School Segregation and Native Flight

Evidence from School Catchment Area Borders.

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Abstract:

Although extensively theorized, determining the exact mechanisms that produce ethnic or racial segregation in schools and neighborhoods has proven difficult. In this article, we investigate one of the potential causes of ethnic segregation in schools; native flight. Both observational and experimental evidence suggests that native or White parents have a strong preference for schools with a majority of native or White students. This may strongly contribute to school segregation. In contexts where school enrollment is determined primarily by geographic proximity to schools, these preferences may prompt such parents to move away from schools with high minority concentrations among students, thus contributing to both residential and school segregation. Drawing on extremely detailed, population-wide, geo-coded register data on families and school catchment areas for elementary schools in Oslo, Norway, we investigate whether native parents move away from schools with higher shares of students with non-Western immigrant backgrounds. We employ a Geographic Regression Discontinuity (GRD) design by exploiting the fact that within neighborhoods, the characteristics of schools differ discontinuously along school catchment area borders. The results show that native origin families systematically move away from schools with high shares of students with non-Western immigrant backgrounds, and suggest that such moves are causally linked to their school catchment areas, not just their neighborhoods. This process likely contributes to both school segregation and residential segregation.

Key words: Ethnicity/race; school segregation; residential segregation; native/white flight

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Introduction

Although school segregation is a well-known phenomenon around the world, we still have a limited understanding of the mechanisms that give rise to these patterns (Böhlmark, Holmlund, and Lindahl 2016). Free choice systems are known to exacerbate both socioeconomic and ethnic school segregation (Wilson and Bridge 2019), but in school systems where local catchment areas fully or in part determine school attendance, school segregation is much more closely linked to residential segregation. In such systems, your address matters for where your children go to school. If preferences for schools strongly impact parents' residential decisions, and if such preferences are related to the racial or ethnic student composition at schools, 'flight' – a moving pattern whereby racial or ethnic majority families move away from neighborhoods and schools with high or increasing concentrations of minorities – may be an important mechanism contributing to exacerbated school segregation. Such a process may also be self-reinforcing as new families react to the changing composition of their local school due to the flight decisions of previous families (see Schelling (1978) for a theoretical demonstration.).

For policymakers who wish to reduce school segregation, it is crucial to understand how and why such patterns emerge and persist. However, it is difficult to establish whether patterns of 'flight' are causally linked to school characteristics, as parents' moving patterns may be motivated by other factors than the student composition at their local school. Life course transitions associated with having a first or second child might motivate young couples to move from urban to more suburban neighborhoods (Wessel and Nordvik 2019; Wessel and Lunke 2021), with larger housing units, a garden patch, and what may be perceived as more child-friendly environments. Such a 'life course explanation' was a common narrative among out-movers interviewed in a recent case study focused on a relatively disadvantaged urban neighborhood with a high minority concentration in Oslo (Kadasia, Andersen, and Dalseide 2020). Furthermore, parents might be motivated by other features, such as housing prices, crime, pollution or socioeconomic

composition. In this article, we address whether schools might play a key role in producing patterns of flight.

Schools and neighborhoods may be segregated along a range of interrelated characteristics, such as socioeconomic status, culture, race, religion, or ethnicity, and several different mechanisms may contribute to segregation. Empirically, this paper concerns the segregation of residents from native and immigrant origins in Oslo, Norway, and our focus is on whether ‘native’ families tend to move away from schools with a high share of students of non-Western immigrant origins. While racial categories are rarely used to characterize individuals in the Norwegian context (Andersson 2017), we nevertheless relate closely to the broad US literature on racial segregation and ‘White flight’. While we study ‘native flight’ in a European context, where the largest minority groups consist of immigrants and their children, we believe that our contribution is relevant for understanding the general mechanisms that produce racial or ethnic school segregation.

To investigate whether ‘native flight’ is causally linked to school characteristics, we use highly detailed administrative register data linked to geographical coordinates for place of residence for the entire population of Oslo. We exploit discontinuous differences in the student composition of local schools at the catchment area border, using a Geographic Regression Discontinuity (GRD) design. By comparing families that reside in the same neighborhood but within different school catchment areas, this approach allows us to study the effect of schools with different student compositions while accounting for neighborhood characteristics.

Flight and School Segregation

Neighborhood Preferences and Flight

Focusing on racial and ethnic segregation and neighborhood preferences, a large US literature has documented that White families tend to move away from neighborhoods with large or growing shares of minorities. One strand of this literature addresses people’s expressed neighborhood

preferences (Clark 2002; Clark and Coulter 2015; Clark and Fossett 2008; Emerson, Chai, and Yancey 2001; Fossett 2006; Krysan 2002; Krysan et al. 2009). Generally, these studies document preferences for neighborhoods dominated by the individuals' own racial or ethnic group, especially among US Whites, and preferences for mixed neighborhoods among minorities. Another strand of this literature addresses people's actual moving behavior. These studies have shown moving patterns that correspond with the notion of 'flight' from and 'avoidance' of neighborhoods with high or increasing shares of racial or ethnic minorities (South and Crowder 1997; Crowder 2000; Crowder and South 2008; Crowder, Pais, and South 2012). Boustan (2010) also found the suburbanization of Whites in the postwar period to be in part caused by the urbanization of Blacks.

Related research in Europe more or less exclusively focuses on natives' mobility patterns as a response to recently immigrated ethnic minority populations. Thus far, European studies on 'native flight' have shown mixed results. Studies have found evidence of both native flight and avoidance in the Netherlands (Van Ham and Feijten 2008; Bolt, Van Kempen, and Van Ham 2008). In France, however, Rathelot and Safi (2014) found evidence of native avoidance, but no evidence of flight in Paris, while McAvay (2017) found patterns of native out-mobility and minority retention in France. In Britain, Simpson and Finney (2009) found that out-migration seemed related to improvements in families' living conditions, and they rebut that growth of segregated urban areas can be explained by flight behavior.

Findings from Nordic countries, which are particularly relevant comparisons for our study, are also mixed. BråmÅ (2006) found that native avoidance behavior, but not flight, was a major cause of residential segregation in Sweden. The importance of native avoidance in Stockholm was also supported by Andersson (2013). On the other hand, Aldén, Hammarstedt, and Neuman (2015) found that both native flight and native avoidance contribute to explaining why the native Swedish population growth drops when the share of non-European immigrants exceeds an observed tipping point. In Denmark, Andersen (2017) showed that native avoidance and, to a lesser degree, native flight, explain the neighborhood share of non-Western ethnic minorities, whereas Stonawski

et al. (2021) found patterns of native out-mobility from areas with high or increasing shares of ethnic minorities in Copenhagen, especially among parents. In Norway, Wessel and Nordvik (2019) found that parents and parents-to-be are especially prone to exhibit flight behavior by leaving neighborhoods with a high share of immigrants. These last two studies suggest that choice of school factors into natives' decisions to move.

School Preferences and Flight

Compared to the literature on neighborhoods, the evidence on school-related White or native flight is more limited. Some US studies have shown that White parents tend to prefer sending their children to majority-White schools, often resorting to private or charter schools (Betts and Fairlie 2003; Renzulli and Evans 2005; Fairlie and Resch 2002), but see a counterpoint by Rapp and Eckes (2007). Both in the US (Bischoff and Tach 2020) and internationally (Wilson and Bridge 2019), free school choice has been shown to contribute to school segregation. A few US studies have also used vignette experiments to investigate preferences for schools with different racial compositions among parents and students (Billingham and Hunt 2016; Hailey 2020; Bielamowicz 2019). Such studies have consistently found preferences for own-group majority schools among Whites, and, in a recent study, more flexible racial preferences among other racial groups, particularly among Blacks (Hailey 2020).

Few studies have investigated parents' school choices or preferences in Nordic countries. Two studies, addressing the Swedish system of free school choice, indicated that parents' choice of school is related to neighborhood characteristics (Malmberg, Andersson, and Bergsten 2014), and that the generalized choice reform resulted in small increases in socioeconomic and ethnic school segregation (Böhlmark, Holmlund, and Lindahl 2016). A Finnish study also found that the ethnic and socioeconomic composition of the school mattered for school choice and avoidance behavior among middle-class residents in Helsinki (Bernelius and Vaattovaara 2016). Recently, Bjerre-Nielsen and Gandil (2020) found that parents opted out of schools where a high share of students

had low socioeconomic status or non-Western immigrant origins in Denmark, and often either sent their children to another public school, to a private school, or moved to a different area. This provides support for the notion that parents hold school preferences and act on these, even to the point of moving. A similar conclusion was drawn by Kauppinen, van Ham, and Bernelius (2020), who studied the impact of school catchment area boundaries in Helsinki, Finland, using a GRD design. They found clear evidence of avoidance behavior among affluent native families with young children.

Motivations for Fleeing

There may be several reasons why native parents would avoid or ‘flee’ schools with high minority concentrations. In attempts to explain why Whites in the US prefer majority-White schools or neighborhoods, scholars have primarily debated two dominant theoretical positions (Billingham and Hunt 2016).

The first is the ‘*pure race*’ explanation, whereby Whites’ or other racial groups’ preferences for schools or neighborhoods are primarily motivated by stereotypes, prejudice, ethnocentric or racist attitudes towards out-groups, such as Blacks. The evidence on whether this explanation extends to Norway is scarce. One study, based on a sample from an Eastern city district in Oslo, asked parents of children who were about to, or had recently, transitioned to lower secondary school how important different factors were for their choice of school (Morken and Theie 2015). The number of Norwegian native-language pupils was the only indicator of immigrant background composition at the school that was used. 57% of the respondents stated that this factor was “quite important” or “very important”, though this was not ranked highest on the list of factors that mattered (it was ranked 10 of 15). While we find it plausible that some parents may be motivated by stereotypes, prejudice etc., we note that families residing near schools with high minority concentrations are likely a relatively tolerant segment of the native population.

The other explanation is the '*racial proxy*' explanation, whereby people use the racial or ethnic composition of a school or neighborhood as a proxy for other, salient characteristics, such as crime rates, safety, school or neighborhood quality, or socioeconomic status (see for instance Harris 2001). Average test results from standardized national tests taken in 5th grade are published annually by the Norwegian Directorate for Education and Training (Udir n.d.), and rankings of school results frequently reach media headlines (Berge and Lepperød 2018; Kjelstrup 2019). The share of minority language students, the number of students by grade level, teacher/student ratio, and other information on schools is also publicly available (Oslo Kommune n.d.-b). However, a number of potentially salient characteristics of schools are not publically or easily available, such as information about the learning environment, the quality of teachers or school facilities. It is entirely possible that some parents take the ethnic composition of schools as a proxy for such characteristics. This mechanism could however, in theory, work both ways; if parents are indifferent to the share of minority students and respond only to other characteristics of the school that are correlated with the share of minority students, this would produce similar results. Such interpretations are, however, not well supported by the abovementioned evidence on school preferences. A related point, inspired by Crowder and Krysan (2016) is that families might vary in whether they have, or seek out, information on schools, and whether they act on this information by moving out. Additionally, parents might be aware that schools with high proportions of immigrant origin students in need of special language support receive extra financial resources (Taguma et al. 2009), which could serve as a counterweight.

Hailey (2020) proposes a third explanation by suggesting that people's perceptions of the characteristics of schools and neighborhoods are racialized; the '*racialized prism*' explanation. In this view, people evaluate otherwise similar options differently, and make biased judgements of known information about schools depending on their racial demographics. Thus, White parents may view, for instance, a majority-White school as safer than a majority-Black or Latino school even when they have comparable safety levels.

We would add a fourth likely important explanation; *concern over potentially adverse peer effects*. Internationally, the research literature reveals modest, if any, effects of ethnic minority classmates on student outcomes (see for instance Van Ewijk and Sleegers 2010; Brunello and De Paola 2017). With one exception (Hardoy and Schøne 2013), Norwegian studies have found such effects to be non-existing or even slightly positive (Fekjær and Birkelund 2007; Hermansen and Birkelund 2015; Hardoy, Mastekaasa, and Schøne 2018), perhaps due to compensating resource allocation or relative grading (Hægeland, Raaum, and Salvanes 2005). However, even if attending schools with high minority concentrations is not detrimental to students' outcomes, a belief among native parents that their child will fare worse by attending such schools may be enough to produce patterns of flight. Based on media reports and debates, where high minority concentrations are frequently described as problematic (examples include Fremstad 2017; Stavrum 2019; Zahid 2018), it seems reasonable that such concerns motivate some parents to move.

These explanations are useful as a framework for our discussion. However, we are unable to differentiate between them empirically, as we observe behavioral patterns, not preferences or motivations, and do not know what features the student composition might proxy for. We also find these perspectives not mutually exclusive, as they probably reflect heterogeneous motivations among parents.

Our Contribution

Previous research on White or native flight and school segregation generally falls into one of two categories. First, several studies document associations between school characteristics and White or native flight. While these results are important, it is difficult to give them a causal interpretation. Only two studies, by Bjerre-Nielsen and Gandil (2020), and Kauppinen, van Ham, and Bernelius (2020), have used a research design suitable for causal inference, and the latter studied avoidance behavior rather than flight. In the second category we find studies that document preferences for own-group majority schools and show that such preferences are causally linked to their ethnic or

racial composition. While equally important, they cannot directly show whether such preferences translate into actual school choices or flight (Billingham and Hunt 2016; Hailey 2020; Bielowicz 2019). In this paper, we attempt to assess 1) whether native families systematically move away from schools with higher shares of non-Western immigrant origin students, and 2) whether such moves are causally linked to characteristics of the school.

The Oslo Context

Oslo is the capital of Norway, a Nordic social-democratic welfare state. As of January 1st 2019, the municipality of Oslo had a total population of 681 071 (Statistics Norway 2020a), a population that increased steadily from 507 467 at the turn of the century. Oslo is the municipality with the highest share of immigrant origin minorities in Norway. As of 2019, approximately 25% of the total population of Oslo were immigrants (born abroad with two parents born abroad), while 8% were Norwegian-born children of two immigrants (Statistics Norway 2020b).

Oslo is also a segregated city. Whereas the western and south-western parts of the city are relatively affluent and dominated by the native ethnic majority, the central, southern and, in particular, eastern city districts are less affluent and more ethnically diverse (Wessel 2015, 2017; Toft 2018; Haandrikman et al. 2021). This division has evolved as a consequence of long historical processes, such as industrialization, urbanization, and building regulations, as well as more recent developments, such as the settlement of newly arrived, relatively disadvantaged immigrants in neighborhoods in the central, eastern and southern parts of the city (Myhre 2017).

The vast majority of children in Oslo attend public schools. As of 2019, only 8 percent of school-aged children in Oslo were not registered at a public school¹. Out of 118 elementary schools (including 14 combined elementary and secondary schools) in Oslo in 2019, only 13 were private

¹ They either attended private schools, attended schools with special needs education, had private home schooling, were erroneously registered as resident in Oslo, did not attend school at all (despite legal requirements) or were not registered at a school in Oslo for some other reason.

schools (Abildsnes 2020). The private schools are primarily religious schools, providers of education with alternative pedagogical approaches, or providers of education in other languages, and most are not regarded as of higher quality than public schools (Lauglo 2010).

Admission in the public school system in Oslo is based on the principle that children have the right to attend their local school, as defined by the catchment areas drawn by the municipality. These encompass a given geographical area surrounding the school. Children start school in August the year that they turn 6 years old. In December in the year before the child starts school, the parents receive a letter from the local school informing them of the child's enrollment. This initial enrollment is based on the catchment areas and the registered place of residence as of November 1st. Final enrollment is in April. The municipality may redefine the catchment areas of schools in response to capacity constraints, but not as a tool for affecting the compositions of students (The Norwegian Directorate for Education and Training 2014)². Thus, public schools in Oslo differ greatly in their student composition mainly due to residential segregation. In the school year 2016/2017 the proportion of minority language students in public elementary schools varied between 0% and 98.3% (Oslo Kommune n.d.-b). A full, updated map of the school catchment area borders are available at Oslo Municipality's web page (Oslo kommune n.d.-a).

While parents may not know the exact student compositions at schools, we find it plausible that parents in Oslo have, or can gain, some general idea about whether the local school has a relatively high or low share of immigrant origin students. School compositions generally reflect neighborhood compositions, and information on the proportion of minority language students at schools is publicly available (Oslo Kommune n.d.-b), meaning that some information on the student composition of the local school is available to parents and may impact their decisions.

² We have also had a meeting with representatives from the municipality where the procedures for the redrawing of catchment area borders were explained to us.

Data and Methods

Data

In our main analysis, we rely on administrative register data covering all residents in Oslo over the years 2012 to 2014, provided by Statistics Norway. We also use information from 2011 for lagged characteristics and 2015 to identify movers in 2014. Unique personal identifiers allow us to link data from different administrative registers, including population registers, tax records, educational registers, etc. Additionally, we have access to geocoded data on place of residence on a 100x100m grid, provided by Statistics Norway, allowing us to locate the place of residence of each individual or family with great precision – a prerequisite for our research design.

We have further obtained data from the municipal Education Agency on local school catchment area boundaries that affected children who started in elementary school in the years 2013-2015. These came in the form of lists of addresses that we geocoded onto a 100x100m grid using publically available geocodes (Norwegian Mapping Authority/Geonorge 2018), allowing us to link school catchment areas to grid cells. This was done separately, and no sensitive or identifiable information was ever linked to addresses. Additionally, we randomly assigned a pseudonym to each school before linking catchment areas to register data to preserve the anonymity of the schools.

Sample and Variables

Our main interest is in whether ethnic majority families respond to the proportion of ethnic minority students at their local school by moving out. Since we do not have register data on ethnicity, we use immigrant background and country of origin as a proxy for ethnic minority/majority categorization. In our main specification we define the ethnic majority families as families where at least one parent is born in Norway by two Norwegian-born parents, and none of the parents originate from a non-Western country. Although somewhat arbitrary, this classification is both relatively simple and ensures a reasonable sample size. We define the minority

student group as immigrants (born abroad to two foreign-born parents) and descendants of immigrants (born in Norway to two foreign-born parents) originating from non-Western countries³. This choice is based on an assumption that individuals originating from non-Western countries are especially likely to be subject to prejudice and avoidance behavior from the native origin population. However, this classification is somewhat arbitrary, and we therefore also test the sensitivity of our estimates to the classification of both majority families and minority students.

We do not have access to data on actual school enrollment, so to calculate the share of non-Western origin pupils at each local school, we use the share of children in elementary school age (aged 6-12 years) among children residing in the school catchment area each year. Although some children attend other schools than their local school, as discussed below, we believe this measure is a very good proxy for the share of non-Western origin pupils in schools.

We take families as our units of analysis, as we believe the decision to move will usually be taken at the family level. Families are defined according to Statistics Norway's definition as "persons resident in the same dwelling and related to each other as spouse, registered partner, cohabitant, and/or parent and child (regardless of the child's age)" (Statistics Norway n.d.). We further limit our main analysis sample to include only native families where the oldest child is older than 2 and younger than 6 years old on January 1st in the given year. We test the sensitivity of our estimates to this specification.

At the family level, we include information on several indicators of demographic/housing characteristics (family size, age of the oldest family member, parents' marital status, and the family's type of dwelling, measured by a dummy for living in an apartment building) and socioeconomic characteristics (parents' total income, total gross wealth and debt, and highest attained level of education, in addition to a measure of the share of parents currently enrolled in education). We lagged income and education (level and enrollment) by one year.

³ Western countries include EU/EEA countries, USA, Canada, Australia and New Zealand. If immigrant parents have different countries of origin, the mother's country of origin is used.

In our data, some grid cells contained residents on both sides of a catchment area border. We omitted these residents from the analyses because we cannot with certainty identify which catchment area they belonged to. This reduces our effective sample size by 10 percent in our main analysis (from 26,426 family-year observations in 5636 unique grid cells to 23,782 family-year observations in 5049 unique grid cells). While dropping observations close to the border is problematic, we are forced to do so because they cannot be clearly assigned to the treatment or control group.

Challenges to Causal Identification

There are three major hurdles to overcome when studying whether parents selectively move in accordance with preferences for their school's ethnic composition; neighborhood-level confounding, self-selection, and school-level confounding.

Neighborhood-level confounding. School characteristics correlate with neighborhood characteristics. Thus, neighborhoods that differ with regard to their local school's share of immigrant origin students are also likely systematically different with regard to a number of other features, including the ethnic or socioeconomic composition of neighborhoods, crime rates, pollution, geographical features, dwelling types etc. Estimates may be biased if these neighborhood-level characteristics affect natives' propensity to move.

Geographic self-selection. People who move to a neighborhood and school with a high share of immigrant origin residents and students are likely to differ from people who don't on a wide range of characteristics. These range from characteristics we can observe with register data, such as income, education etc., to unobserved characteristics, such as tolerance, values, preferences etc. Thus, estimates comparing rates of out-mobility between different catchment areas may be biased by the fact that the people who initially live in these areas are different.

School-level confounding. Characteristics of schools may correlate with the share of immigrant origin students at the school. The quality differences between Norwegian schools are

likely to be modest (Ofstedal Telhaug, Mediås, and Aasen 2006). Nevertheless, schools with a high share of immigrant origin students may for instance be struggling with teacher attrition (OECD 2010; Bonesrønning, Falch, and Strøm 2005), and/or be characterized by a lower socioeconomic status among the students (Hermansen and Birkelund 2015). Such factors may confound the effect of the share of immigrant origin students on native out-mobility.

We employ a geographical regression discontinuity (GRD) approach to remove neighborhood-level confounding and reduce bias due to geographical self-selection. In effect, our design compares similar families that reside in the same neighborhood, but in different catchment areas. Neighborhood-level characteristics are assumed to be a continuous function of distance to the catchment area border, and, to the extent that these are not extremely local and sharply differ along these borders, they are thus controlled for in our models.

School characteristics that induce *school-level confounding* will not be netted out in our design. However, school-level characteristics that correlate with the student composition are an integral part of the potential consequences of school segregation (Borgen 2021). Thus, controlling for school characteristics in an attempt to estimate the net effect of the share of immigrant origin students may introduce biases, and we find it more relevant to study the effect of schools characterized by, among other things, the share of immigrant origin students.

Main Assumptions

The main weakness of this design is that it relies on a somewhat tenuous assumption, namely that assignment to the treatment (belonging to a school with a higher share of students from non-Western origins) is as good as random along the border between schools. This assumption might be wrong, in particular if either of the following assumptions are violated:

- a) *Aside from the characteristics of the local school, characteristics that affect the out-mobility of native origin pre-school parents do not differ discontinuously along the border.*

This assumption may be violated for instance if the borders are not arbitrarily drawn (e.g., rental or public housing apartments systematically cluster on one side of the border or if considerations to local communities have been central to determining the local catchment area), or if parents' characteristics differ systematically along the border for other reasons. A violation of this assumption would likely bias our estimates upwards since such push-factors are likely correlated with the student composition in schools. We can (and do) test whether our assumption holds for a number of observed characteristics of families, but cannot do so for characteristics that we do not observe in our register data.

- b) *Families either do not have, or do not act on information on where the school catchment area borders go when deciding where to live initially.*

This assumption may be violated if parents of young children or parents-to-be take school catchment area borders into account when deciding where to settle. If so, some families self-select into their treatment condition. Additionally, our sample is in part endogenously conditioned on previous moves. If the share of immigrant origin students at a school cause some families to move in 2012, the families remaining in 2013 will consist of a relatively tolerant subsample of families who did not move in 2012, plus new families. Both of these selection processes likely go in the same direction as flight patterns, and will likely bias our estimates downwards.

School catchment area borders are somewhat, but not entirely arbitrarily drawn. The Municipality of Oslo draws up catchment areas primarily based on geographical distance to schools, but other factors, such as ensuring safe school routes and considerations for tight local communities may also weigh in (Education Agency of Oslo na). Such considerations in boundary drawing may be a source of bias.

The school enrollment process is not entirely deterministic, and subject to exceptions. Parents have some opportunities to opt out of their local schools. First, parents may appeal the decision

on what school should be considered their local school to the County Governor. For the school years 2012/2013-2015/2016, the municipal Education Agency reported 124 such appeals out of nearly 30,000 enrollments. In the vast majority of such appeals, the decision was not changed (Education Agency of Oslo 2019; e-mail correspondence).⁴ We therefore consider this to be a minor issue. Second, parents can apply to another nearby school (or send their children to one of the few private schools in Oslo). The application will be granted if the school they apply to has capacity to take more children (Education Agency of Oslo na)⁵, and this likely represents a more common and less costly avenue of avoidance, as shown by Bjerre-Nielsen and Gandil (2020). Schools with high shares of minority language students experience significantly more of this type of student flight (Abildsnes 2020). This indicates that among those who do not respond to the local schools' minority concentration by moving, many submit a transfer application. By studying only one of the ways parents might select schools for their children, i.e., by moving, we essentially study those who do not transfer their children, are unaware of this option or are not willing to take the risk of a rejected application. We also note that parents may also move or apply to have their children attend another school after school has started.

In sum, while school catchment area borders are partially arbitrarily drawn, they are unlikely to be strictly exogenous. We nevertheless believe that our GRD approach will substantively reduce bias from neighborhood-level characteristics.

Model Specifications

We use the border discontinuities to study the effect of belonging to a school characterized by – among other things – a higher share of students from non-Western immigrant backgrounds. Our

⁴ 2 appeals were rejected by the Education Agency (EA); in 3 appeals, the County Governor (CG) partially ruled in favor of the plaintiff; in 19 cases, the child was assigned to another school due to changes in the capacity, so that the case was not considered by the CG; 90 appeals were rejected by the CG; in 5 appeals, the decision was changed by the EA; 5 appeals were withdrawn by the parents (Education Agency of Oslo 2019e-mail correspondence).

⁵ In an attempt to collect information on the volume of such applications and the share of such applications that are approved, we sent out e-mails to all elementary schools in Oslo, asking them to supply us with information on this. Unfortunately, only one school replied with this information.

running variable is not strictly distance to the border, but rather, distance to the nearest grid cell where all valid addresses belong to another school catchment area. A map of distances to the school borders is shown in **Figure 1**. Due to the discrete nature of the distance between grid cells, the lowest (absolute) value on this variable is 100 meters. We therefore subtract 99 meters from the absolute value of our running variable on either side of the border in our main specifications. We also limit our bandwidth to 600 meters from each border, but assess the sensitivity of our estimates to these specifications. We pool data for the years 2012-2014.

[FIGURE 1]

In our data, we have 306 borders that are shared by pairs of schools (hereafter: dyads), along which we can compare families on either side of the border. We use a nearest neighboring school-approach, where each family is assigned to the school whose catchment area they reside inside, and a neighboring school, which is always the school where the distance between the family's place of residence to the catchment area border is shortest. Each family is only included once. Ideally, we would study each dyad separately and only compare families that live in the same neighborhood but belong to different schools. However, only a limited number of people live on either side of the border in each dyad. We therefore divide our sample into four quartiles of school dyads based on the difference in the share of students with non-Western immigrant background, between the two schools in each dyad (see supplementary material S1). Quartile 1 contains the dyads where the difference between schools in the share of non-Western immigrant origin students is smallest, while quartile 4 contains the dyads where this difference is largest. The mean difference in this share is negligible in the lowest quartile, increases monotonically, and is quite substantial in the highest quartile (2, 6, 14 and 35 percentage points, respectively). Therefore, we expect our effect estimates to be close to zero in the lowest quartile, but increase more or less monotonically to quartile 4. While we present results for each quartile, we focus our attention on the highest quartile, as this is where we expect to find an effect if there is one, while results for the lowest quartile(s)

may be seen as placebo estimates. We follow Gelman and Imbens (2019) in focusing on a linear specification of our model, but also show results using 2nd through 4th degree polynomials.

Within each dyad, the running variable takes negative values in the school catchment area with the lowest share of students with non-Western immigrant background (“untreated”), and positive values for the school with highest share of students from non-Western immigrant backgrounds (“treated”). It is zero at the border by construction. Thus, our running variable, x_i , takes the following values:

$$x_i = \begin{cases} distance_i - 99 & \text{if } SL_i \geq SN_i, \text{ and } distance_i \leq 600 \\ -1 \times distance_i + 99 & \text{if } SL_i < SN_i, \text{ and } distance_i \leq 600 \end{cases}$$

where SL_i is the share of non-Western immigrant background students at the local school of family i , while SN_i is the same share at the nearest neighboring school. Our treatment indicator, D_i takes the values 1 if x_i is greater than zero, and 0 otherwise.

Our outcome variable, hereafter denoted *moved*, is a dummy variable that takes the value 0 if the family did not move to a different school catchment area in a given year (i.e. that they either lived in the same 100x100m grid cell or another grid cell within the same school catchment area). It takes the value 1 if they moved to a grid cell not within the same school catchment area that year, regardless of where that catchment area is located. Our main linear specification can be written as

$$moved_{iq} = \alpha + \beta_1 \times x_{iq} + \rho \times D_{iq} + \beta_2 \times D_i \times x_{iq} + \varepsilon_{iq}, \quad (1)$$

where, α is the constant term, β_1 is the coefficient for the running variable, and β_2 is the coefficient for the running variable interacted with the treatment indicator, ε_{iq} is the residual, and ρ captures the parameter of interest; the difference in out-mobility at the border. The units are families, and the models are estimated separately for each quartile q . Using p -th order polynomial specifications, this model can be written as:

$$moved_{iq} = \alpha_q + \beta_{01} \times x_{iq} + \beta_{02} \times x_{iq}^2 + \dots + \beta_{0p} \times x_{iq}^p + \rho \times D_{iq} + \beta_1^* \times D_i \times x_{iq} + \beta_2^* \times D_i \times x_{iq}^2 + \dots + \beta_p^* \times D_i \times x_{iq}^p + \varepsilon_{iq} \quad (2)$$

We also expand our models to include control variables⁶.

Descriptive Statistics and Balance Tests

Table 1 shows descriptive statistics for our analysis sample, by quartile and separately for schools with high (treated) and low (untreated) shares of non-Western origin students. The average difference in the share of native origin families that moved is much higher in the highest quartile, at 11 percentage points. Regarding the other variables, there are marked differences, but the important question is whether these come in the form of a discontinuous jump at the border. To assess whether there are discontinuities at the borders for observable potential confounders, we have run the model presented in Equation 1, but using variables listed in Table 1 as outcomes. **Table 2** presents the main results from this exercise, using a linear specification, while RD plots, also for higher order polynomials, as in Equation 2, are included in the supplementary material (S2). Overall, the results from these balance tests are satisfactory. Out of 36 models (nine variables over four quartiles), we observe nine statistically significant shifts at the borders, but none in the highest quartile, which is the quartile we are primarily interested in. A visual inspection of the RD plots suggests that few of the shifts in lower quartiles likely represent sharp discontinuities, but we nevertheless present models that control for these variables to reduce potential bias⁷.

[TABLE 1] [TABLE 2]

⁶ In an ideal setting, we could have used the school border as an instrument for the ethnic composition of the local school in a fuzzy RD setup. However, since all other characteristics of the school that correlate with the minority concentration potentially differ along border, the exclusion restriction would be violated in such a setup.

⁷ In particular, there are marked differences at the border in quartile 3, where families residing in catchment areas with a higher proportion of non-Western immigrant origin students on average are younger, have lower income and debt, are more often enrolled in education and more often reside in an apartment building. This suggests that these catchment area borders separate apartment buildings (possibly student dwellings) from detached housing, townhouses or similar and that results from this quartile should be interpreted with caution.

Main Results

Ethnic School Segregation and Out-Mobility

While Wessel and Nordvik (2019) have shown that parents with pre-school children have a strong tendency to move out of *neighborhoods* with high concentrations of immigrants in Oslo, **Figure 2** shows that this is also the case for *school catchment areas*. Here, dark grey represents school-by-year-level out-mobility among native families where the oldest child is aged between 2 and 5 years old, while light grey represents the out-mobility among native families where the oldest child is aged between 14 and 17. We use the latter group as a baseline comparison and placebo group, as it is likely unaffected by catchment areas. Among those with pre-school children, there is a strong, positive relationship between out-mobility and the share of students with non-Western immigrant backgrounds at the local school. Among parents with older children, we find no such relationship. In other words, native origin parents with young children do systematically move away from schools with high shares of students with non-Western immigrant backgrounds. The question that we attempt to answer in the remainder of this article is whether this mobility pattern is driven solely by neighborhood-level characteristics, or if families' local school also plays a causal role.

[FIGURE 2]

GRD Estimates of the Effect of Local School Affiliation on Native Out-Mobility

In **Table 3**, we present GRD estimates of the effect of the local school affiliation on out-mobility, by quartile, using 1st to 4th order polynomials, both with and without family-level controls. Estimates for the 4th quartile, with a linear specification, are our main results. Corresponding RD plots for models without controls are shown in **Figure 3**, with the main specification also shown separately. There are three important features to note.

First, the results using 1st order polynomials are consistent with our expectations, and suggest that school borders have a large effect on native parents' out-mobility. Recall that we expect small point estimates for quartile 1, where there is hardly any difference in the concentration of students

from non-Western immigrant backgrounds (2 percentage points), and larger estimates for quartile 4. In quartile 1, the effect of residing in the school catchment area with the highest concentration on out-mobility is estimated to 3.3 percentage points at the border. In the fourth quartile (our main specification), the effect is estimated to 7 percentage points. In other words; belonging to a school with (on average) 35 percentage points higher concentration of non-Western immigrant background students increases yearly out-mobility among native families by around 7 percentage points – a quite substantial effect.

Second, these results are quite robust to the inclusion of controls for family-level characteristics. While the point estimate for quartile 1 is attenuated and remains non-significant with the inclusion of family-level controls (and the point estimate for quartile 2 remains very small and insignificant), the point estimate for quartile 4 remains largely unaffected.

Third, these results are highly sensitive to the choice of functional form. When we use 2nd to 4th degree polynomials, most point estimates change substantially, and the point estimate for quartile 4 is greatly reduced. We focus on estimates based on 1st degree polynomials going forward, due to issues related to the sensitivity and interpretation of results from regression discontinuity analyses using high-order polynomials (Gelman and Imbens 2019). However, we find it pertinent to also report these estimates, as they may indicate that our main GRD results are driven by nonlinear patterns rather than discontinuities.

[TABLE 3] [FIGURE 3]

Sensitivity Analyses and Robustness Checks

We run two types of placebo regressions. The first, already shown in **Table 3** and **Figure 3**, is the results from the 1st quartile. Here, the proportion of non-Western students is practically identical within each dyad, so if differences in families' out-mobility is driven by differences in this proportion or correlated school characteristics, we should expect results from the 1st quartile to be small and non-significant. That is what we find, at least in the linear specification. The second

placebo regression is an analysis where we study families whose oldest child is aged 14-17 years, as explained above, otherwise using the same model specifications as in our main analysis (**Table 3**). If differences in out-mobility at the border are driven by school catchment areas and not other, unobserved factors, we should expect results for this group to be small and non-significant. This is also what we find. These results are shown graphically in **Figure 3**, while model results are provided in the supplementary material (S3).

As a comprehensive sensitivity analysis, we also include a specification curve in the supplementary material (S4) where we test 2880 different specifications of our main model, and plot the main coefficient from each. Overall, this analysis shows that our main estimates are sensitive to certain model specifications. In particular, including families where the youngest child is younger than 2 years old, and not using a 99 meter border distance correction systematically produces lower point estimates. The vast majority of estimates point in the same direction as our main results, although our main models may overestimate the effect somewhat. Mean and median coefficients are 0.04.

Since our GRD design is sensitive to residential self-selection around the border, we have made attempts at employing a second identification strategy as a robustness check; a two-way fixed effects Difference-in-Differences (DiD) estimation where we exploit plausibly exogenous variation in the local schools' concentration of minority students arising from the redrawing of school catchment area borders (S5). This approach effectively removes bias due to both neighborhood-level confounding and geographic self-selection. However, due to the low number of border redrawings (particularly border redrawings between schools with a substantial difference in student composition), the number of 'treated' families and the statistical power in these analyses is low, and the estimates are not particularly robust, although they are consistent with our main results.

Limitations

Our study has several limitations worth noting. First, we cannot rule out the possibility of selection along the border between schools. We have attempted to compensate for this by reporting results based on the redrawing of such borders (S5). Additionally, we cannot definitively rule out the possibility that unobserved characteristics of families differ along the borders, although our balance tests revealed no such discontinuities in the fourth quartile for the variables we included.

Second, actually moving to a different school is only one avenue of ‘flight’ for native parents. Parents may also apply for their child to attend another nearby or private school, and those who move may be those who are not willing to take the risk of a rejected application, or are unaware of this option. In this sense, our results are conservative. Our attempt to survey the extent of applications to nearby schools was unfortunately unsuccessful. Related to this, we do not use data on where families move to. Some movers may relocate to school catchment areas with *higher* minority concentrations. While we could have investigated the characteristics of destination areas, such an analysis would be sensitive to regression to the mean, in the sense that even random moves would produce flight-like patterns due to top and bottom effects (Stonawski et al. 2021).

Third, our study is limited in time and space, to the Oslo context in the period 2012-2014. The effect we estimate is also local in the sense that it pertains to native families with small children residing near catchment area borders where schools differ substantially, who have not already moved. The external validity of our findings depends on whether the mechanisms that produce these patterns easily generalize to other contexts. Given the progressive resource allocation of the Norwegian school system, and that Norwegians on average have relatively tolerant attitudes towards minorities (Blom 2011), we find it likely that patterns of flight will be stronger in less egalitarian or tolerant contexts. Our results also support the notion that theories of school-related flight can be applied to non-US contexts and immigrant origin minorities.

Finally, we cannot say for sure what characteristic of the local school parents flee. While the share of immigrant origin students is a likely suspect, this share is also strongly correlated with the

socioeconomic composition of the school and other potentially salient factors, which are difficult to disentangle.

Discussion and Conclusions

We found that native families with pre-school children systematically tend to move away from schools with high shares of students with non-Western immigrant backgrounds. Although our GRD results are sensitive to model specifications, they still clearly suggest that such moves are in part related to characteristics of their local school, not just their neighborhood. While such moving patterns may have many explanations, our results suggest that a simple life course explanation, whereby young, native, urban couples with young children suburbanize because they want larger dwellings with a garden patch in a child-friendly neighborhood, is insufficient. This is because it cannot explain why similar families, living in the same neighborhood, but on either side of the catchment area border, move out at different rates. So, why do more native families move when their local school has a higher share of students with non-Western immigrant backgrounds?

One explanation is that some parents prefer schools that do not have high shares of immigrant origin students. Such preferences may be motivated by a wide array of reasons.

Some parents may hold prejudiced or racist views of minorities. Parents may reside in neighborhoods with a high share of minorities despite holding such views, but opt out in anticipation of their child starting in school (in accordance with the ‘pure race explanation’). Both theory (Allport 1954/1979) and experimental evidence (Finseraas and Kotsadam 2017; Finseraas et al. 2019) suggest that contact and cooperation with ethnic or racial minorities reduce prejudice or negative attitudes towards minorities. Thus, if flight is primarily motivated by prejudice, the most effective long-term approach to reduce it may be to increase contact and integration in arenas such as workplaces, neighborhoods and schools.

Some parents may also view a high share of immigrant origin students as an indicator of other, more salient issues at the school, such as teacher quality, the socioeconomic composition of the students, etc. (the ‘proxy explanation’). If so, policies that allocate more resources to schools with more disadvantaged students and policies that equalize school contexts may reduce parents’ propensity to flee. In Norway, several such policies already exist (Taguma et al. 2009), and may explain why low-achieving students get better test scores from attending schools with high shares of immigrant origin students. Clearly communicating such progressive resource allocations may prompt more parents to stay. However, if parents also interpret information about schools differently, depending on the composition of the students (the ‘prism explanation’), such efforts are likely insufficient if segregation is not also reduced.

Finally, parents may worry that their children will fare worse academically or socially from having peers of immigrant background, despite empirical evidence to the contrary. If so, communicating more clearly the main research findings regarding immigrant-origin peer effects may reduce patterns of flight.

The other explanation is that parents respond to other characteristics of schools than the minority concentration. While US studies have found preferences for majority-White schools among White US parents, we cannot say for sure if these preferences translate to an aversion to schools with high concentrations of immigrant origin minorities among native Norwegian parents, as our study is moot with regards the parents’ motivations. We thus cannot differentiate between these explanations. But we believe that they are not mutually exclusive. Native parents are heterogeneous, and their motivations for moving or staying may differ substantially, so that no single explanation is universally valid. Investigating the existence, prevalence and relevance of different types of school preferences should be done using qualitative, survey-based and experimental methods, and we strongly recommend this as an avenue for future research.

In the end, the main reason why schools are segregated is that neighborhoods are segregated. If policymakers wish to reduce school segregation, reducing residential segregation is likely the

most effective means. As both Bjerre-Nielsen and Gandil (2020) and our study shows, attempting to reduce school segregation through, for instance, the redrawing of school catchment area boundaries may not be effective if parents respond by moving or opting out in other ways.

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Tables

Table 1: Descriptive statistics for the main GRD sample

	Quartile 1		Quartile 2		Quartile 3		Quartile 4	
	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest
Count	3,148	3,435	3,461	3,180	3,083	3,159	2,406	1,910
Mean difference in the share of non-Western immigrants and descendants between schools	0.02		0.06		0.14		0.35	
Share of non-Western immigrants and descendants at the school (mean)	0.15	0.17	0.18	0.25	0.16	0.31	0.22	0.53
Share of non-Western immigrants and descendants at the school (min)	0.00	0.02	0.01	0.05	0.00	0.11	0.00	0.22
Share of non-Western immigrants and descendants at the school (max)	0.81	0.84	0.75	0.80	0.62	0.74	0.57	0.84
Moved in year t	0.15	0.16	0.17	0.19	0.18	0.24	0.18	0.29
Share of parents in families with higher education in year t-1	0.86	0.85	0.84	0.85	0.88	0.83	0.83	0.79
Share of parents in families enrolled in education in year t-1	0.08	0.08	0.10	0.10	0.08	0.10	0.09	0.12
Share of families living in an apartment building in year t	0.31	0.45	0.55	0.57	0.59	0.76	0.51	0.75
Age of the oldest family member (mean) in year t	37.56	37.33	37.23	37.17	37.47	36.63	37.31	35.92
Number of persons in family (mean) in year t	3.55	3.50	3.44	3.45	3.46	3.36	3.43	3.31
Total income among parents in the family (mean) in year t-1	957094	931337	846874	820811	862626	748245	780022	682852
Total debt among parents in the family (mean) in year t	3602141	3251586	2953910	2920113	3196581	2538855	2642383	2243888
Total gross wealth among parents in the family (mean) in year t	4174899	3072769	3824143	2312766	2914979	1947731	1897746	1348532
Share of families with married parents in year t	0.55	0.50	0.48	0.47	0.46	0.45	0.45	0.39

Note: Quartiles are based on the absolute differences in the share of non-Western immigrant origin students at the schools. Descriptive statistics are shown separately for families residing within the catchment area of schools with the highest and the lowest share of non-Western immigrant origin students within each dyad. Income, wealth and debt are in 2014 NOK.

Table 2: GRD balance tests

	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Higher education				
Coefficient	-0.002	0.016	-0.010	0.009
(Robust SE)	(0.016)	(0.017)	(0.016)	(0.022)
<i>N</i>	6582	6632	6235	4314
Enrolled				
Coefficient	-0.006	0.011	0.036***	-0.009
(Robust SE)	(0.010)	(0.011)	(0.011)	(0.014)
<i>N</i>	6583	6634	6241	4314
Apartment building				
Coefficient	0.109***	-0.019	0.100***	0.024
(Robust SE)	(0.023)	(0.022)	(0.021)	(0.027)
<i>N</i>	6583	6641	6242	4316
Age, oldest family member				
Coefficient	-0.142	-0.208	-0.626*	-0.547
(Robust SE)	(0.258)	(0.253)	(0.246)	(0.298)
<i>N</i>	6583	6641	6242	4316
Family size				
Coefficient	-0.028	-0.032	-0.049	-0.020
(Robust SE)	(0.034)	(0.033)	(0.034)	(0.042)
<i>N</i>	6583	6641	6242	4316
Total income				
Coefficient	-55367.409	-27635.176	-100726.104***	-7538.297
(Robust SE)	(29457.553)	(20323.414)	(26923.717)	(18146.261)
<i>N</i>	6583	6641	6242	4316
Total Debt				
Coefficient	-417097.454*	90975.969	-577827.349***	92118.780
(Robust SE)	(162858.895)	(125718.782)	(119754.614)	(99622.430)
<i>N</i>	6583	6641	6242	4316
Total gross wealth				
Coefficient	-1722642.123**	-844921.990*	-688159.950	-183365.128
(Robust SE)	(655935.724)	(424324.248)	(406555.118)	(128622.762)
<i>N</i>	6583	6641	6242	4316
Married				
Coefficient	-0.029	-0.009	-0.001	0.022
(Robust SE)	(0.023)	(0.023)	(0.023)	(0.028)
<i>N</i>	6583	6641	6242	4316

Note: GRD estimates, using a 1st degree polynomial specification, where the outcome variables are a set of potential confounders. Quartiles are based on the absolute differences in the share of non-Western immigrant origin students at the schools. Quartile 4 is our main sample of interest. Heteroscedasticity robust standard errors (SE) in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Two-tailed tests.

Table 3: GRD estimates

	Quartile 1		Quartile 2		Quartile 3		Quartile 4	
	No controls	All controls	No controls	All controls	No controls	All controls	No controls	All controls
1 st order poly.								
Coefficient	0.033	0.012	-0.003	0.003	0.049*	0.030	0.070**	0.068**
(Robust SE)	(0.018)	(0.017)	(0.019)	(0.018)	(0.020)	(0.019)	(0.026)	(0.024)
N	6583	6582	6641	6632	6242	6235	4316	4314
2 nd order poly.								
Coefficient	0.053*	0.028	-0.018	-0.009	0.049	0.033	0.038	0.024
(Robust SE)	(0.026)	(0.024)	(0.027)	(0.025)	(0.028)	(0.027)	(0.036)	(0.034)
N	6583	6582	6641	6632	6242	6235	4316	4314
3 rd order poly.								
Coefficient	0.065*	0.032	-0.017	-0.013	0.056	0.033	0.026	0.006
(Robust SE)	(0.030)	(0.028)	(0.031)	(0.030)	(0.033)	(0.032)	(0.043)	(0.041)
N	6583	6582	6641	6632	6242	6235	4316	4314
4 th order poly.								
Coefficient	0.060	0.033	-0.021	-0.014	0.058	0.036	0.005	-0.009
(Robust SE)	(0.032)	(0.031)	(0.034)	(0.032)	(0.037)	(0.035)	(0.046)	(0.044)
N	6583	6582	6641	6632	6242	6235	4316	4314

Note: GRD estimates of out-mobility, using 1st-4th degree polynomial specifications. Models with “no controls” include no controls except the given polynomial specification of the running variable. Models with “all controls” include family-level controls for the share of parents with higher education and enrolled in education (t-1), a dummy for living in an apartment building (t), the age of the oldest family member (t), the number of persons in the family (t), the total income among parents in the family (t-1), the total debt and gross wealth among parents in the family (t) and a dummy for whether the parents are married (t). Quartiles are based on the absolute differences in the share of non-Western immigrant origin students at the schools. Quartile 4 is our main sample of interest. Heteroscedasticity robust standard errors (SE) in parentheses.

* $p < 0.05$, ** $p < 0.01$. Two-tailed tests.

Figures

Figure 1: Map of distances to the school border

Distance from borders 2012

Note: The map shows all populated 100x100m grid cells in Oslo in 2012, colored by the distance to the nearest occupied grid cell in another school catchment area. Numbers in the legend represent the lowest value of each 100m bin (“100” means “100-199” etc.). Grid cells with distances over 700 are top-coded to 700. Populated grid cells are included regardless of whether they are inhabited by families that meet our sample restrictions.

Figure 2: Native out-mobility and school segregation

Note: The lines are lowess smoothers drawn based on the underlying individual-level data. Circles represent school-by-year estimates of out-mobility by the share of non-Western immigrant origin students at the school, weighted by the number of native families.

Figure 3: GRD plots

Note: Circles represent binned, unadjusted out-mobility among native families, by the distance to the nearest occupied grid cell in another school catchment area (contracted around the border), weighted by the number of families. Quartiles are based on the absolute differences in the share of non-Western immigrant origin students at the schools. Positive values on the x-axis represent schools with relatively higher shares of non-Western immigrant origin students. Families where the oldest child is aged 2-5 are shown in dark grey, while families where the oldest child is aged 14-17 (a plausible placebo group) are shown in light grey. Our main sample and specification (quartile 4, 1st degree polynomial) is highlighted. In the panel, the top row plots show 1st degree polynomials, the second row shows 2nd degree polynomials, etc. Shaded areas are 95 % confidence intervals.