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Abstract: In this paper, we propose a new method for assessing the extent to which schools are successful in mixing students from different backgrounds. It is based on a comparison of variation in the composition of the student population in small-scale residential neighbourhoods with variation in the composition of the student population at local schools. From this we compute a measure that corresponds to the number of small scale neighbourhood that needs to be sampled in order to arrive at the observed mixing of students in schools. Using this measure we can show that in a large majority of Swedish municipalities, schools are successful in mixing students from different types of neighbourhoods, but in 25% of the municipalities mixing is not so good. Three fundamental determinants of mixing are large-scale residential segregation, average school size, and number of students in the municipality. These factors are strong determinants of mixing and when they are included, other contextual factors provide very little additional explanation of why mixing varies among municipalities. With the fundamental determinants excluded the contextual factors have an effect. For example, tertiary education, many migrants, and high proportions of independent schools tend to lower the level of mixing.

Keywords: School segregation, residential segregation, mixing, student allocation, measuring mixing, determinants of mixing

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Introduction

Residential segregation is largely shaped by complex factors or factors beyond political control; in contrast, the allocation of students to schools is often controlled by administrative decisions. Hence, in the public debate, school segregation is often a more sensitive issue than residential segregation. At the same time, because place of residence plays an important role in which schools students attend, patterns of residential segregation influence school segregation. Thus, it can be difficult to determine how admission policies shape school segregation.

In this paper, our aim is to make a contribution to the literature that addresses how school allocation patterns influence school segregation. A similar question underlines much of the evaluation of systems used to assign students to schools, such as catchment areas, school choice systems, parental strategies, financial constraints, time constraints and geographical constraints (Alegre and Ferrer 2010). Our focus will not be on these systems but on the resulting mixing of students from different neighbourhoods in schools in municipalities. The result will be a performance measure for school municipalities that answers the following questions: To what extent do schools recruit students from different neighbourhood types? Furthermore, how does such school recruitment influence school segregation in the context of residential segregation?

There is a reason that both high levels of residential segregation and high levels of school segregation are viewed as matters of concern for equal educational opportunity. Different social contexts - the family, the neighbourhood, and the school - play an important role in shaping an individual's life course. Of these contexts, the family is the most important. Usually, the influence of the neighbourhood and the school on young peoples' life courses are added to the family effect. The influence of family can also be mediated by the residential context and the school context. If children from poor families are sorted into neighbourhoods and schools with high concentrations of children with similar backgrounds, their chances of breaking out of the cycles of poverty may be diminished (Brooks-Gunn and Duncan 1997). Conversely, schools and neighbourhoods with high concentrations of children from privileged backgrounds can help already advantaged children secure a continued privileged existence (Hanushek *et al.* 2003).

Thus, to analyse how allocation to schools influences school segregation, we suggest a method that can differentiate between deviations in the school system that reflect residential segregation and deviations that depend on school recruitment methods. The new method that we suggest divides the standard deviation of neighbourhoods by the standard deviation of schools to determine the number of neighbourhoods from which schools draw students.

In addition to using a new measure, we argue that there are three fundamental factors that affect the impact of school recruitment on school integration: the presence of large-scale segregation, the average size of the schools and the size of the school market. We will show that these factors crucially affect the extent to which municipalities succeed in mixing students.

Two arguments motivate this study's evaluation of how well municipalities integrate students in schools. First, if school segregation exceeds the neighbourhood segregation following school reforms, the reform in question (e.g., free school choice) can be said to increase school sorting, which is believed to negatively influence student outcomes and harm equal access to opportunity (Allen 2007; Osth *et al.* 2013; Rangvid 2007). In a New York Times interview, Nicole Mader (author of a paper on school segregation) said that "*If 40 % of elementary school students aren't going to school where they live, how can residential segregation be the only factor driving school segregation?*" (Elizabeth A. Harris 2018). This is yet another observation of high interest in the question of how well schools mix students from different neighbourhoods. As mentioned, school segregation hinders the overall achievement of students within a school system, as noted in Sweden in an OECD report (OECD 2015).

In contrast, if neighbourhood segregation is stronger than school segregation, schools may manage to mix students from different backgrounds, but the home environment will be associated with limited equality in opportunity for children and adolescents. Policies that lead to 'extra-mixed' schools (i.e., schools that provide diversity beyond that at the neighbourhood level) are thus important to identify. Examples include municipalities creating one large school (grades 6-7) to prevent school segregation (Carlbom 2017, April 27); such large schools draw students from both a large *number* of neighbourhoods and different *types* of neighbourhoods, hence creating a mix of students. Similarly, as in other countries, Swedish schools must offer equal education regardless of geographical location or parental background, and schools should also be compensatory (Regeringskansliet 2010). Mixed schools can be one way of supporting this idea because inequality has damaged the outcomes of the once-unitary Swedish school system (Erikson and Jonsson 1996).

The idea here is not to consider educational outcomes at the student level. Other studies have considered the interaction between grades and segregation, which is important and motivates this study. Most such studies of students' outcomes and segregation have reported increased achievement differences among schools when school segregation increases (Reardon and Owens 2014); additionally, school segregation also increased the importance of both family background and neighbourhood effects on grades (Andersson *et al.* 2018).

We investigate municipalities to determine whether there is variation in the extent to which schools in different municipalities mix students. As most Swedish schools are run by municipalities, there might be differences in how they are run and how they use educational priority policies to mix students. However, educational priority policies aim primarily to compensate for uneven achievement in schools. To a lesser extent, these policies help with the sorting of students into different schools (Franck & Nicaise).

Literature and background

Earlier research on how school allocation patterns influence school segregation provides important background for this study. Recently, the Casey review, a governmental report conducted in the UK, reported stronger ethnic segregation in schools than in residences; that is, school administrations did not manage to integrate students in schools (Ministry of Housing and Government 2016). Harris and Johnston found that the empirical evidence for this conclusion was somewhat mixed; instead, he found that residential segregation was greater (Richard Harris and Johnston 2018). A study in the same vein by Boterman recently stated that the educational landscape and the residential segregation landscape are correlated (Boterman 2018). Boterman argued that although Dutch urban areas are mixed, school segregation is considerable. He showed high segregation (measured by the dissimilarity index) for schools in Amsterdam and stated that school choice was partly to blame.

The discussion above shows that there are important critical aspects to consider. First, the segregation patterns for schools and neighbourhoods might differ according to *various characteristics*, such as whether the student was foreign born, has low-/high-income parents, has well-/low-educated parents or lives with a single parent. For instance, there is evidence that schools are rather strongly segregated in terms of foreign-born students (Andersson *et al.* 2010) and are even more segregated than neighbourhoods (Böhlmark *et al.* 2015).

Another critical aspect of studies comparing school and residential segregation is the *scale of analysis*. For example, when a school is very small, chances are it has a rather homogenous composition of students compared to a large school. Similarly, small neighbourhoods do not mix students as much as large neighbourhoods do if students are selected randomly. A recent study analysing ego-centred neighbourhoods in Sweden that included the 25 closest peers found a higher standard deviation for neighbourhoods than for the school peer population (Andersson *et al.* 2018). Thus, the finding of higher neighbourhood segregation than school segregation was in accordance with Richard Harris and Johnston (2018). It naturally follows that the more numerous the schools in a municipality, the greater the segregation will be, and the fewer the schools, the lower the school segregation. Additionally, Johnston *et al.* (2006 found greater segregation in schools in an earlier study despite Richard Harris and Johnston (2018) more recent findings of greater neighbourhood-level. The discussion of scale is thus crucial to mixing in schools and to the comparison of school and neighbourhood segregation because the use of large-scale neighbourhoods encompassing a population with various characteristics will most likely show comparably larger school homogeneity/segregation, while the use of small-scale neighbourhoods will show less school segregation then neighbourhood segregation.

Brandén and Bygren (2018) present a recent Swedish contribution to the study of school segregation that takes school choice into consideration. They write that the establishment of new schools increases the in-school segregation of students based on ethnic background and parent education level. When new schools are established, they decompose the flow of students from neighbourhoods into more homogenous schools, which increases school segregation. Importantly, Brandén and Bygren also add the influence of the establishment of voucher schools, which they found to increase school segregation to a greater degree than the establishment of public/municipal schools. This effect may occur because voucher schools profile their offerings more strongly, direct their marketing more specifically, or represent a special case that attracts more highly educated parents to a greater degree. The latter possibility, that voucher schools attract more highly educated parents, is the conclusion of the Branden and Bygren study. Another finding is that integrated neighbourhoods experience a greater increase in segregation when new schools are added. This increase in choice promotes more sorting among students. Thus, the authors' finding does not support the political idea that free school choice counteracts residential segregation. A common earlier argument was that parents in disadvantaged areas could opt out of local schools in favour of schools that are closer to advantaged residential areas (Brandén and Bygren 2018).

The Swedish study is not alone in finding that compared with residential segregation, school segregation can be worsened by sorting and the non-conscious allocation of students. Burgess *et al.* (2005 found that for most ethnic groups, children are more segregated at school than in their neighbourhood. There is clearly a relation between segregation in schools and in neighbourhoods, but they do not map one-to-one; the results differ across ethnic groups. In addition, interestingly, this study found that school segregation increased with population density (Burgess *et al.* 2005). Such results were also found in a Swedish study on travel-to-school patterns: Swedish students and parents had a tendency to avoid local schools if they lived in neighbourhoods with large foreign-born populations (Andersson *et al.* 2012b). In terms of school segregation being greater than residential segregation, Lankford and Wyckoff (2006 write about race in the United States. They found that the racial composition of schools and neighbourhoods is a very important factor in the school and residence decisions of white families. White families opt out of urban public schools in favour of private schools or suburban schools; consequently, schools are more ethnically segregated than neighbourhoods as a result of the school choices that families make (p. 50).

Taylor and Gorard (2001 analyse the role of residence in school segregation and warn that the effect of residential segregation on school segregation is greater than expected when there is a return to catchment areas and distance-based school allocation. Inherited ideas about schools serving the children in the closest neighbourhoods and the role of differentiation in house prices and selection in residential mobility are put forward in discussions of the importance of residential segregation. The study by Frankenberg (2013 examined the residential and school segregation indices in the largest metropolitan areas in the US since 2000, comparing relationships between the extent of school and residential patterns and changes over time. The study found variation across the states in the correlation between residential and school segregation indices. The northern metropolitan areas were the most segregated in terms of both school and residence; as a by-product, children were segregated all times of the day, both in and out of school (Frankenberg 2013). Thus, residential segregation is an important basis for school segregation, a phenomenon that has been proven in earlier studies in the US (Reardon *et al.* 2000) despite school integration efforts (Rivkin 1994).

The relation between residential segregation and school segregation also comes in focus in the debate on how school choice influences school segregation. In principle, school choice can both increase and decrease school segregation relative to existing patterns of residential segregation. The general conclusion of studies of this question is that school choice does little to reduce school segregation and can often lead to increased segregation (Elacqua 2012; Karsten *et al.* 2003; Kristen 2008; Mickelson *et al.* 2008; Riedel *et al.* 2010; Saporito 2003; Waslander and Thrupp 1995).

The discussion of students increasingly choosing schools coincides with a regional development trend towards larger differences among regions in Sweden. That is, municipalities in Sweden increasingly differ in terms of population and residential segregation. Since 1985, Sweden has experienced a dramatic increase in the population with a tertiary education, and this increase has been much greater in metropolitan areas than in other parts of Sweden (Nielsen and Hennerdal 2018). Thus, at present, metropolitan children whose parents have less education are much more likely than children living in more peripheral areas to meet adults with a more education or peers from families with a more education. Moreover, municipalities in different regions might act more or less effectively against school segregation. This coincides with equity funding and broader policies regarding equality in education in municipalities and views of compensatory education. *Educational priority policies* (EPPs), which include both funding and other types of interventions, are applied (Franck and Nicaise).

How well do schools mix students from different neighbourhoods?

A typical feature of Swedish urban planning during the post-war period is a tendency to combine smaller, homogenous areas of public rentals, single-family dwellings, or cooperative tenure into larger neighbourhood units that have a mixed-tenure composition (Holmqvist and Bergsten 2009). A typical post-war urban neighbourhood in Sweden thus offers residents a homogenous small-scale neighbourhood enclosed within a larger unit that contains other homogenous units with different tenure types. To the extent that this planning idea has been fulfilled, it has created the possibility of designing school catchment areas that contain a mixture of tenure types and, hence, the possibility of creating schools with a mixed social composition of students. This reflects the fact that the homogenous subunits in general are too small to provide a school with a sufficient number of students.

The tendency for smaller geographical units to have, on average, more homogenous populations than larger geographical units is a common pattern across different national and regional contexts. This implies that in many cases, school catchment areas will encompass neighbourhood subareas that are more homogenous than the school catchment area itself as a whole. Therefore, for non-selective schools, it can be expected that the level of mixing in schools will be more pronounced than the level of mixing in the residential neighbourhoods nearest the students. As a measure of this tendency toward mixing at the school level, we propose comparing the variation in student composition across schools to the variation in composition across small-scale residential neighbourhoods. Taking advantage of the availability of geocoded registry data, we will define these small-scale residential neighbourhoods using an individualized neighbourhood approach in which a student’s neighbourhood is defined as encompassing the 25 closest age peers of the student (individuals born in the same year, the year before, and the year after the student under study are considered age peers). Clearly, such neighbourhoods will be smaller than the catchment area of a school if the general principle is that students are assigned to classes of children born in the same year and if class sizes are in the range of 20-30 students.

More specifically, to measure the extent to which the schools in a specific municipality mix students from different small-scale neighbourhoods, we will compute the ratio of the standard deviation in student composition across neighbourhoods to the standard deviation in student composition across schools and to use the square of that ratio as measure of mixing. The motivation for this measure is that it can be interpreted as the average number of different residential neighbourhoods sampled by schools to recruit students. A case in which the standard deviation in student composition across small-scale neighbourhoods is large and the standard deviation in student composition across schools is small indicates that students are sampled randomly from a large number of neighbourhoods. On the other hand, when the standard deviation across schools is large and the standard deviation across neighbourhoods is low, it indicates a case in which very few neighbourhoods are sampled.

The exact formula for *NNeigh*, the number of neighbourhoods sampled, is:

$$NNeigh = \left(\frac{Std\ dev\ in\ student\ composition\ across\ residential\ neighborhoods}{Std\ dev\ in\ student\ composition\ across\ schools}\right)^2$$

This is based on the formula for the standard error of the mean:

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} \iff n = \left(\frac{\sigma}{\sigma_{\bar{x}}}\right)^2$$

where sigma σ is the standard deviation of x in the population, and $\sigma_{\bar{x}}$ is the standard deviation of the mean of x in the sampling distribution. The original formula states that increasing the sample size will reduce the variance in the sampling distribution relative to the variance in the underlying distribution. This original formula can be translated for our purposes to mean that the more neighbourhoods from which students are drawn, the lower the variance in school composition across schools in the municipality.

From the residential segregation literature, it is well known that smaller residential areas generally tend to be more homogenous than larger residential areas. This is reflected by measures of segregation, which tend to be lower when larger geographical units are used. Considering that classes in schools often consist of 20 or more students of the same age, this number of students in a single age cohort would correspond to a neighbourhood that have a population of 1000 or more inhabitants across different age cohort, that is, a relatively large neighbourhood.

In Table 1, this logic has been used to provide a possible scheme for evaluating how well schools mix students from different neighbourhoods. The possibilities range from no mixing to excellent mixing. Column two shows the reduction in segregation achieved when different numbers of neighbourhoods are sampled.

TABLE 1. MIXING IN SCHOOLS ACCORDING TO THE NUMBER OF NEIGHBOURHOODS SAMPLED.

Mixing	Reduction of school segregation relative to residential segregation	Remaining segregation across schools	Ratio of standard deviations	Number of neighbourhoods sampled
None	0	1	1	1
Minimal	0.29	0.71	1.41	2
Poor	0.42	0.58	1.73	3
Restricted	0.50	0.50	2.00	4
Good	0.67	0.33	3.00	9
Excellent	0.80	0.20	5	25

Factors that influence mixing

Theoretically, the degree to which schools are able to mix students from different neighbourhoods will depend on the number of students at each school and the extent to which the neighbourhoods from which students are recruited are selected randomly. Two factors favour a non-random selection of neighbourhoods. One is whether school assignments are influenced by school distance, either because students living near the school are given priority or because there is a preference for nearby schools among students. The second factor is whether schools are differentiated in ways that make students from particular neighbourhoods more interested in some schools than in others.

The effect of local recruitment on school mixing will be most marked if there is large-scale residential segregation, that is, if small-scale neighbourhoods located near one another tend to have similar composition. If this is the case, there will be little variation in student composition in the neighbourhoods from which students are admitted, and the result will be schools with homogenous student bodies.

It could be argued that school differentiation is more likely in densely populated areas where students can access multiple schools within a comfortable commuting distance, at least if school choice is an option. Earlier studies have demonstrated that the ethnic and social composition of the student group is important when families decide which school to attend (Andersson *et al.* 2012a). Consequently, it is possible that small differences in student composition among schools can strengthen over time, for example, if students with a native background choose to avoid schools with many migrants or if students from families with highly educated parents select schools with students with similar family backgrounds.

Based on this discussion, one can hypothesize that school mixing will be positively influenced by school size and negatively influenced by the size of the local school market and by large-scale residential segregation. Larger schools will increase the likelihood that different neighbourhoods are sampled and thus can be expected to increase mixing, as we measure it. A large local school market will make it easier to establish many schools without schools becoming too small, and with many schools, there will be more room for school differentiation. Hence, there may be less mixing, based on our above argument. Finally, with large-scale residential segregation, the composition of neighbourhoods that are close to one another will be similar, and hence, geographically concentrated recruitment patterns may result in little variation among students.

Thus, the mean size of schools, the number of students in the municipality, and large-scale residential segregation can be seen as fundamental determinants of mixing. At the same time, these fundamental determinants can be related to contextual factors at the local level. Such contextual factors can include urban planning ideals, tenure mixing policies and migrant density (all of which influence residential segregation). Local politics can influence the establishment of schools, and hence school size, and voucher schools also have a potential role. Socio-economic segregation and attitudes towards school choice may be related to the socio-demographic composition of the population. It is also possible that conditions for mixing may vary among different types of municipalities. In many cases, it can be assumed that these contextual factors are accounted for in the fundamental determinants, but they might also have an independent effect.

Methods and Data

Data for computing the number-of-neighbourhoods measure

To analyse the extent to which Swedish schools mix students from different neighbourhood types, we will take advantage of a data set used to analyse trends in educational inequality in Swedish schools from 1991 to 2012 (Andersson, Hennerdal, and Malmberg, 2018). The dataset is based on longitudinal registry data for the Swedish population from Statistics Sweden. The analysis uses data from Statistics Sweden via Micro data on line access (MONA) in the Geographical Context Project at the Department of Human Geography at Stockholm University (Geostar 2015). The data include longitudinal individual micro data in Swedish registers, including geo-coordinates. The data contain information about which school students attend, students' residential location (250 metre grid cells), type of housing, family type, and information on parents' education, income, receipt of social allowances and employment status.

Based on the residential geocodes, each student's neighbouring peers are identified, making it possible to compute the socio-demographic composition among each student's nearest peers by K-level (PK); 12 (PK1); 25 (PK2); 50, 100, 200, 400 (PK6); and 400 (PK7). The variables used are parents on social allowance, parents with a tertiary education, foreign-born parents, family's disposable income, and single-family housing.

Similarly, information on which school students attend allows us to compute the socio-demographic composition of the student body of each student's school. The student-school links are available for each student's year of graduation from compulsory school; additionally, the composition of the student population uses information on the preceding year's graduates and the succeeding year's graduates. The residential neighbourhood surrounding each 15-year-old student is defined in this study as the peers aged 13 to 17 years (at the beginning of the year) who live closest to the student, see Table 2 for variables.

In this paper, we use the 2012 data to study neighbourhood segregation patterns and school segregation patterns in Swedish municipalities. For each municipality, the standard deviation of the student composition in schools and the standard deviation of the peer group composition in neighbourhoods is computed. For neighbourhoods, we consider the k=25 level (PK2); that is, neighbourhoods that include the 25 nearest peers of students graduating from compulsory schools. The contribution of each school and neighbourhood to the variance is weighted by the number of graduating students in each school and neighbourhood.

As discussed earlier, the number-of-neighbourhoods measure of mixing can be obtained by squaring the ratio between the neighbourhood standard deviation and the school standard deviation. In the estimated models, we use the log of the number-of-neighbourhoods measure.

Fundamental determinants

Additionally, data for the three fundamental determinants hypothesized to influence school mixing are based Andersson, Hennerdal, and Malmberg (2018). The mean school size here is simply the number of graduating students from each school in 2012. Our measure of school market size is the number of graduating students in the municipality, which is used in log format. Finally, large-scale segregation is based on values for individualised neighbourhoods, including the 400 closest peers (PK6), Table 2.

Individualized neighbourhoods are created from each individual's coordinate of residence and stretched out from that individual (creating a buffer) until the 400 closest peers are captured. The distance that must be overcome to capture 400 peers might therefore differ by municipality. Nevertheless, because peers are defined using an age interval (see below) these are the peers with whom a student is likely to mix at school regardless of distance.

TABLE 2. CONTEXT OF THE 400 CLOSEST PEERS AND THEIR PARENTS' CHARACTERISTICS.

PK6 k=400		Share of the 400 closest peers
	Parent receiving social allowance	Share of the peers who had a parent on social allowance the previous year
	Parent with a tertiary education	Share of the peers that had a parent with a tertiary education
	Foreign-born parent	Share of the peers with parents born outside of Sweden
	Family disposable income	Mean value among peers and percentile rank in relation to the total adult population for the family's disposable income
	Single-family housing	Share of the peers living in single-family housing

Table 3 the structural variables and shows that the number of schools differs considerably across municipalities.

TABLE 3. DESCRIPTIVE STATISTICS, FUNDAMENTAL DETERMINANTS.

Municipality	Mean	St. Dev.	Min	Pctl (25)	Pctl (75)	Max
Number of schools with graduating students	5.3	9.8	1	1	6	121
Number of graduating students in 2012	340.7	615.4	15	102.2	363.5	7,862
Average number of students per school	68.7	26.4	15	51.5	81	161
Large-scale residential segregation, k=400						
Parents with a tertiary education, SD	0.049	0.032	0.003	0.025	0.067	0.172
Foreign-born parents, SD	0.068	0.066	0.002	0.021	0.087	0.317
Single-family home, SD	0.095	0.075	0.006	0.035	0.137	0.331
Income percentile, SD	0.037	0.032	0.002	0.013	0.047	0.161
Social allowance, SD	0.032	0.029	0.001	0.013	0.041	0.164

Notes: 1) A single parent may live with a cohabiting partner who is not the child's parent. 2) Non-employed may refer to parental leave or retirement. 3) Values are between 0 and 1.

Contextual variables

Municipality type

Today's Swedish municipalities are a result of a major reform of local government structure that was enacted in the 1960s and early 1970s. An important aim of this reform was to create municipalities that were large enough to provide efficient welfare services to citizens, not least with respect to education and the introduction of a nine-year comprehensive school (Dahllöf 1966; Erlingsson *et al.* 2015; Husén 2013). Municipalities throughout Sweden vary in school contexts. Some municipalities have a large population, and some are sparsely populated with a large geographic area. Still other municipalities rely on a young, well-educated work force, whereas others have an older population and might rely on manufacturing industries for employment opportunities. To control for how these various municipalities mix students in schools, we use an often employment classification scheme from SKL (Swedish Association of Local Authorities and Regions (SALAR) 2016).

TABLE 4. SALAR CLASSIFICATION OF MUNICIPALITIES

Municipality type	Number of municipalities in group	Number of schools
Metropolitan municipalities	3	249
Suburban metropolitan municipalities	38	266
Large cities	31	449
Suburban municipalities near large cities	22	53
Commuter municipalities	51	114
Tourism and travel industry municipalities	20	58
Manufacturing municipalities	54	123
Sparsely populated municipalities	20	45
Municipalities in densely populated regions	35	133
Municipalities in sparsely populated regions	16	60
Total number of municipalities in Sweden	290	

Housing market structure

Another way to measure the differences among municipalities is to examine how the housing market is divided among different tenure types: Ownership, public rental, private rental, and cooperative. The ability of individuals to access different parts of the housing market is strongly influenced by tenure type. Therefore, differences in housing market structure can be considered an underlying factor that determines residential segregation and hence the possibilities of mixing. To capture differences in housing market structure, we employ the tenure type landscape concept developed by (Wimark *et al.* 2018). Tenure-type landscapes are typical configurations of residential areas with respect to tenure type. The variables we use are the proportion of households in each municipality that live in each of the 12 different landscape types identified by (Wimark *et al.* 2018). Descriptions are provided in Table 5 below.

TABLE 5. DESCRIPTIVE STATISTICS FOR HOUSING MARKET STRUCTURE VARIABLES, PROPORTION OF HOUSEHOLDS IN DIFFERENT TYPES OF TENURE CONFIGURATIONS

	Mean	St. Dev.
Owner-occupied, concentrated	0.092	0.099
Owner-occupied, small scale	0.077	0.084
Owner-occupied, large scale	0.375	0.312
Cooperative, concentrated	0.031	0.080
Cooperative, small scale	0.096	0.098
Cooperative, large scale	0.011	0.073
Public rental, concentrated	0.030	0.071
Public rental, small scale	0.137	0.100
Other small scale	0.005	0.023
Private rental, concentrated	0.028	0.057
Mixed private rental	0.109	0.106
Mixed, even	0.009	0.038

Patterns of ethnic segregation

Municipalities also vary with respect to patterns of ethnic segregation. We capture this variation by computing the proportion of the population that lives in different types neighbourhoods. The neighbourhood type classification is adapted from (Malmberg *et al.* 2018).

TABLE 6. DESCRIPTIVE STATISTICS FOR ETHNIC SEGREGATION VARIABLES. PROPORTION OF HOUSEHOLDS IN DIFFERENT TYPES OF MIGRANT NEIGHBOURHOODS

Neighbourhood type	N	Mean	St. Dev.
Local concentration of migrants			
Type A: Very high, large-scale concentrations of migrants	290	0.004	0.030
Type B: High, large-scale concentration of migrants	290	0.021	0.070
Type C: High local concentrations of non-European migrants	290	0.019	0.057
Type D: Moderate concentration of non-European migrants	290	0.099	0.186
Urban-level concentration of migrants			
Type E: Very high	290	0.008	0.068
Type F: High	290	0.032	0.109
Type G: Moderate	290	0.100	0.192
Type H:	290	0.099	0.186
Few non-European migrants			
Type I: Very high concentration of European migrants	290	0.003	0.052
Type J: High concentration of European migrants	290	0.052	0.183
Type K Moderate concentration of European migrants	290	0.149	0.275
Type L High concentration of Swedish-born	290	0.415	0.406

Other municipality variables

In addition to the above variables, we use five other contextual variables.

TABLE 7. DESCRIPTIVE STATISTICS FOR ADDITIONAL CONTEXTUAL VARIABLES.

Statistic	Mean	St. Dev.	Min	Pctl (25)	Pctl (75)	Max
Share of independent schools	7.203	7.744	0.000	0.900	11.000	42.900
Share of foreign-born residents	0.115	0.056	0.040	0.079	0.136	0.398
Share at risk of poverty	13.07	3.64	5.20	10.90	15.17	26.60
Share with a tertiary education	0.141	0.060	0.070	0.101	0.160	0.450
Median income	272.2	20.5	216.7	259.7	278.7	368.0

Results

Before we analyse the degree of mixing in Swedish municipalities, we will provide some data on the variation of residential segregation and school segregation in Sweden. After that, we will explore the variation in the degree to which schools mix students from different neighbourhoods using the number-of-neighbourhoods measure. We will also analyse how the degree of mixing varies in relation to different contextual variables. Then, we will present our main model, which shows the influence of structural variables on mixing, that is, how mixing is influenced by large-scale segregation, mean school size, and the size of the student population. Finally, we will show that when these structural variables are included, few of the contextual variables remain as significant predictors of mixing.

Residential segregation and school segregation of lower secondary school students in Sweden

The percentile plots in Figure 1 show how residential segregation and school segregation varies across Swedish municipalities using the standard deviation to measure variation in the composition of residential neighbourhoods and schools. From the plots, it is clear that there is more variation in the composition of neighbourhoods (at the k=25 level) than in the student composition of schools, Figure 2. For schools, the median value of the standard deviation varies from 2.5% (students from families who receive a social allowance) to 6.5% (students from single-family homes), whereas for neighbourhoods, the median value of the standard deviation is between 9.2% (students from families who receive a social allowance) to 26.7% (students from single-family homes), Figure 1. Thus, schools are more mixed than (small-scale) neighbourhoods.

Figure 1 also shows the large variation in residential segregation across municipalities. When the 95th percentile is compared to the 5th percentile, segregation in strongly segregated municipalities is 2 to 4 times larger than in weakly segregated municipalities. However, the difference in school segregation across municipalities is even greater: the 95th percentile value is between 18 and 35 times larger than the 5th percentile value across municipalities. This suggests that there is indeed a regionalization of school segregation in Sweden.

Figure 1 also shows that residential segregation is especially strong for children living in single-family housing, and there is strong regional variation in this indicator. In many municipalities, there is also strong segregation of children with foreign-born parents. But there is a large group of municipalities with little segregation in this dimension. In contrast, residential segregation in relation to parent educational background shows less variation across municipalities.

Finally, Figure 1 shows that the level of school segregation is relatively low in most municipalities, but there is a smaller group of municipalities where school segregation is more pronounced.

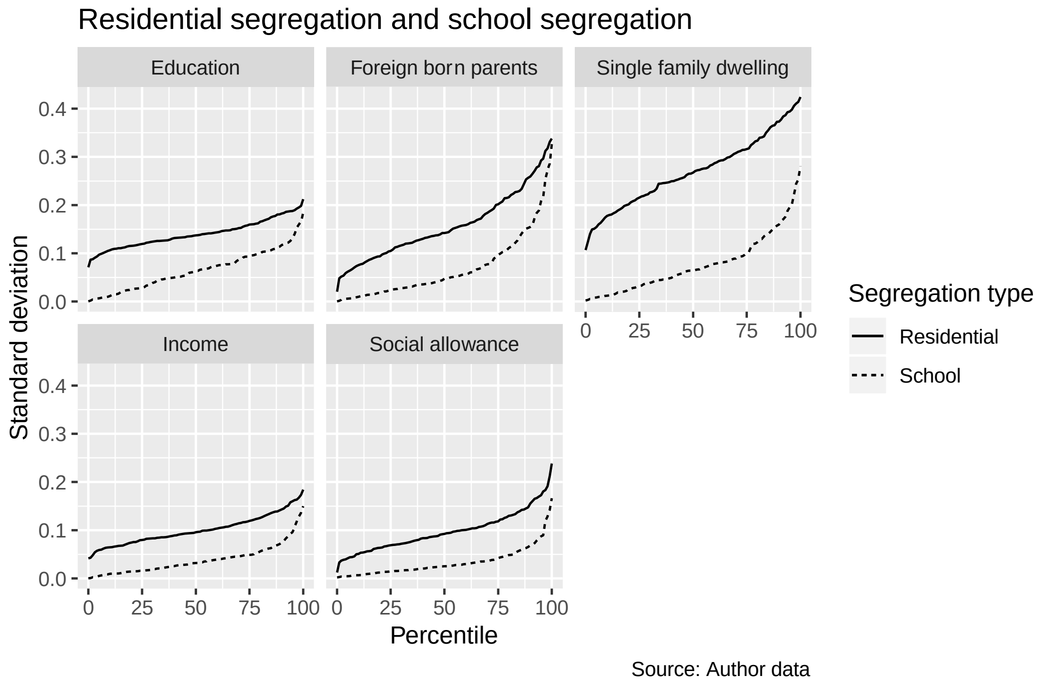

FIGURE 1. RESIDENTIAL SEGREGATION AND SCHOOL SEGREGATION, MEASURED IN STANDARD DEVIATIONS, ACROSS SWEDISH MUNICIPALITIES.

Variation in how well schools mix students from different neighbourhoods

To explain the variation in school mixing, we use the dependent variable number of neighbourhoods. The number of neighbourhoods from which schools draw is the number with which we can compare how many neighbourhoods schools sample from, on average, in each municipality, Figure 2.

We use the standard deviation of school composition compared to the standard deviation of neighbourhood composition as a measure of mixing. Our argument for this is that the square of the ratio (Std neigh/Std school) can, as discussed above, be interpreted as the number of neighbourhoods from which schools recruit students. If students are sampled from many neighbourhoods, the std of school composition will be low compared to the std of neighbourhood composition. This follows from sample theory, in which the variance in the error distribution will decrease as the sample size increases.

Municipalities with one school are excluded from the models but included in the map below. In Sweden, there are 290 municipalities, each of which has at least one school from which students graduated from year 9 of compulsory school. In Figure 3, the results of these calculations are shown in the form of percentile plots. The first observation is that for the majority of the municipalities, there is very good mixing in the schools. Thus, the median number of neighbourhood measures is eight or above for all the indicators except parent educational background. Mixing is especially good with respect to residents of single-family dwellings, where the median value corresponds to sampling from 15 residential neighbourhoods. There is also very good mixing of students from families who receive a social allowance in the majority of the municipalities (median value 11.3 neighbourhoods). Conversely, in at least 25% of municipalities, mixing is less good, particularly with respect to parent educational background. In 25% of the municipalities, mixing based on parental educational background draws from fewer than 2.63 neighbourhoods, and in 10% of the municipalities, mixing draws from fewer than

1.73 neighbourhoods. Mixing of children with foreign-born parents is only slightly better for the least-performing 10% of municipalities: 2.04 or fewer neighbourhoods. Mixing based on income in this group is slightly better: 2.87 neighbourhoods or fewer.

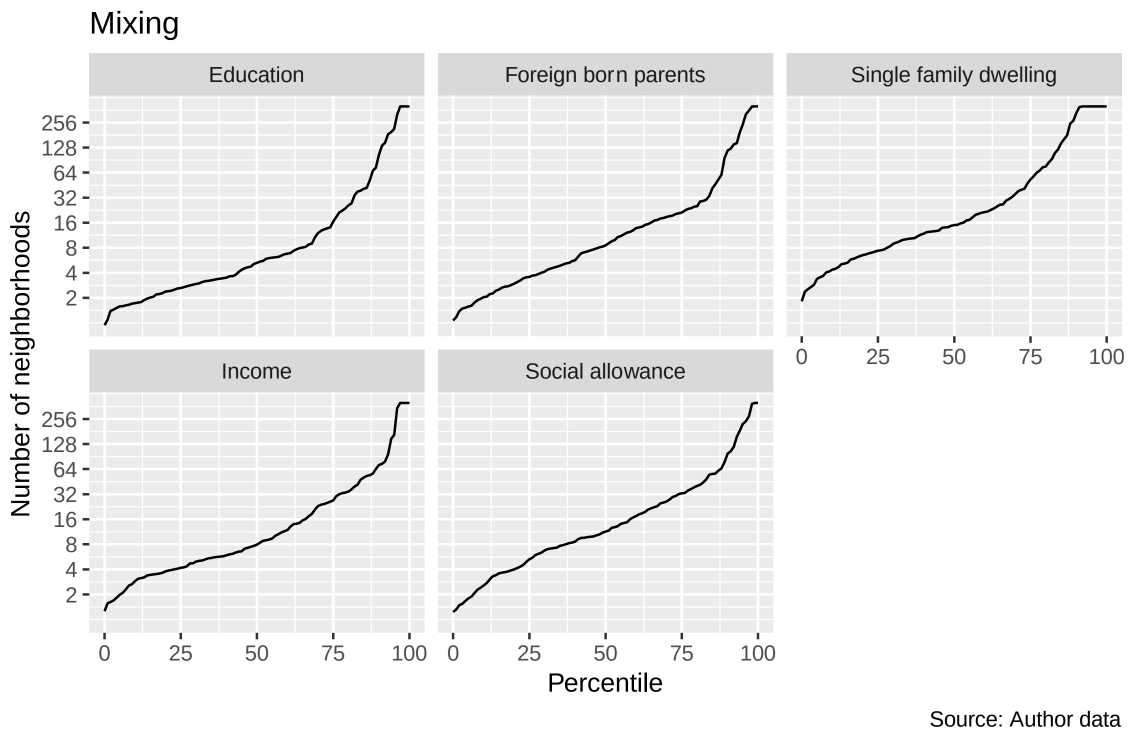

FIGURE 2. THE DEPENDENT VARIABLE NUMBER OF NEIGHBOURHOODS ACROSS MUNICIPALITIES, IN PERCENTILES.

TABLE 8. DESCRIPTIVE STATISTICS FOR THE DEPENDENT VARIABLE NUMBER OF NEIGHBOURHOODS (NNEIGH) IN MUNICIPALITIES.

Percentiles	**0**	**5**	**10**	**25**	**50**	**75**	**90**	**95**	**Max**
Education	0.94	1.58	1.73	2.63	5.26	16.55	103.74	214.25	400.00
Foreign-born parents	1.07	1.57	2.04	3.58	8.55	21.16	117.35	243.54	400.00
Single-family dwelling	1.82	3.38	4.37	7.37	14.98	52.98	332.10	400.00	400.00
Income	1.26	1.98	2.87	4.18	7.95	26.93	71.64	164.98	400.00
Social allowance	1.23	1.79	2.55	5.29	11.35	32.80	98.09	223.90	400.00

This variation in mixing is also illustrated in the maps in Figure 3, which show that mixing is high in the inner parts of southern Sweden, especially in terms of children from residential neighbourhoods with different proportions of single-family dwellings. There is less mixing along the coast of southern and central Sweden, where the three metropolitan areas are located. Additionally, in northern Sweden, there is less mixing in most coastal municipalities. In the inland portion of northern Sweden, mixing is low in the northernmost part and in the Jämtland region near the geographical centre of the country. In contrast, there is more mixing in the inland parts of the Västerbotten region.

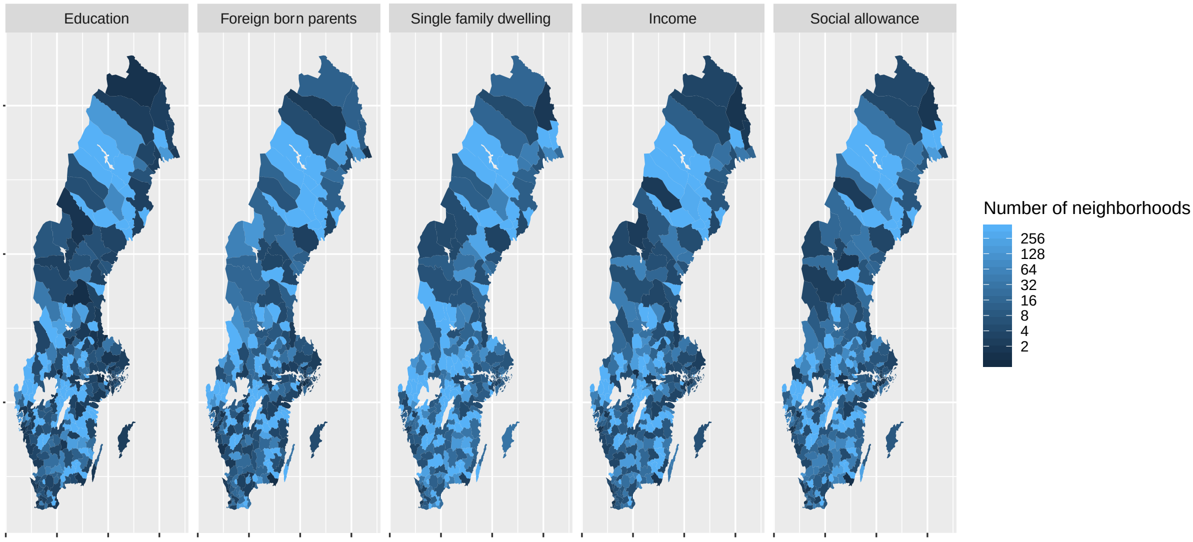

FIGURE 3. MIXING IN SCHOOLS ACROSS SWEDISH MUNICIPALITIES MEASURED BY THE NUMBER OF NEIGHBOURHOODS MEASURE

Contextual variables and mixing

As shown in Table 8 and Figure 2, there is considerable variation across municipalities in the extent to which schools mix students from different neighbourhoods. The geographical pattern, though, is not very clear cut. Are there municipal characteristics that can explain this variation in mixing? Below, we answer this question by analysing the extent to which the degree of mixing is linked to different contextual variables.

Municipality type

Figure 4 first presents boxplots for the degree of mixing in municipalities in different municipality type (SALAR) categories. The plots show that there are two types of municipalities where mixing is very limited: metropolitan municipalities and large city municipalities. For metropolitan municipalities, this is true for all the indicators, but for large city municipalities, poor mixing is mainly evident for parental education, parental migrant status and, to some extent, family disposable income. Among suburban metropolitan areas, some have moderately good mixing and others have relatively poor mixing, especially with respect to parental education and, to some extent, parental migrant background. Poor mixing is not only a characteristic of highly urbanized municipalities. It can also be found in sparsely populated municipalities and municipalities in densely populated regions, especially in relation to parental education. The highest degree of mixing is found in manufacturing municipalities and in tourism municipalities.

The boxplots also confirm that mixing with respect to type of housing is generally good outside metropolitan municipalities (although it is somewhat weaker in large city municipalities). Moreover, it is interesting to note that in general, mixing with respect to income is better than mixing in relation to parental education.

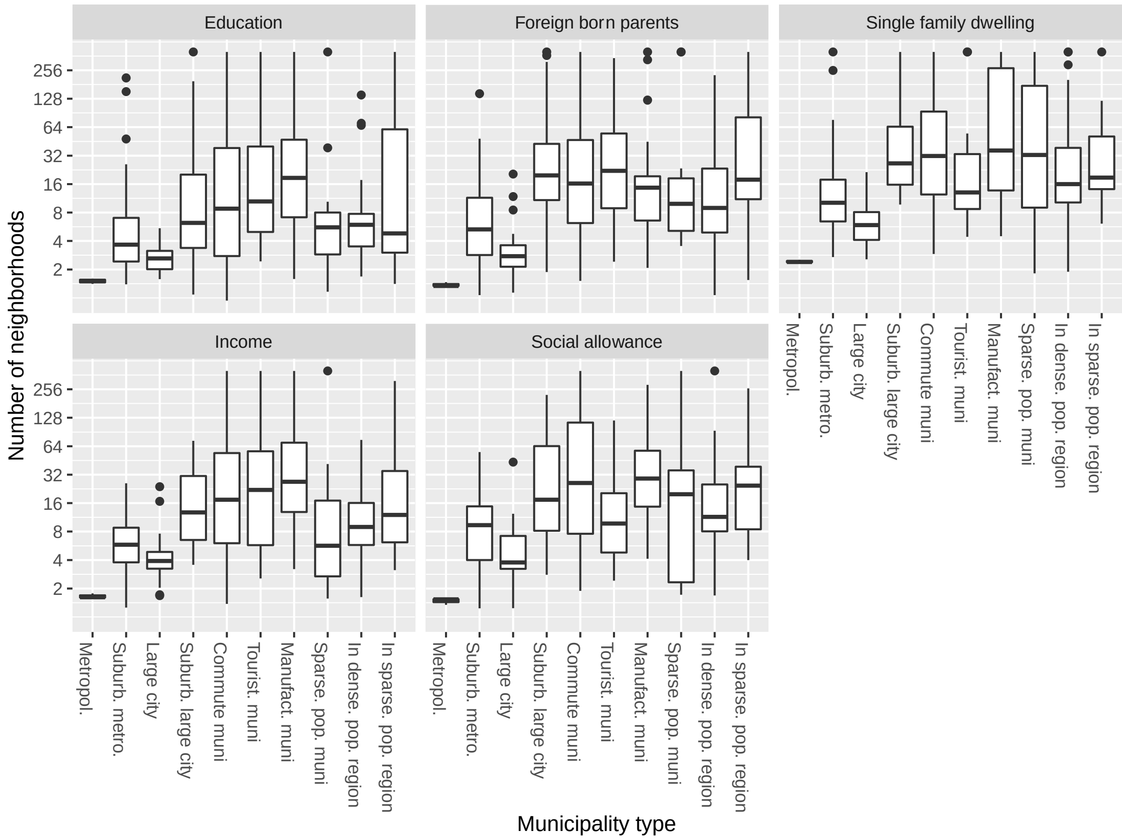

FIGURE 4. VARIATION IN MIXING (NUMBER OF NEIGHBORHOOD MEASURE) BY MUNICIPALITY TYPE AND INDICATOR.

Ethnic composition

Figure 5 shows the extent to which the degree of mixing is influenced by the ethnic composition of the mu nicipality, first, based on the total proportion of foreign born in the municipality, and second, in relation to the share of the municipalities' households that live in neighbourhoods with different types of ethnic composition. The figure shows that mixing is stronger in municipalities where a large proportion of the population is foreign born and where many families live in neighbourhoods with high proportions of non-European migrants. This tendency is especially strong in relation to mixing based on parental migrant status. Mixing is also lower in municipalities in which many families live in non-migrant dense neighbourhoods but where many migrants live at a greater distance. Conversely, in municipalities where most neighbourhoods are dominated by Swedish-born residents across different spatial scales, schools tend to be mixed successfully.

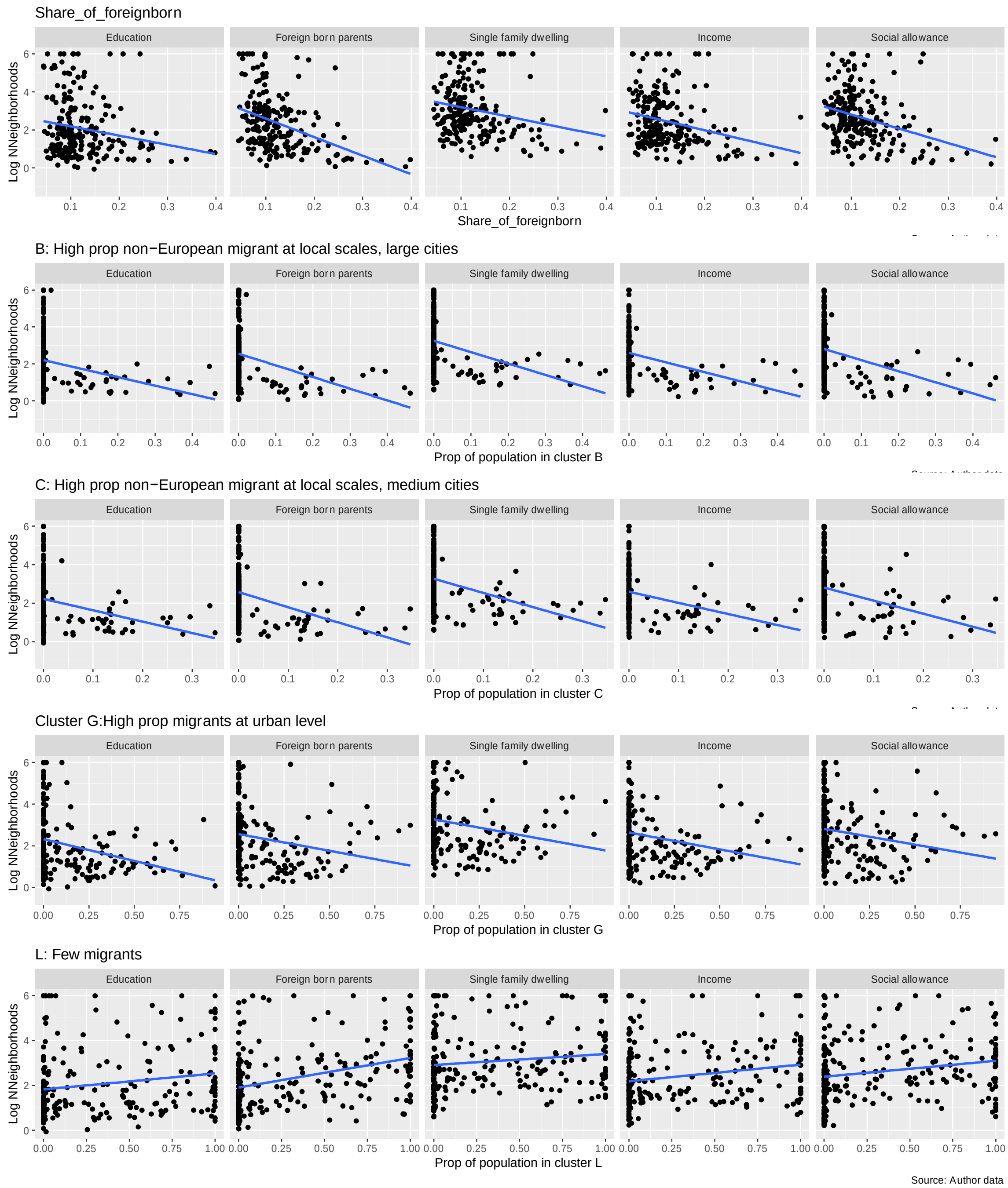

FIGURE 5: VARIATION IN MIXING ACROSS SWEDISH MUNICIPALITIES: CORRELATIONS WITH MUNICIPAL-LEVEL INDICATORS OF ETHNIC COMPOSITION (PROPORTION).

Socio-economic characteristics, independent schools, and the housing market structure

Figure 5 shows that the degree of mixing is related to socio-economic characteristics, the market share of independent schools and the housing market structure of the municipality. As these graphs show, mixing is better in municipalities in which a low proportion of the population has a tertiary education, but mixing is more weakly related to median income.

Additionally, the share of students who attend independent schools is negatively correlated with mixing. In other words, municipalities with high proportions of students in non-municipal schools tend to be less well mixed compared to places where municipal schools play a dominant role.

In addition, differences in mixing are related to the housing market structure. In municipalities where a high proportion of families live in neighbourhoods with high concentrations of public housing, there is less mixing than in municipalities with fewer public rental-dominated neighbourhoods. In contrast, municipalities with a high proportion of the families in neighbourhoods dominated by owner-occupied housing have high levels of mixing.

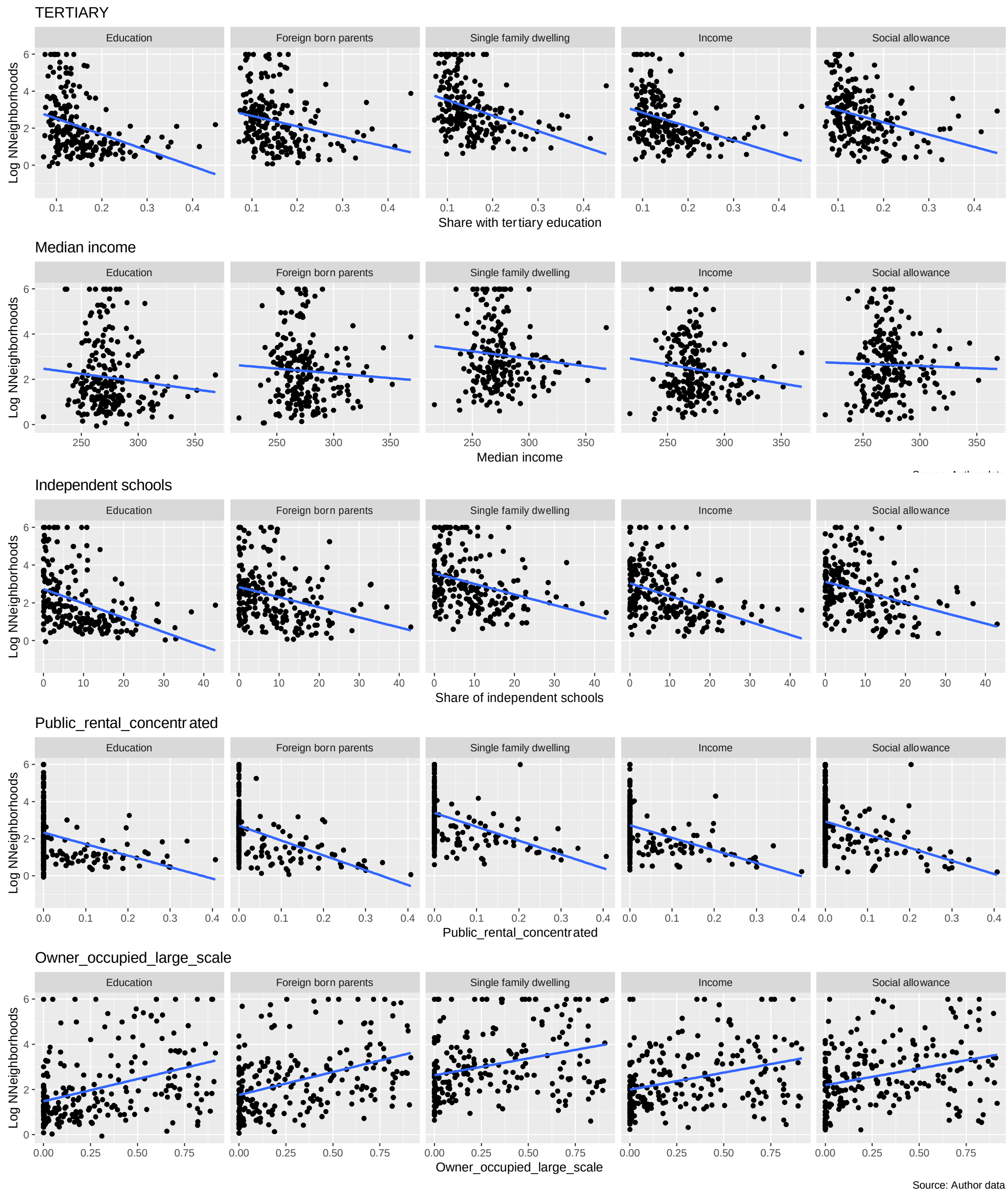

FIGURE 6: VARIATION IN MIXING ACROSS SWEDISH MUNICIPALITIES, CORRELATIONS WITH MUNICIPAL-LEVEL SOCIO-ECONOMIC INDICATORS, HOUSING MARKET STRUCTURE INDICATORS AND THE PROPORTION OF STUDENTS IN INDEPENDENT SCHOOLS.

Contextual variables are important
The above discussion shows that the degree of mixing can be linked to the type of municipality, ethnic composition, socio-economic characteristics, housing market characteristics, and the presence of independent schools. This shows that contextual factors are important. One possible interpretation of the results is that the selective behaviour of parents with a tertiary education can work against mixing. We have found both that mixing in relation to parental educational background is often poor and that there is less mixing in municipalities in which more of the population has a higher education. Another interpretation is that a presence of ethnic minorities can work against mixing. That is, mixing is counteracted by tendencies toward white flight.

Fundamental Determinants of mixing
In Table 9, we present estimation results for model specifications that include variables that are fundamental to the degree of mixing: Large-scale residential segregation, which implies that small-scale residential neighbourhoods that are close together will have similar compositions; school size, since fewer residential neighbourhoods need to be sampled for students; and number of students in the municipality, because a larger stock of students makes it possible for schools to be more selective and more differentiated.

The results shown in Table 9 powerfully confirm the importance of these fundamental determinants of mixing. *Large-scale residential segregation* has a clear negative effect on the number-of-neighbourhood measure of mixing. To make the parameter estimates comparable, our measure of large-scale segregation has been standardized and, as shown, the effect of large-scale segregation on mixing is very similar for the different indicators, with the exception of social allowance. Additionally, *average school size* has the expected effect. Municipalities where the average school size is larger have a higher level of mixing compared to municipalities with small schools. The effect is relatively strong. An increase in average school size by one standard deviation increases the sampled number of neighbourhoods by more than 50%. Again, there is a consistent effect across the different indicators. Conversely, in municipalities where the *number of students* is high, there tends to be less mixing. Because this variable is on a log scale, the parameter estimates of the number-of-students variable can be interpreted as elasticities. Thus, a 1 % increase in the size of the municipal student body leads to an approximately 0.5% decrease in the degree of mixing (0.75% for the social allowance indicator). It should also be noted that the estimated parameters for the fundamental determinants all have small standard errors. They are significant at the 1% level.

These estimates imply that the fundamental determinants are indeed as important as our theoretical considerations have led us to believe. The r-square values clearly show that these variables cannot explain all the variation in mixing. Nevertheless, they cannot be ignored when attempting to understand patterns of mixing across municipalities.

TABLE 9. THE EFFECT OF FUNDAMENTAL DETERMINANTS ON SCHOOL MIXING MEASURED BY NUMBER OF NEIGHBOURHOODS (LOG). ESTIMATES FOR TERTIARY EDUCATION, FOREIGN-BORN PARENTS, SINGLE-FAMILY DWELLING, INCOME, AND SOCIAL ALLOWANCE.

	Tertiary education	Foreign-born parents	Single-family dwelling	Income	Social allowance
Large-scale segregation	-0.529***	-0.548***	-0.516***	-0.454***	-0.246**
	(0.121)	(0.113)	(0.124)	(0.111)	(0.098)
Average school size	0.022***	0.015***	0.029***	0.022***	0.028***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Number of students in municipality, log	-0.559***	-0.567***	-0.577***	-0.521***	-0.767***
	(0.148)	(0.137)	(0.150)	(0.135)	(0.119)
Constant	3.779***	4.567***	4.466***	3.957***	5.150***
	(0.784)	(0.743)	(0.817)	(0.725)	(0.646)
Observations	216	216	216	216	216
R^2	0.378	0.406	0.445	0.388	0.397
Adjusted R^2	0.370	0.397	0.438	0.379	0.388
Residual Std. Error (df = 212)	1.211	1.123	1.094	1.066	1.070
F Statistic (df = 3; 212)	43.030***	48.271***	56.771***	44.766***	46.479***

Note: *p<0.1; **p<0.05; ***p<0.01

Contextual variables and mixing: Model results

The fundamental factors thus very robustly account for a substantial part of the variation in mixing. This raises the question of to what extent contextual factors are important when the fundamental factors are taken into account. The answer to this question is given in Tables A1 to A4 in the appendix. First, these tables report estimation results for models that account for variation using only contextual variables; second, the results obtained when these models are re-estimated with the fundamental determinants are reported.

Table A1 uses models that include three contextual variables: the share of students in independent schools, the share of migrants in the population, and the share of the population with a tertiary education. In models that do not include the fundamental determinants, these variables have significant effects on mixing. The proportion of the population with a tertiary education, for example, reduces mixing with respect to all five indicators. The share of foreign born residents reduces mixing for all indicators except tertiary education. The share of independent schools reduces mixing with respect to tertiary education and income. When the fundamental determinants are introduced, only one of these effects remains significant: the negative effect of independent schools on mixing in terms of parent education level.

Table A2 reports the estimation results with municipality types as explanatory variables, using manufacturing municipalities as the reference category. The results when the fundamental determinants are excluded are similar to those reported in Figure 4: Mixing is lower in metropolitan municipalities, in large city municipalities, and in metropolitan suburban municipalities. Mixing also tends to be lower in large city suburban municipalities and some other categories. When the fundamental determinants are introduced, the negative effects of metropolitan municipalities and large city municipalities disappear. For the other municipality types, some of the estimates remain negative and significant, but overall, many of the effects shown in the restricted model without fundamental determinants disappear.

Table A3 reports the results when migrant neighbourhood variables are used. In the restricted model, the proportions of different types of neighbourhoods provide some significant estimates, but almost none of these effects remain significant when the fundamental determinants are included.

Table A4 reports the results when housing market structure variables are included in the model. The estimates reported for the models without fundamental determinants indicate that the housing market structure is important for mixing. When the fundamental determinants are included, this variable is no longer important, and the housing market structure has essentially no effect.

These estimation results show that even though contextual variables are important for mixing, their influence generally disappears when the fundamental determinants are included. This does not necessarily imply that the effect of the contextual variables is spurious. An alternative interpretation is that the effects of the contextual variables are mediated by the fundamental determinants. This could certainly be the case for contextual variables that are indicators of ethnic residential segregation and housing market structure. Because large-scale segregation is one of the fundamental determinants, it fully accounts for the ways in which patterns of ethnic segregation and housing market structure influence mixing. This can be considered an example of conditional independence. Following (Pearl 2009), it can be argued that if there is a factor A that influences outcome C only via an intervening variable B, then C should be statistically independent of A if B is controlled for. If B in our case is large-scale segregation, then controlling for B can make mixing (C) independent of contextual variables (A) that have an effect on mixing through segregation.

Another mechanism that needs to be considered is the role of the average school size. It is possible that contextual variables lose their significance because they have an influence on average school size, which in turn directly affects mixing. Average school size is directly influenced by the establishment of new schools, and since the early 1990s, private actors have had the opportunity to open new schools and obtain public funding. The average school size in Sweden can thus be seen as strongly influenced by parental demand for small or niche schools.

At the same time, multi-collinearity can play a role, especially in relation to the number of students in the municipality. Municipality size can be reflected in many contextual variables and can make it difficult to obtain precise estimates when the number-of-students variable is included.

Discussion

In this paper, we propose a new method for assessing the extent to which schools are successful in mixing students from different backgrounds. First, we assess variation in the composition of the student population in small-scale residential neighbourhoods and variation in the composition of the student population at local schools—in each case using the standard deviation to measure variation. Second, we determine the number of randomly selected neighbourhoods—from a population of neighbourhoods with a variation in composition corresponding to the observed standard deviation in neighbourhood composition—from which students need to be sampled to arrive at a variation in school composition that corresponds to the observed standard deviation in school composition. Because increasing the sample size leads to a decline in the variance of the mean, low levels of school segregation relative to residential segregation will correspond to a case in which many residential neighbourhoods are sampled. Poor mixing—that is, a variation in school composition that is similar to the variation in neighbourhood composition—will correspond to a case in which few neighbourhoods are sampled.

Applying this approach to geo-coded, individual-level registry data on students who leave Swedish schools and their parents, we can show that in a large majority of Swedish municipalities, schools are successful in mixing students from different types of small-scale residential neighbourhoods. In approximately 25% of the Swedish municipalities, the mixing is not as good, resulting in levels of school segregation that are close to those of small-scale residential neighbourhoods.

We also analyse which factors contribute to poor mixing and successful mixing. Three factors are singled out as the fundamental determinants of mixing. The first is large-scale residential segregation: when there is large-scale segregation, sampling from different small-scale neighbourhoods will not ensure the mixing of select students from neighbourhoods that are close to one another. The importance of this factor is evidenced by the fact that municipalities characterized by large scale segregation have lower levels of mixing. The second factor is the average size of the schools. The importance of this factor is almost self-evident: because large schools need to sample more students, the likelihood of sampling from different neighbourhoods is increased, while when schools are small, they can be filled with students from just a few neighbourhoods or a single neighbourhood, which will reduce mixing. Again, this assumption is borne out by our empirical evidence. Average school size positively affects the number-of-neighbourhoods measure of school mixing. The third important factor is the number of students in the municipality. The role of this factor is less self-evident, but if there are many students, it will be easier to fill schools with students who have particular interests, which may reduce mixing; in contrast, if there are few students in the municipality, schools must recruit more broadly, and mixing will increase. This idea is also strongly supported by the data. In municipalities with many students, there is a less mixing.

Together, the fundamental determinants have such a strong effect that when these variables are included, other contextual factors provide very little additional explanation of why mixing varies among municipalities. In contrast, in models where the fundamental determinants are excluded the contextual factors have an effect. For example, municipalities with many individuals who have a tertiary education and those with many migrants and high proportions of independent schools tend to have lower levels of mixing. This is also true for metropolitan municipalities and large city municipalities. High levels of mixing are found in municipalities in which many families live in neighbourhoods dominated by owner-occupied housing and in neighbourhoods with few migrants. Conversely, municipalities with high proportions of residents living in neighbourhoods with concentrations of public rentals and in neighbourhoods with high concentrations of non-European migrants do less well in terms of mixing in schools.

These results are based on an examination of mixing in relation to parent educational background, parent migrant status, family income, type of housing, and family receipt of social allowances. We found that mixing in terms of parent educational background is lowest, followed by parent migrant status. The best mixing results are for type of housing. This is interesting because Swedish urban planning has established tenure-type mixing as an important ideal. Such mixing has focused on placing neighbourhoods with different types of tenure close to each other, often with the explicit goal of ensuring that local schools serve students from areas characterized by different tenure types (Franzén and Sandstedt 1993).

Thus, planning measures can potentially influence mixing patterns. A second policy implication of this study is that in terms of mixing, small schools are not ideal. Small schools are often perceived in a positive light and supported by parents, but our results suggest that the positive views toward small schools may be linked their association with limited amounts of mixing. To the extent that mixing is a goal, there are reasons not to offer excessive support for small schools. A third policy implication is that successful mixing requires policies that limit large-scale residential segregation. Earlier studies have demonstrated that one driving force behind large-scale segregation is residential choices made by elite groups. On the other hand, large-scale segregation in Sweden has been linked to large housing estates in larger cities. Finally, the negative link between municipality size and mixing indicates that mixing policies are especially needed in metropolitan municipalities, large city municipalities, and other municipalities with large populations. Our results indicate that these municipalities are at risk for more selective student allocations, and consequently, it may be important not to adopt laissez-fair policies regarding school segregation.

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Table A1.

	Tertiary education	Foreign born parents	Single family dwelling	Income	Social allowance	Tertiary education	Foreign born parents	Single family dwelling	Income	Social allowance
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
PK6						-0.593***	-0.379**	-0.655***	-0.490***	-0.216**
						(0.136)	(0.154)	(0.144)	(0.139)	(0.106)
mean_school_size						0.020***	0.015***	0.030***	0.021***	0.027***
						(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Log_students						-0.521***	-0.791***	-0.505***	-0.422***	-0.648***
						(0.156)	(0.171)	(0.161)	(0.152)	(0.155)
Friskolor_andel_grundskola	-0.052***	-0.020	-0.023	-0.044***	-0.024*	-0.033**	0.002	0.016	-0.017	0.001
	(0.014)	(0.013)	(0.014)	(0.013)	(0.013)	(0.013)	(0.012)	(0.012)	(0.012)	(0.011)
Share_of_foreignborn	-1.341	-8.206***	-2.792*	-3.124**	-5.537***	1.761	-2.599	2.222	1.767	-2.856**
	(1.685)	(1.592)	(1.641)	(1.481)	(1.521)	(1.530)	(1.858)	(1.498)	(1.610)	(1.389)
Tertiary	-4.898***	-2.946*	-6.346***	-4.032***	-4.148***	2.955	2.680	-1.598	-0.472	-1.561
	(1.727)	(1.631)	(1.682)	(1.518)	(1.559)	(1.983)	(1.676)	(1.609)	(1.570)	(1.641)
Constant	3.430***	3.995***	4.584***	3.816***	4.150***	3.326***	5.716***	3.790***	3.473***	5.128***
	(0.297)	(0.280)	(0.289)	(0.261)	(0.268)	(0.798)	(0.939)	(0.881)	(0.831)	(0.733)
Observations	216	216	216	216	216	216	216	216	216	216
R^2	0.196	0.202	0.166	0.211	0.186	0.399	0.419	0.459	0.399	0.413
Adjusted R^2	0.185	0.191	0.154	0.200	0.174	0.382	0.402	0.443	0.382	0.396
Residual Std. Error	1.377 (df = 212)	1.301 (df = 212)	1.342 (df = 212)	1.211 (df = 212)	1.243 (df = 212)	1.200 (df = 209)	1.118 (df = 209)	1.088 (df = 209)	1.064 (df = 209)	1.063 (df = 209)
F Statistic	17.272*** (df = 3; 212)	17.909*** (df = 3; 212)	14.023*** (df = 3; 212)	18.892*** (df = 3; 212)	16.122*** (df = 3; 212)	23.123*** (df = 6; 209)	25.131*** (df = 6; 209)	29.553*** (df = 6; 209)	23.152*** (df = 6; 209)	24.485*** (df = 6; 209)

Note: *p<0.1; **p<0.05; ***p<0.01

Table A2

	Tertiary education	Foreign born parents	Single family dwelling	Income	Social allowance	Tertiary education	Foreign born parents	Single family dwelling	Income	Social allowance
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
PK6						-0.580***	-0.579***	-0.523***	-0.415***	-0.314***
						(0.130)	(0.116)	(0.138)	(0.116)	(0.102)
mean_school_size						0.025***	0.018***	0.029***	0.022***	0.026***
						(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Log_students						-0.740***	-0.636***	-0.511**	-0.498***	-0.666***
						(0.201)	(0.184)	(0.198)	(0.178)	(0.167)
Metro	-2.707***	-2.317***	-3.071***	-2.940***	-3.013***	2.187**	1.954**	0.585	0.527	0.392
	(0.831)	(0.765)	(0.768)	(0.699)	(0.718)	(0.945)	(0.880)	(0.863)	(0.827)	(0.831)
Metro_suburb	-1.450***	-0.814***	-1.444***	-1.668***	-1.316***	0.027	0.279	-0.235	-0.667**	-0.647**
	(0.326)	(0.300)	(0.301)	(0.274)	(0.281)	(0.332)	(0.297)	(0.309)	(0.287)	(0.277)
Cities	-2.187***	-1.540***	-2.155***	-2.023***	-1.882***	0.008	0.370	-0.405	-0.576	-0.290
	(0.339)	(0.312)	(0.313)	(0.285)	(0.293)	(0.412)	(0.384)	(0.382)	(0.357)	(0.367)
City_suburb	-0.878**	0.651*	-0.247	-0.843**	-0.233	-0.614*	0.779**	0.058	-0.660**	-0.162
	(0.407)	(0.375)	(0.376)	(0.342)	(0.351)	(0.354)	(0.328)	(0.331)	(0.308)	(0.310)
In_dense	-1.247***	-0.177	-0.764**	-1.097***	-0.657**	-0.621**	0.324	-0.377	-0.708***	-0.274
	(0.345)	(0.318)	(0.319)	(0.290)	(0.298)	(0.307)	(0.286)	(0.282)	(0.267)	(0.271)
Sparse	-1.182**	0.128	-0.354	-1.262***	-0.702*	-0.730*	0.151	0.142	-0.901**	-0.307
	(0.476)	(0.439)	(0.440)	(0.401)	(0.411)	(0.441)	(0.410)	(0.406)	(0.383)	(0.388)
Tourism	-0.335	0.537	-0.867**	-0.167	-1.028***	0.139	0.530	-0.444	0.141	-0.778**
	(0.435)	(0.401)	(0.402)	(0.366)	(0.376)	(0.392)	(0.364)	(0.360)	(0.339)	(0.345)
Commute	-0.762**	0.163	-0.395	-0.467	-0.017	-0.083	0.511*	-0.005	-0.121	0.216
	(0.360)	(0.331)	(0.333)	(0.303)	(0.311)	(0.328)	(0.293)	(0.291)	(0.275)	(0.275)
In_sparse	-0.008	0.007	-0.008	-0.009**	-0.004	-0.001	0.009**	-0.002	-0.005	0.001
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
Constant	3.117***	2.638***	3.959***	3.447***	3.401***	4.769***	4.410***	4.264***	4.254***	4.936***
	(0.230)	(0.212)	(0.213)	(0.194)	(0.199)	(1.059)	(0.954)	(1.050)	(0.930)	(0.857)
Observations	216	216	216	216	216	216	216	216	216	216
R^2	0.214	0.258	0.265	0.292	0.270	0.432	0.445	0.465	0.449	0.444
Adjusted R^2	0.179	0.225	0.232	0.261	0.238	0.398	0.412	0.434	0.416	0.412
Residual Std. Error	1.382 (df = 206)	1.273 (df = 206)	1.278 (df = 206)	1.163 (df = 206)	1.194 (df = 206)	1.183 (df = 203)	1.109 (df = 203)	1.098 (df = 203)	1.034 (df = 203)	1.049 (df = 203)
F Statistic	6.217*** (df = 9; 206)	7.939*** (df = 9; 206)	8.234*** (df = 9; 206)	9.445*** (df = 9; 206)	8.478*** (df = 9; 206)	12.868*** (df = 12; 203)	13.546*** (df = 12; 203)	14.712*** (df = 12; 203)	13.762*** (df = 12; 203)	13.534*** (df = 12; 203)

Note: *p<0.1; **p<0.05; ***p<0.01

Table A3

	Tertiary education	Foreign born parents	Single family dwelling	Income	Social allowance	Tertiary education	Foreign born parents	Single family dwelling	Income	Social allowance
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
PK6						-0.553***	-0.506***	-0.574***	-0.517***	-0.201*
						(0.125)	(0.146)	(0.152)	(0.143)	(0.106)
mean_school_size						0.024***	0.016***	0.029***	0.022***	0.027***
						(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Log_students						-0.535***	-0.600***	-0.572***	-0.509***	-0.645***
						(0.156)	(0.139)	(0.149)	(0.137)	(0.129)
Share_L	0.034	0.860***	-0.257	0.159	0.072	-0.090	0.400	-0.569**	-0.134	-0.114
	(0.306)	(0.274)	(0.285)	(0.267)	(0.265)	(0.257)	(0.253)	(0.236)	(0.234)	(0.232)
Share_G	-1.539**	-0.058	-0.984*	-0.908*	-0.723	-0.582	0.578	-0.003	-0.238	-0.339
	(0.600)	(0.536)	(0.559)	(0.523)	(0.519)	(0.515)	(0.475)	(0.468)	(0.455)	(0.450)
Share_C	-2.514	-3.903**	-3.854*	-2.155	-3.011	-2.514	-0.855	-1.960	-0.091	-2.119
	(2.175)	(1.944)	(2.025)	(1.897)	(1.882)	(1.866)	(1.808)	(1.718)	(1.714)	(1.699)
Share_B	-1.935	-2.329	-3.349**	-2.587*	-3.139**	2.077	0.472	0.235	0.726	-0.926
	(1.742)	(1.558)	(1.622)	(1.520)	(1.508)	(1.513)	(1.394)	(1.346)	(1.349)	(1.302)
Share_A	-3.026	-5.008*	-4.964*	-5.319**	-6.397**	1.956	1.657	0.845	1.158	-3.150
	(3.013)	(2.693)	(2.805)	(2.628)	(2.607)	(2.566)	(2.524)	(2.334)	(2.415)	(2.253)
Constant	2.375***	2.262***	3.504***	2.651***	2.893***	3.639***	4.489***	4.670***	3.918***	4.680***
	(0.190)	(0.170)	(0.177)	(0.166)	(0.165)	(0.846)	(0.754)	(0.821)	(0.745)	(0.686)
Observations	216	216	216	216	216	216	216	216	216	216
R^2	0.112	0.210	0.157	0.141	0.173	0.395	0.416	0.466	0.391	0.420
Adjusted R^2	0.091	0.191	0.137	0.120	0.153	0.371	0.394	0.445	0.368	0.397
Residual Std. Error	1.455 (df = 210)	1.301 (df = 210)	1.355 (df = 210)	1.269 (df = 210)	1.259 (df = 210)	1.210 (df = 207)	1.126 (df = 207)	1.086 (df = 207)	1.076 (df = 207)	1.062 (df = 207)
F Statistic	5.279*** (df = 5; 210)	11.163*** (df = 5; 210)	7.814*** (df = 5; 210)	6.875*** (df = 5; 210)	8.765*** (df = 5; 210)	16.881*** (df = 8; 207)	18.463*** (df = 8; 207)	22.589*** (df = 8; 207)	16.628*** (df = 8; 207)	18.711*** (df = 8; 207)

Note: *p<0.1; **p<0.05; ***p<0.01

Table A4

	Tertiary education (1)	Foreign born parents (2)	Single family dwelling (3)	Income (4)	Social allowance (5)	Tertiary education (6)	Foreign born parents (7)	Single family dwelling (8)	Income (9)	Social allowance (10)
PK6						-0.500***	-0.491***	-0.484***	-0.390***	-0.143
						(0.125)	(0.137)	(0.161)	(0.139)	(0.104)
mean_school_size						0.025***	0.016***	0.028***	0.021***	0.027***
						(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Log_students						-0.466**	-0.397**	-0.611***	-0.512***	-0.381***
						(0.180)	(0.161)	(0.163)	(0.149)	(0.147)
Owner_occupied_concentrated	2.062*	3.054***	2.891***	3.395***	3.880***	0.462	1.128	0.678	1.489	3.021***
	(1.152)	(1.010)	(1.074)	(0.975)	(0.966)	(1.060)	(1.012)	(1.001)	(0.960)	(0.919)
Owner_occupied_small_scale	2.872	5.861***	4.187**	5.026***	6.550***	-1.543	2.074	-0.747	0.850	3.842**
	(1.982)	(1.737)	(1.847)	(1.676)	(1.661)	(1.885)	(1.768)	(1.735)	(1.664)	(1.615)
Owner_occupied_large_scale	2.472***	2.988***	1.843***	2.118***	2.547***	0.751	1.276*	-0.320	0.367	1.933***
	(0.651)	(0.571)	(0.607)	(0.551)	(0.546)	(0.721)	(0.682)	(0.696)	(0.657)	(0.621)
Coop_concentrated	-0.130	-0.929	-1.891	-2.104*	-2.049*	1.680	-0.448	-0.040	-0.922	-1.405
	(1.321)	(1.157)	(1.231)	(1.117)	(1.107)	(1.165)	(1.079)	(1.076)	(1.008)	(1.015)
Public_rental_concentrated	-2.327	-3.873***	-4.585***	-4.152***	-3.422***	0.523	0.021	-0.804	-0.637	-1.326
	(1.500)	(1.315)	(1.398)	(1.269)	(1.257)	(1.354)	(1.408)	(1.312)	(1.308)	(1.199)
Public_rental_small_scale	0.682	0.479	-0.309	-2.216**	0.197	0.411	-0.287	-0.651	-2.616***	0.332
	(1.093)	(0.958)	(1.019)	(0.924)	(0.916)	(0.973)	(0.917)	(0.891)	(0.851)	(0.836)
Constant	0.867*	0.757*	2.160***	1.560***	1.078***	2.822**	2.951**	4.913***	4.028***	1.879*
	(0.488)	(0.427)	(0.454)	(0.412)	(0.409)	(1.268)	(1.156)	(1.142)	(1.065)	(1.053)
Observations	216	216	216	216	216	216	216	216	216	216
R^2	0.189	0.307	0.229	0.263	0.292	0.401	0.420	0.452	0.423	0.457
Adjusted R^2	0.166	0.287	0.207	0.242	0.272	0.375	0.395	0.428	0.398	0.433
Residual Std. Error	1.393 (df = 209)	1.221 (df = 209)	1.299 (df = 209)	1.178 (df = 209)	1.167 (df = 209)	1.206 (df = 206)	1.125 (df = 206)	1.103 (df = 206)	1.050 (df = 206)	1.030 (df = 206)
F Statistic	8.140*** (df = 6; 209)	15.453*** (df = 6; 209)	10.352*** (df = 6; 209)	12.446*** (df = 6; 209)	14.378*** (df = 6; 209)	15.322*** (df = 9; 206)	16.567*** (df = 9; 206)	18.868*** (df = 9; 206)	16.790*** (df = 9; 206)	19.269*** (df = 9; 206)

Note: *p<0.1; **p<0.05; ***p<0.01

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