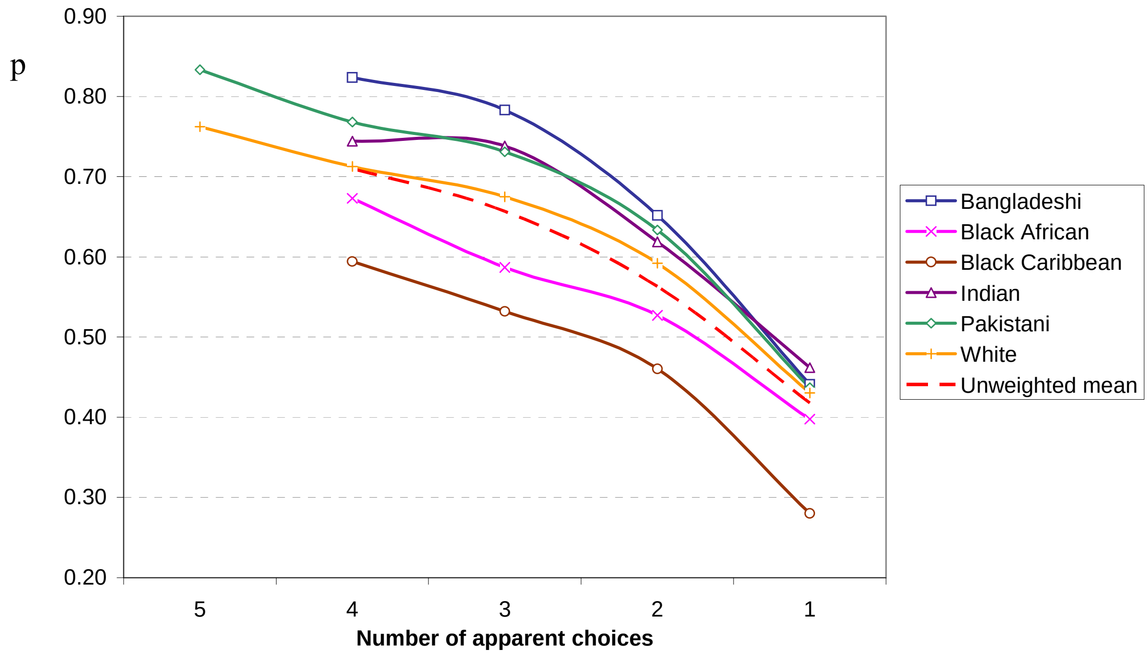

Figure 3. Proportion of pupils attending a near primary school (by ethnic group).

3. Modelling segregation

Figure 3 may suggest a migratory process of ethnic separation. However, this is not the only way that segregation can occur. Local processes are possible where there is a choice of schools available and where particular ethnic groups are attracted into specific schools (and not others).

If such processes are occurring, then they can be detected. For example, for each of a subset of local intake schools it is possible to look inside the school core catchment area and find (a) the proportion of all pupils there who are Black Caribbean: this is the expected proportion (E); and also (b) calculate the proportion of pupils who are in the catchment and who attend the school that are Black Caribbean: this is the observed proportion (O).

If each school receives a representative sample of the population within its catchment then there should be little difference between O – E, but often there is, particular when schools are competing for the spaces of recruitment. Figure 4 plots the difference (O – E) for the Black Caribbean group (y-axis), against the expected proportion for the same group (x-axis), conditioned on the average size of the choice set for pupils within the schools. The coplots are read from left to right, bottom to top: the bottom-left plot shows the relationship between y and x for schools with least competition with others; the top-right plots shows the relationship for schools with most competition. Each circle on a plot represents a school, although because the coplots 'overlap' the same school can appear in more that one plot.

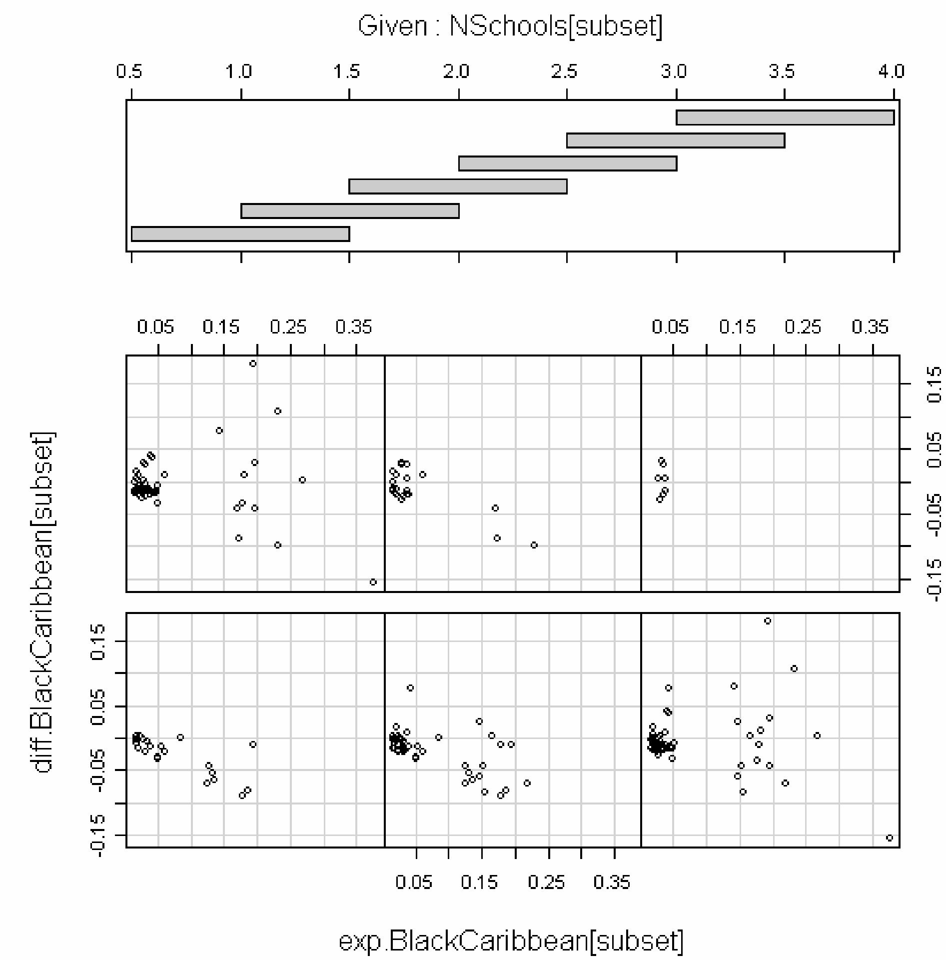

Figure 4. Coplots showing O – E against E for Black Caribbean pupils, conditioned on a measure of how much local intake primary schools in Birmingham are in competition.

4. Conclusions

The analysis presented here extends Johnston et al.'s (2006) finding that ethnic segregation is greater for primary schools than for residential areas by providing a more direct comparison between schools and their recruitment areas, by explicitly considering the local supply of school places, and by noting two processes of ethnic separation: migratory and local. The 50% 'core catchment' threshold used for the analyses is, of course, arbitrary but it is also true that the local measures of difference are conservative: they measure O – E where E → O by design.

This study concerns segregation – a word that generally is used pejoratively. There is a need to be careful about normative statements implying that ethnic minority students should not choose to send their children to schools where that ethnic group is more dominant (than it is, say, at the neighbourhood level). The simple fact is that, in England, 89% of white pupils are in predominantly white primary schools.

Finally, whilst it is tempting to subscribe to the ‘orthodox view’ that choice (in an education market) is socially divisive, there are also clear counter-arguments. The simplest is to note that it can be better than ‘allocation by mortgage’.

5. Acknowledgements

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6. References

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