School Segregation: Is it All About Residential Sorting? Evidence From a Nationwide School System *

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Abstract

Catchment areas are widely used in the school assignment process to define priorities. Usually drawn around schools, they are likely to reflect residential sorting. This paper focuses on the French context, where assignment to schools is residence-based but one third of students bypass the default assignment by resorting to opt-out options. Using novel geographic information data, I first show that the social composition of neighboring schools' catchment areas sometimes dramatically differs. It suggests that, despite residential sorting and current school location, there is room for reducing social segregation across schools' recruitment pools. In the second part of the paper, I evaluate the causal impact of a change in catchment areas' boundaries on families' behavioral reactions using a difference-in-differences strategy. I show that families react both to assignment to a worse school and to a better school in terms of social composition. Reactions are stronger for families with a high socioeconomic status than for those with disadvantaged backgrounds. Given these behavioral reactions, only students with a low socioeconomic status experience a change in their exposure to students with a high socioeconomic status at the school level when assigned a different school in terms of social composition.

JEL Codes: H75, I21, I24, J18, R23

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1 Introduction

The question of how to organize students' assignment to schools has led to many discussions among both policy-makers and researchers. This question is of prior importance for two main reasons. The first one is that different school assignment mechanisms may induce different incentives for schools to improve. Advocates of school choice argue that such assignment mechanisms foster competition between schools and improve their overall quality (Foliano and Silva, 2020). The second reason, on which this paper focuses, is that school assignment mechanisms may lead to the sorting of students between schools on the basis of their social background, ability or ethnicity, which could in turn have important consequences on their long-run outcomes. While all these dimensions of segregation are correlated, I focus in this paper on social segregation.

Students' sorting could deteriorate the quality of the schools attended by students with a low socioeconomic status (hereafter SES). Indeed, deprived schools have a hard time attracting experienced teachers and retaining the ones they recruit (Goldhaber et al., 2015; Allen et al., 2018; Benhenda and Grenet, 2020). Moreover, in the presence of peer effects, social sorting could be detrimental to low-SES students. Peer effects could for instance affect their cognitive outcomes (Matthewes, 2020) as well as their school behaviour (Avvisati et al., 2014). Finally, mixing students from different backgrounds may improve their non-cognitive outcomes (Burgess and Platt, 2018 ; Alan et al., 2021), which have been found to be important determinants of labor market outcomes (Heckman et al., 2006). Overall, the share of high-SES friends among low-SES individuals, which is partly determined by the level of social diversity at the school level (Chetty et al., 2022b), has proved to be a strong predictor of upward income mobility (Chetty et al., 2022a).

Distance to school is widely used as a priority criteria when assigning students, either by relying on Euclidean distance to schools, or through the drawing of catchment areas around schools, making residential sorting one of the likely determinants of school segregation (Wilson and Bridge, 2019). However, the decision to include an address rather than another in the catchment area of a given school is a political decision: a school could be at the frontier of two very different neighborhoods in terms of social composition, but its catchment area may be drawn around only one of these two neighborhoods. Generally speaking, for a given level of residential segregation, education authorities have several options for delineating catchment areas, each of them resulting in a different level of segregation across schools' recruitment pools. Redrawing catchment areas could therefore be an important tool at the disposal of local authorities to equalize schools' social composition. However, the actual level of school segregation ultimately depends on families' enrollment decisions. In the short-term, redrawing catchment areas in a desegregation perspective could lead parents unhappy with their newly assigned school to resort to opt-out options such as charter or private schools. In the medium-term, they could even move away to live in the catchment area of a school with a less diverse social intake.

This paper focuses on the French context where default assignment to schools is residence-based but where one third of students actually bypass this assignment by resorting to opt-out options, namely dispensations to enroll in a public middle school different from the assigned one, and private schools. More specifically, this paper addresses the two following questions: (i) Given the current level of residential segregation and location of schools, could alternative catchment areas be drawn to provide a more diverse recruitment pool for public middle schools while only moderately increasing students' commuting time? (ii) Given that opt-out options are available to families, to what extent assigning a student to a different school in terms of social composition affects her probability to use opt-out options, and ultimately, her exposure to students from advantaged backgrounds?

To answer these questions, I exploit novel geocoded datasets provided by the Statistical Office of the French Ministry of Education allowing to recover each student's assigned school and attended school for the 2021-2022 school year. This is supplemented by data that I collected from a sample of local education authorities to get geographic information on middle schools' catchment areas for years before 2020.

In a first part, I assess whether more diverse catchment areas could be drawn. Importantly, I take current patterns of residential segregation and schools' location as given, and assign a reference neighborhood to each public middle school. To determine the boundaries of each middle school's reference neighborhood, I first compute, for all middle schools, the maximum walking travel time between that middle school and students living in its catchment area. This maximum travel time can be considered as the acceptable travel time set by local authorities for a given middle school. All students for whom the travel time to a middle school is less than the acceptable travel time for that school are part of its reference neighborhood. I then compare for each middle school the social composition of its catchment area to the one of its reference neighborhood in order to assess whether middle schools reflect their neighborhood in terms of social composition. While I observe a strong correlation between the social composition of schools' cacthment areas and that of their reference neighborhoods, I also find that 12% of middle schools have a catchment area which does not reflect their reference neighborhood in terms of social composition. These findings indicate that residential segregation fails at fully explaining segregation across schools' recruitment pools. To further examine this issue, and assess whether there is room for drawing more diverse catchment areas, I also use a complementary approach where I ignore local education authorities preferences for travel time. I construct all pairs of middle schools within a local authority and restrict my sample to pairs of schools for which the walking travel time is less than 15 minutes, hereafter referred to as neighboring schools. Then, I compute the difference in social composition between catchment areas of schools belonging to a same pair. Looking at the distribution of this difference, I show that 40% of these pairs are made of schools whose catchment areas greatly differ in terms of social composition, highlighting that segregation across catchment areas could be reduced by redrawing them, while only moderately changing students' travel time to school.

In a second part, I focus on families' behavioral reactions to changes in catchment areas, focusing on a sample of six local authorities for which I could collect historical data on catchment areas. To that aim, I use a difference-in-differences strategy, comparing before and after a change in catchment area, enrollment decisions of families having a child entering Grade 6 who were impacted by this change, to the ones of families for whom the assigned school remained the same. The control group is made of families living in streets assigned to a school that kept the same catchment area throughout the 2013-2019 period. The treatment group is made of families living in streets assigned to different schools over time. I estimate these behavioral reactions separately for high-SES and low-SES families, and depending on whether the newly assigned school is better or worse in terms of social composition relative to the initial one. The results indicate that both high-SES and low-SES families resort to opt-out options when assigned to a much worse school in terms of social composition, but reactions are much larger for high-SES families than for low-SES ones. The likelihood of enrolling in the assigned middle school decreases by 34 percentage points (from a baseline of 62%) for high-SES students, against 17 percentage points for students from a disadvantaged background (from a baseline of 72%). I find that reactions are also strong when the shock is positive: when assigned to a much better school in terms of social composition, enrollment of high-SES students in their assigned school increases by 22 percentage points, from a 25% baseline, and by 15 percentage points for low-SES students, from a 53% baseline. These reactions are large, especially for high-SES students. As a result, assigning low-SES students to different schools in terms of social composition does impact their exposure to high-SES students at the school level. By contrast, even when high-SES students are assigned to a very different school in terms of social composition, their clever use of opt-out options makes them experience no change in the social composition of their schoolmates. The estimates are obtained using the estimation method proposed by Callaway and Sant'Anna (2021) to correct for the potential biases arising from using a two-way fixed effects model when there is variation in treatment timing. These results are also robust to using a measure of perceived school performance instead of a measure of social composition as a proxy for school attractiveness.

Beyond enrollment at the middle school level, I show that changing middle school assignment boundaries also impacts enrollment behaviors at the primary school level for high-SES students. When their child is about to be assigned to a much worse school than the expected one, high-SES families increase their enrollment in private primary schools to secure a seat in private middle schools. By contrast, when the change in school assignment leads their child to be assigned to a much better school, they less frequently resort to private primary schools.

Within the broad literature on the relationship between public school assignment systems and school segregation,[1] this paper is more closely related to the few papers analyzing behavioral responses to changes in school assignment for residence-based school assignment systems.[2] Bjerre-Nielsen and Gandil (2020) study the efficacy of redrawing catchment areas at the primary school level in Denmark, whose education system looks close to the French one in terms of the opt-out options offered to families. While they focus on students at the primary school level, my empirical setting is about students at an older age, for whom the acceptable travel time to school is likely to be greater. That makes it easier to break the link between residential sorting and segregation between catchment areas. In the same way, the set of opt-out options considered for children entering middle school may be larger than the one considered for children aged six, translating into increased possibilities of avoiding the assigned school. Boutchénik (2020) focuses on middle school students in the Parisian area while I include a larger number of French local authorities in my work. Both papers indicate that high-SES families strongly react to being assigned a different school in terms of social composition or perceived school performance.

While changes in neighborhood priorities have been used as natural experiments, the extent to which, within a school system, alternative neighborhoods could be defined to equalize access to high-quality schools across socioeconomic backgrounds has been less documented. On this respect, the descriptive part of my paper is closely related to the one of Monarrez (2021) who proposes an original decomposition method where he measures the contribution of school location, school boundaries, and residential segregation on racial segregation across US schools. My paper takes a different approach than the one he follows as I analyze the extent to which given current school locations and residential segregation, it would be possible to draw more diverse catchment areas.[3] Finally, the results from the descriptive part of my paper are also

[1]See for instance Black (1999), Fack and Grenet (2010), and Gibbons et al. (2013) for the role of neighborhood priorities on housing prices ; Terrier et al. (2021) and Akbarpour et al. (2022) for the impacts of the algorithms used to determine school offer on school stratification ; Burgess et al. (2015) and Oosterbeek et al. (2021) for the extent to which preferences differ according to families' demographics characteristics ; Facchetti et al. (2021) and Rasul et al. (2021) for the role of information on these preferences ; and Monarrez et al. (2022) for the consequences of the provision of charter schools on school segregation.

[2]The role of neighborhood priorities in centralized school assignment systems has also been studied, see Calsamiglia and Guell (2018) and Gortazar et al. (2020).

[3]In a similar fashion and focusing on a specific education authority in France, Murat (2018) has also examined

related to studies proposing a decomposition of school segregation by isolating the contribution of opt-out options and the one of residential segregation (Cadoret, 2017 ; Boutchenik et al., 2021). In these papers, segregation between catchment areas is used as a proxy for residential segregation while my findings question the reliability of this proxy. Besides, their main finding is that if all French students were enrolled in their assigned school, the level of school segregation would only be reduced by 39% to 49%. Therefore, analyzing whether it is possible to draw alternative catchment areas to reduce segregation across them is of prior importance.

The contributions of this paper are threefold. First, I use a variety of data sources that I clean and gather to create a new database containing historical data on catchment areas for several local authorities. Second, I propose methods to assess the extent to which segregation across catchment areas mirrors residential segregation. Finally, this paper adds to the scarce evidence on behavioral reactions to changes in catchment areas. The relevance of these contributions extends beyond the French case since most school systems use catchment areas to define school priorities. This is particularly the case in the US, where all metropolitan cities have catchment areas (Monarrez and Chien, 2021). In Europe, a report published by Eurydice, the European network on school systems set by the European Commission, notes that catchment areas are widespread until the lower secondary level of schooling (Commission/EACEA/Eurydice, 2020).[4] Importantly, this report also indicates that adjusting school catchment areas is one of the most common measures used by European policymakers to improve socio-economic diversity in schools.

The rest of the paper proceeds as follows. Section 2 describes the institutional background. Section 3 presents the data, the way variables are constructed, as well as sytlized facts on school enrollment behaviors in the French context. Section 4 provides a comparison between segregation across neighborhoods and segregation across catchment areas. Section 5 presents both the identification strategy and the results for the analysis of behavioral reactions from families to changes in catchment areas. Section 6 concludes.

2 Institutional Background: Students Assignment at the Middle School Level

In France, school is compulsory from the age of six to the age of 16. Elementary education spans from Grades 1 to 5 and takes place in primary schools. Secondary education takes place in middle schools (from Grades 6 to 9) and high schools (from Grades 10 to 12). Up to the

the extent to which alternative school location and catchment areas could reduce segregation between schools' recruitment pools.

[4]This is for instance the case in England (Burgess et al., 2020), Scotland (Rossi, 2021), Spain (Calsamiglia and Guell, 2018), and Denmark (Bjerre-Nielsen and Gandil, 2020).

end of middle school, almost all French students follow the same comprehensive curriculum.[5] Students assignment to public middle schools is residence-based through catchment areas, but families have two opt-out options: asking for a dispensation to get admitted in another public school than the assigned one, and enrolling in a private school.

The definition of catchment areas. Catchment areas are voted by the 98 French departmental councils, which are elected representative assemblies. They have many responsibilities,[6] among which the opening and closing of middle schools, as well as the drawing of catchment areas. These catchment areas are only relevant for assignment to public middle schools and do not serve any other purpose.

When delineating catchment areas, departmental councils are responsible for making sure that schools are socially diverse,[7] but there is actually no monitoring of this. Qualitative evidence indicates that the main factors driving the drawing of catchment areas are school capacity constraints and commuting time so that each middle school enrolls a large enough number of students, without being overcrowded, and that each student has a seat in a nearby school. The balance in terms of the social composition of catchment areas is taken into account only if it is compatible with the aforementioned objectives (Agulhon and Palma, 2013).

Changes in catchment areas are usually voted the year before they are phased in, following discussions to which the school community may participate. Some redefinition of catchment areas may be abandoned because of the opposition of that community. Therefore, while meetings about changes in catchment areas happen several months before they are actually modified, there is during this phase uncertainty on whether these changes will actually be voted by the departmental councils.

Opt-out options. Two features of the French education system allow families to bypass catchment areas. The most common way of bypassing catchment areas is to apply for a private middle school: in 2018, 22% of Grade 6 students were enrolled in a private middle school. Almost all French private middle schools are publicly funded and have to follow the same national curriculum as public middle schools. However, contrary to public ones, they can charge fees and are not subject to catchment areas so that they can freely select their students. A second way of bypassing catchment areas is to enroll in another public middle school than the assigned one. To do so, families need to ask local education authorities (*Académies*, hereafter LEA) for a dispensation. Such a dispensation could be granted for several motives such as having a

[5] There is a track for special need students from Grade 6 to 9 in which 2.7% of middle schools students were enrolled in 2015.

[6] For instance, they manage public transportation and are in charge of social reintegration programs.

[7] Article L111-1 of the French Education Code states that "The State shall ensure, in tandem with public and private schools under contract, and with local authorities, that school diversity is improved.".

sibling already enrolled in a school, having disabilities, or enrolling in an extracurricular course which is not proposed in the assigned school. Low-SES students may have higher priority than high-SES ones in case a school is oversubscribed.[8] Overall, these dispensations are not granted through a centralized assignment system but rather in a discretionary way. Enrolling in another public middle school than the assigned one is a less prevalent way to bypass catchment areas than enrolling in a private middle school as the Ministry of Education estimates that 12% of students resorted to this mechanism in 2018 (Touahir and Maugis, 2021).

3 Data and Stylized Facts on School Enrollment Behaviors

3.1 Datasets

This paper mainly builds on the matching of three rich datasets: two administrative datasets provided by the Statistical Office of the French Ministry of Education (*Direction de l'Évaluation, de la Prospective et de la Performance*, MENJ-DEPP), and one dataset constructed for the purpose of this study.

Data at the student level. The first dataset covers the universe of students enrolled in French public and private middle schools from school year 2013-2014 to 2019-2020, and provides basic information on students' demographics (gender, date and country of birth), their parents' occupation, and information on their enrollment status (school attended). It also contains the geographical coordinates of their place of residence.

Data on catchment areas for school year 2021-2022. The second dataset is at the street level and is a listing linking each street number to its assigned school for almost all public middle schools for school year 2021-2022. I transform this listing into a shapefile. To do so, I submit the list of addresses to an API[9] which returns back the corresponding geographic coordinates. I therefore get a shapefile consisting of points, where each point corresponds to a street number and indicates the assigned middle school for students living there.

Data on catchment areas for school year 2013-2014 to 2019-2020. For years before 2021, there is no national dataset linking streets to their assigned middle school. I therefore collected such data by contacting the 98 departmental councils responsible for the drawing of catchment areas. Unfortunately, only some of them were able to send me the information on catchment areas for years before 2020. When they did so, they sent data in various formats such as shapefiles, Excel files, or pdf files. For some *Départements* which were unable to send data on

[8]The way families can get a dispensation is detailed on the website of the Ministry of Education.
[9]https://adresse.data.gouv.fr/api-doc/adresse

catchment areas, I used the archives of departmental councils meetings, where catchment areas are set and voted. After cleaning these different datasets, I have historical data on catchment areas for six *Départements*. This is the third main dataset used in this paper.

3.2 Construction of the Final Dataset

To know student i's assigned middle school had he been entering middle school in year t, I match the data at the student level with the one on catchment areas: each student's assigned middle school is the one of her address.

Finally, I have a dataset at the student level where I know for *all students* their assigned middle school, had they been entering Grade 6 in 2021, the middle school they actually enrolled in for year 2019,[10] and their socio-demographic characteristics.[11] For students living in the six *Départements* for which I got historical data, I have a dataset at the student×school year level where I know for each student her assigned school the year she entered Grade 6, but also the middle school which would have been assigned to her, had she entered Grade 6 another year. From this dataset I can tag students living in streets for which the assigned school changed over the 2013-2019 period and streets which have been assigned to the same school all over the period.

Measure of students' socioeconomic status. Students' socioeconomic status (SES) is measured using the French Ministry of Education's official classification, which uses the occupation of the child's legal guardian to define four groups of SES : very-high SES, middle-high, middle-low, and very-low. Table A2 details the occupations corresponding to each of the socioeconomic groups and the share of middle school students who can be found in each of these groups in 2015. In this paper, I consider two broader categories: (1) high-SES students (34 percent of middle school students) refers to the first two categories while (2) low-SES students (66 percent) designates students from the two other categories.

Measure of travel time. I use the package `osrmtime` (Huber and Rust, 2016) in order to compute walking travel time between students' place of residence and the middle schools of their local authority, as well as within all the pairs of middle school located in a same local authority.

[10] The latest available data which could be used for this working paper is for year 2019. Since some changes in catchment areas have probably occurred over these two years, this entails some measurement error which are however likely to be too small to affect the main results discussed in the descriptive part of this paper. The data for year 2021 should be available by late 2022 and results will be updated accordingly in the next version of this working paper.

[11] For this working paper, I only deal with a subset of 18 local authorities. Table A1 shows that very large urban areas are overrepresented in this sample. Besides, this subset of local authorities approximately covers two thirds of middle schools located in the largest urban areas.

Measure of school attractiveness. Families strongly value peer quality (Abdulkadiroğlu et al., 2020). Therefore, school attractiveness in year t is mainly measured using the share of high-SES at the school level in year $t-1$. This information is not publicized but may be shared through informal channels (parents associations, for instance).

As a proxy for school attractiveness, I also use a measure of perceived school quality obtained in a publicly available dataset. This data indicates the share of students who passed the Grade 9 national exam, and the share of students who were awarded honors[12] at the school$\times$year level. In the same spirit as in Boutchénik (2020), I use the latter indicator as a measure of perceived school quality since it features more variability than the former one, as shown in Figure A.1. More precisely, I use the average share of honors over the last three pre-treatment years to account for the fact that there may be within-school variability over years for that outcome.[13]

These two measures of school attractiveness are strongly correlated (see Figure A.2).

3.3 Stylized Facts on School Enrollment Behavior

Figure 1 shows how the type of enrollment for students entering Grade 6 in year 2019 evolves with respect to the school attractiveness of their assigned school, as measured with the share of high-SES in that school the year before students start middle school, and depending on students socioeconomic status. On average, 73% of low-SES students are enrolled in their assigned school, while this figure amounts to 57% for high-SES students. There is a positive relationship between school quality of the assigned school and enrollment in that school, but that relationship is much weaker for low-SES students than for high-SES students. Low-SES students assigned to a school in the lowest decile of school attractiveness are around 69% to enroll in their assigned school, while they are 79% to do so when that school is in the highest decile of school attractiveness. By contrast, only 34% of high-SES students attend their assigned school when it is in the lowest decile of school attractiveness, while that figure amounts to 70% when the assigned school is in the highest decile. More generally, whatever the attractiveness of the assigned school, low-SES students are more likely to attend that school than high-SES students.

One way of avoiding the assigned school is to enroll in another public school through a dispensation. On average, low-SES students are slightly more likely to use this opt-out option (12%) than high-SES students (10%). There is a negative relationship between school quality and enrollment in another public school than the assigned one for both types of students up to the fourth decile of school attractiveness, while that share does not change much for students assigned to a school ranging from the fifth to the tenth decile of school attractiveness. In line

[12] Honors are awarded to students who score more than 12/20 at the Grade 9 national exam.

[13] School composition is measured using the four cohorts enrolled in that school, while the share of honors is based on a single cohort, the reason why within-school-across-years variability is more a concern for the latter measure than for the former.

with the results from Boutchenik et al. (2021), enrolling in another public school than the assigned one does not seem to be a main driver of school segregation in the French context.

The main opt-out option used by families is enrollment in a private middle school. 13% of low-SES students resort to this opt-out option. This figure is almost three times as high among high-SES students (36%). The relationship between school attractiveness and enrollment in a private school is negative for both types of students, but it is much stronger among high-SES students. While the share of low-SES students enrolled in a private school ranges from 15% for the lowest decile of school attractiveness, to 10% for the highest one, that share varies from 50% to 21% for high-SES students.

These relationships are informative as they show that low-SES students resort much less to opt-out options than high-SES students, whatever the school attractiveness of their assigned school, and that private schools are the main opt-out options used by families. However, they are not causal and therefore fail to inform policymakers on the effectiveness of changing school assignment boundaries to fight against school segregation. In particular, families living in the catchment area of weakly attractive schools may have different preferences with respect to school quality than families living in the catchment area of highly attractive schools. In Section 5 of this article, I present my identification strategy to estimate a causal relationship between change in school attractiveness of the assigned school through redrawing of catchment areas and enrollment behaviors. However, in the short term, catchment areas can be redrawn to have a more diverse social intake only if schools are located in neighborhoods which are not completely segregated. In the next section, I compare residential sorting and segregation across catchment areas to analyze whether more diverse catchment areas could be drawn.

4 Comparing Residential Sorting and Segregation across Catchment Areas

The share of low-SES students at the catchment area level approximately ranges from 10% to 100% (see Figure A.3), which may reflect the fact that schools are located in segregated neighborhoods. In this preliminary descriptive part, I look at whether departmental councils could draw more diverse catchment areas, and therefore reduce this variability, taking school location and residential segregation as given. I use two complementary methods to do so.

Method 1: construction of a reference neighborhood around each school. The first approach consists in constructing, for all public schools, a reference neighborhood. The aim is to check whether each school's catchment area is representative in terms of social composition of the neighborhood in which this school is located. The main issue in doing so is that there is no easy definition of what should be the neighborhood of a school. I propose the following method where I take residential segregation, school location, and local education authorities' preferences for travel time as given:

1. Compute for middle school s the 95th percentile of the distribution of travel time to that school, focusing on students who are assigned to that middle school through catchment areas. This is considered as the acceptable travel time for students, set by departmental councils for middle school s.

2. The reference neighborhood for middle school s is the isochrone around that middle school, drawn using the acceptable travel time computed in the previous step. Therefore, all students having a travel time to middle school s which is lower than the acceptable travel time for that school are part of its reference neighborhood.

I compare the social composition of each catchment area with the one of its corresponding reference neighborhood in Figure 2, where each dot stands for a middle school. The position of the dot on the x-axis depends on the share of low-SES in its reference neighborhood, while the one on the y-axis depends on the share of low-SES in its catchment area. Most dots are around the 45-degree line, indicating that catchment areas are often representative of their neighborhood in terms of social composition. However, there are also several cases in which dots stand far from this 45-degree line, emphasizing that departmental councils sometimes draw catchment areas in such a way that their social composition differs from the one of their neighborhood.

Now, an important question is whether when doing so, they attenuate the impact of residential sorting on segregation across catchment areas, or by contrast, whether the impact of residential sorting on segregation across catchment areas is magnified by the way catchment areas are drawn. For instance, departmental councils could draw catchment areas in such a way that the recruitment pool of schools which are in the most deprived neighborhood are less deprived than their neighborhood, and the one of schools which are in the least deprived neighborhoods are more deprived than their neighborhood. That would be indicative of a desegregation policy where departmental councils attempt to equalize the social intake of recruitment pools. However, the drawing of catchment areas could also make the recruitment pool of schools which are in the most deprived neighborhood even more deprived than the neighborhood, and the one of schools which are in the least deprived neighborhoods, even less deprived than their neighborhood.

The left-hand side of Figure 2 does not provide an accurate answer to this question since it does not account for the fact that the share of low-SES is unequally distributed across departmental councils: a school located in a neighborhood with 70% of low-SES might be considered as being in a very disadvantaged neighborhood by the standards of the most affluent departmental councils. By contrast, such a neighborhood might be regarded as average by the most deprived departmental councils. To account for the fact that departmental councils have different standards regarding the deprivation of a neighborhood, I center both variables of interest using the share of low-SES at the local authority level: I subtract the share of low-SES at the local authority level from the x-variable and the y-variable.

The right-hand side of Figure 2 shows the graph using the centered variables. Dots at the right of the graph stand for schools which are located in the most deprived neighborhoods, relatively to the local authority to which they belong. For these schools, the catchment area either looks like the neighborhood in terms of the share of low-SES, or has a higher share of low-SES than at the neighborhood level. By contrast, dots at the left of the graph stand for schools located in the most advantaged neighborhoods, relatively to other neighborhoods of the same departmental councils. When the catchment area of these schools differs largely from the neighborhood, it tends to make the catchment area more advantaged than the neighborhood. These visual insights are backed by a linear regression of the centered share of low-SES at the catchment area level on the one at the neighborhood level. The coefficient from this regression indicates that a one percentage point increase in the share of low-SES at the neighborhood level is associated with a 1.02 increase in the share of low-SES at the catchment area level.

Finally, both graphs indicate that most schools' catchment area have approximately the same share of low-SES as in their neighborhood. However, 12%[14] of schools have a catchment area which differ by more than 10 percentage points from the neighborhood. A visual inspection indicates that when this is the case, it tends to magnify residential sorting rather than serve a desegregation purpose: the catchment area of schools located in the most deprived neighborhoods are made more deprived than the neighborhood, while the one of schools located in the most advantage neighborhoods are made more advantaged than the neighborhood. This means that even taking local education authorities preferences for travel time as given, there would be room for drawing more diverse catchment areas. However, these preferences are also the outcome of political decisions which can be questioned. Therefore, I use a complementary approach to studying whether more diverse catchment areas could be drawn, where I ignore local education authorities preferences for travel time.

Method 2: comparing the difference in the share of low-SES across very close schools. The aim of the second approach is to assess whether neighboring middle schools have similar catchment areas in terms of social composition. Indeed, if schools close to each other actually have catchment areas which differ from each other, it should be possible to

[14]From Figure 2, $\frac{149+46+22}{1206+432+14+46+22} = 11.7\%$.

redraw school assignement boundaries between these two schools so as to equalize the social composition of their recruitment pool without increasing too much students travel time to the assigned school.

To implement this second approach, I first compute the walking travel time between all pairs of public middle schools. I consider that pairs of schools for which the travel time is less than 15 minutes are neighboring schools and I restrict my sample to such pairs. Then, within each pair, I compute the difference in the share of low-SES between the catchment areas of both schools.

Figure 2 shows the distribution of that difference across pairs. The mode of the distribution is close to 0, indicating that catchment areas of neighboring schools often have similar socio-economic composition. For these pairs of schools, redrawing catchment areas cannot be used as a tool for fighting against school segregation. By contrast, for 40% of pairs of neighboring middle schools, the difference in the share of low-SES between catchment areas is higher than 10 percentage points. In some cases, these differences are tremendous, even between schools for which the walking travel time is less than 5 minutes. These statistics suggest that residential segregation and current school siting only explain part of the level of school segregation. In fact, for numerous pairs of neighboring schools, it is possible to draw catchment areas with more balanced social composition while only moderately changing students' travel time. Nevertheless, families may react to these changes by resorting to opt-out options.

5 Behavioral Reactions from Changes in Catchment Areas

In this second part, I study the causal impact of a change in catchment areas on families' enrollment behavior using a difference-in-differences strategy. I estimate the impact separately for high-SES and low-SES families, as well as depending on whether the newly assigned school is of better or worse quality relative to the initial one. I mainly focus on three outcomes: being enrolled in the assigned school, being enrolled in another public school than the assigned one, and being enrolled in a private school.

5.1 Identification Strategy and Estimation.

The identification relies on a difference-in-differences strategy. I take advantage of the fact that, all over the 2013-2019 period, some middle schools kept the same catchment area, while for other middle schools the boundaries of catchment areas changed over that same period. The identification strategy therefore consists in comparing the enrollment decisions of treated and control families having a child entering Grade 6 over time. More specifically, I define below two types of treated students, and one control group. Figure 3 also provides an example to clarify these definitions.

Directly treated students. Directly treated students are the ones whose street has been assigned to different middle schools over time: their assigned school depends on the year they enter Grade 6. These treated students are the main focus of this paper: unless specified otherwise, treated students will refer to this group of students.

Indirectly treated students. Indirectly treated students do not experience any change in school assignment. However, they are assigned to a school which experienced a change in catchment area. While they are not required to enroll in another school, the school environment they face may change as a result of the change in the recruitment pool of their assigned school.

Control students. Students who are part of the control group are students living in streets unaffected by changes in catchment areas in that their street is assigned to the same school over the whole period, and that school did not experience any change in catchment areas over that period.

Sample restrictions. I exclude from the treatment group students who live in streets which experienced specific cases of reassignment. First, in the case of school closure, students can no longer be enrolled in the previously assigned school, the reason why I remove from the sample students living in streets which were assigned to another school because the previously assigned school closed. Second, when a school opens, families have a different set of information regarding that school to make their enrollment decision, compared to the information they have for schools which were already enrolling students for several years. Therefore, I exclude students living in streets which were assigned to a school for which this is the first opening year. Besides, some streets were affected by more than one change in catchment area. I drop from my sample students entering Grade 6 after the second change in catchment area.

Identifying assumption. The main identification assumption is that families behavior with respect to the enrollment of their Grade 6 child in the treatment group would have evolved in the same way as in the control group, had the assigned school stayed the same. To back up this assumption, I compute pseudo treatment effects for pre-treatment years and check that they are not statistically different from zero. One potential challenge is that the change in assigned school at the street level triggers a change in the demographic composition of families living in these streets: in that case, the treatment would also affect the distribution of preferences for schools within the treatment group. I address this concern by computing treatment effects separately depending on the socioeconomic status of students. Still, it is possible that following a change in catchment areas, high-SES families are replaced by other high-SES families with different preferences for schools, and therefore having different enrollment behaviors. However, given that I focus on short-term reactions to changes in catchment areas, such demographic changes are likely to be limited: relocating takes time and it is therefore unlikely that families massively move away at the time of the change in catchment areas. I also gauge the extent to which this threat needs to be taken into account in interpreting the results when presenting the descriptive statistics on the treatment groups.

Construction of treatment variables. I construct four discrete treatment variables, depending on the direction of the change in school quality triggered by changes in catchment areas, and on the size of that change. Let $\delta_{t_0-1,s,s'}$ be the difference in the share of high-SES the last pre-treatment year between the newly assigned school and the previously assigned one. Students are assigned to a worse school when $\delta_{t_0-1,s,s'} < 0$ and to a better school when $\delta_{t_0-1,s,s'} > 0$. Additionally, the threshold used to define whether the change in school quality is small or large is 15 percentage points, which corresponds approximately to one standard deviation in the distribution of the share of high-SES students at the national level among public schools. Finally, the four treatment variables considered are : being assigned to a slightly worse school ($-15 < \delta_{t_0-1,s,s'} < 0$), to a much worse school ($\delta_{t_0-1,s,s'} < -15$), to a slightly better school ($0 > \delta_{t_0-1,s,s'} > 15$) or to a much better school ($\delta_{t_0-1,s,s'} > 15$).

Descriptive statistics. Table 1 displays the number of changes in catchment areas by treatment type. Assignment to worse schools (101 changes) is more frequent than assignment to better schools (89 changes). Students assigned to a slightly worse school experience on average an eight percentage point decline in the share of high-SES of their assigned school, while when they are assigned to a much worse school, this decline amounts to 27 percentage points. When students are assigned to a better school, the share of high-SES in their assigned school goes through changes of the same magnitude (+7 percentage points when the newly assigned school is slightly better, +29 percentage points when it is much better). Students are reallocated between schools which are close to each other: on average, the distance between students place of residence and the newly assigned school does not differ much from the distance they had to travel to go to their previously assigned school. It is also worth noting that whatever the type of treatment, treated students live close to many private schools. Therefore, families wanting to avoid the newly assigned school have many possibilities for doing so. Importantly, these local private schools may represent a cheaper opt-out option than relocation. As shown by Fack and Grenet (2010) in a similar context to the one of this study, families are less sensitive to the quality of the local public school when they have the opportunity to send their child in nearby private schools. Consequently, while relocation decisions cannot be observed and may challenge the identification strategy, the fact that treated families live in neighborhoods with many private schools makes it unlikely that they would massively relocate as a result of the treatment.

Estimation. I use a difference-in-differences strategy with variation in treatment timing. A standard approach to do so would have been to use the following equation:

$$y_{i,a,t} = \alpha + T_i + \theta_t + \beta D_{i,t} + \epsilon_{i,a,t} \tag{1}$$

where $y_{i,a,t}$ stands for the outcome of interest for individual i, living in original catchment area a, and entering Grade 6 in school year t. T_i is a dummy for being in the treatment group, θ_t stands for time fixed effects, and $D_{i,t}$ is a dummy which equals one when student i enters Grade 6 after the change in catchment area. Using this approach, β would be the coefficient of interest.

However, a recent literature points out that estimation using this type of model for difference-in-differences with difference in treatment timing could lead to biased estimates (Borusyak and Jaravel (2017); De Chaisemartin and d'Haultfoeuille (2020); Goodman-Bacon (2021); Sun and Abraham (2021)). Most of the papers highlighting this issue also come up with alternative methods which account for the potential biases arising from using that two-way fixed-effects model. In this paper, I compute dynamic treatment effects using the estimation method proposed by Callaway and Sant'Anna (2021), implemented through the `csdid` Stata package.[15] Their estimation method accounts for the fact that treated individuals belong to different cohorts c, defined by their first year of treatment. Therefore, treatment effects are estimated separately for each cohort c using individuals which are never-treated as a control group. These cohorts treatment effects are then averaged to get an estimate for the average treatment effect on the treated.

Using this method, I estimate the dynamic treatment effects β_{t_r} where t_r is the year relative to treatment. For $t_r < 0$, β_{t_r}'s stand for pseudo treatment effects that indicate how the difference in the outcome between the two groups evolved from year $t-1$ to year t. They assess the extent of the violations of the parallel trends assumption in the pre-treatment period. For $t_r \geq 0$, β_{t_r}'s indicate the magnitude of the treatment effects using the last pre-treatment year ($t_r = -1$) as a reference period. Standard errors are clustered at the original catchment area level and the estimation is run separately for two samples of students: high-SES students on the one hand, and low-SES students on the other hand.

[15] Roth et al. (2022) note that most heterogeneity-robust estimators typically yield similar results.

5.2 Results

This section first reports the results for the directly treated students and study how changes in schools assignment affect Grade 6 students enrollment behavior, and thereby, their exposure to high-SES students at the school level. Then, I provide robustness checks as well as results on indirectly treated students and on enrollment at the primary school level.

5.2.1 Students' Enrollment Behavior

Figures 4 and 4 show the estimated coefficients β_{t_r} along with their 95% confidence interval for the three main outcomes of interest. Whatever the sample, treatment, and outcome of interest, it is worth noting that almost all pseudo-ATT's for pre-treatment years are close to 0 and not statistically different from that value at the 5 percent level. This first result provides evidence in favor of the parallel trends assumption.

Assignment to a worse school. Figure 4 focuses on behavioral reactions for students assigned to a worse school in terms of social composition. The top-left graph displays the estimates for high-SES students assigned to a slightly worse school. Interestingly, students from the treatment group entering Grade 6 before the change in school assignment had enrollment behaviors which are comparable to that of high-SES students at the national level, as described in Section 3. By contrast, cohorts entering Grade 6 after the change in school assignment change their enrollment behavior compared to the ones who entered Grade 6 before the treatment kicks in. The share of Grade 6 students enrolled in their assigned school decreases by 12 percentage points, from a 56% baseline, meaning a 21% reduction. This estimate is statistically significant at the 1 percent level. Both dispensations and private schooling are used to avoid the newly assigned public school.

When high-SES students are assigned to a much worse public school, the effects on enrollment behaviors are even more pronounced, as shown on the top-right graph of Figure 4. Enrollment in the newly assigned school decreases by 34 percentage points from a 62% baseline mean, that is a 55% reduction. Families avoid the assigned school mostly by enrolling their child in private schools (+21 percentage points from a 28% baseline) and, to a lesser extent, in another public school through dispensations (+13 percentage points from a 10% baseline). All these coefficients are statistically significant at the 1 percent level.

By contrast, the bottom graphs of Figure 4 indicate that low-SES students do not react to being assigned to a slightly worse school. Nevertheless, they do react to being assigned to a much worse school, event though the size of their reactions is much lower than the ones of high-SES students. The treatment effect on attending the assigned public school is −17 percentage points, statistically significant at the 5 percent level. That estimate is half the size of the coefficient for high-SES students. In relative terms too, the decrease is much lower than the one estimated for high-SES students (−24% from a 72% baseline mean). Another result which stands in contrast with the one discussed for high-SES students is that low-SES students resort to enrollment in another public school more than enrollment in a private school, even though the coefficients for these types of enrollment are not statistically different from each other.

One explanation for the increase of enrollment in another public school is that having an older sibling in a middle school is one of the priority criteria used by the Ministry of Education for granting dispensations. Therefore, students entering Grade 6 after the change in catchment area, but having an older sibling who was admitted in the previously assigned school, may have been granted this type of dispensations to enroll in that previously assigned school.

While I only commented on results for the first post-treatment year, results on avoidance of the assigned school are remarkably similar for the second treatment year. Estimates for the use of opt-out options sometimes differ over years but these differences are not statistically significant.

Assignment to a better school. Figure 4 shows results for students assigned to a better school in terms of social composition. The top-left and the bottom-left graphs focus on the effect of being assigned to a slightly better school for high-SES and low-SES students. They suggest that this treatment triggers no changes in students enrollment behavior.

The top-right graph displays results for high-SES students being assigned to a much better school. It is first worth noting that for this type of treatment, high-SES students from the treatment group were overwhelmingly avoiding their assigned school in the pre-treatment period: only 25% of high-SES students were enrolled in their assigned middle school, 22% in another public school than the assigned one, and 52% in a private school. Assignment to a much better school makes these families reconsider their use of opt-out options, translating in a 22 percentage points increase in the share of students enrolled in their assigned school. This coefficient is statistically significant at the 1 percent level, and much larger than pre-treatment violations of the parallel trends assumption. Families both reduce their enrollment in other public schools (−12 percentage points) and private schools (−10 percentage points). Interestingly, there is evidence that the effect is dynamic: the second post-treatment year, treatment effects for each of the three outcomes are much larger than for the first post-treatment year.

The bottom-right graph focuses on low-SES students being assigned to a much better school. The treatment effect for enrollment in the assigned public school is similar to the one obtained for high-SES students affected by this type of treatment the first post-treatment year (+15 percentage points, statistically significant at the 5 percent level). Given that the baseline value for that outcome was higher among low-SES students, this effect is much lower in relative terms

(+28% for low-SES and +88% for high-SES). There are two other ways in which results for low-SES students depart from the ones of high-SES students. First, we see no dynamic effect of the treatment for low-SES students. Second, the reduction in avoidance is only obtained through a decrease in enrollment in another public school.

Finally, I find no reactions to being assigned a slightly better school, while I find that assignment to a slightly worse school does affect enrollment behaviors of high-SES students. By contrast, the results overall suggest that when students are assigned to a very different school, their reactions in terms of enrollment in the assigned public school are quite symmetric with respect to the direction of the change (much worse or much better).

5.2.2 Students' Exposure to High-SES Students at the School Level

Given that families react to changes in catchment areas, it may be that even if students are assigned to a different school in terms of social composition, the treatment has no effects on the social composition of the school they are actually enrolled in. I look at whether it is the case by using the share of high-SES in the attended school as a dependent variable. Results are displayed in Table 2.

Pre-treatment coefficients for high-SES students assigned to a worse school are small in magnitude and not statistically different from zero. Post-treatment coefficients are negative but not statistically significant, no matter whether the treatment consists in assigning students to a slightly worse school or to a much worse school. These results stand in contrast with the ones for low-SES students assigned to a worse school. While pseudo treatment effects are not statistically different from zero, post-treatment coefficients suggest that they experience a drop in their exposure to high-SES students. For the ones assigned to a slightly worse school, this decrease amounts to -3.22 percentage points from a 31.90% baseline, statistically significant at the 1 percent level. For the ones assigned to a much worse school, the reduction is much larger, both in absolute and relative terms : the coefficient is -8.12 from a 46.41% baseline, and statistically significant at the 1 percent level. These negative effects on exposure persist over the second post-treatment year.

It is harder to conclude on the effect of assigning high-SES students to better performing schools. For the ones assigned to a slightly better school, pre-treatment coefficients are close to 0, and I estimate that their exposure to high-SES students increase by two percentage points the year of the treatment from a 53.32% baseline. However, this coefficient is only marginally significant at standard levels, and the effect fades out in the second post-treatment year. When it comes to assignment to a much better performing school, I estimate that exposure increase by 6.62 percentage points the year of the treatment, statistically significant at the 1 percent level. However, the interpretation of this coefficient rests on the parallel trends assumption which in this case is not backed by pre-treatment coefficients. By contrast, results are much more clear-cut when it comes to low-SES students. Pseudo-treatment effects are close to zero and not statistically significant from it at standard levels. Coefficients for the first treatment year indicate that low-SES students experience an increase in their exposure to high-SES students when they are assigned to a better school. This is the case both when they are assigned to a slightly better school (1.96 percentage points from a 30.85% baseline) and to a much better school (17.20 from a 32.93% baseline). These effects are statistically significant at standard levels and quite stable over post-treatment years.

Overall, these results indicate that changing students' assignment to public middle schools does affect the social environment experienced by low-SES students in their school. By contrast, they suggest that families of high-SES students use opt-out options in such a way that, even if the social composition of their assigned school is much different from the one of the previously assigned one, their actual exposure to high-SES students remains unaffected.

5.2.3 Robustness Checks

I showed that families react to changes in catchment areas by reconsidering their use of opt-out options, especially when these changes imply being assigned to a school of very different quality, and that reactions are larger among high-SES families relative to low-SES ones. In this part, I show that my results are robust to a series of sensitivity tests.

First, I test an alternative measure of school attractiveness. I replicate the main results using a perceived measure of school performance instead of a measure of social composition to proxy school attractiveness. Second, I make sure that my results hold when I vary the thresholds used to define school attractiveness. I provide a four-group decomposition and thereby use additional thresholds compared to the ones used in the main analysis.

Using an indicator of school performance as a measure of school attractiveness. So far, the measure of perceived school quality which was used was the social composition at the school level. However, this information is not publicized. By contrast, results of Grade 9 students at the end of middle school exam are made public by the Ministry of Education and some newspapers use this information to create a ranking of middle schools. Therefore, families may base their enrollment decisions on this indicator rather than on the social composition of the school.

The treatment variables are defined in the same way as when using social composition: a 15 percentage points difference in the average honors rate over the last three pre-treatment years between the previously assigned school and the newly assigned one is the threshold used to define whether the change in perceived school quality is small or large. This corresponds to a little bit more than one standard deviation in the distribution of honors rate among middle schools.

Table A4 displays coefficients using this different measure of school attractiveness to define treatment variables. In line with the fact that social composition and rate of honors at the school level are strongly correlated (see Figure A.2), these results are qualitatively the same as the ones obtained using the main indicator of school attractiveness: avoidance behaviors are more impacted by treatments of large intensity than treatments of low intensity, and the size of the reactions are larger for high-SES families than for low-SES ones.

Using more thresholds to define the intensity of treatment. So far, a single threshold (+/- 15 percentage points difference in the share of low-SES) was used in order to distinguish between school reassignments which lead students to be allocated to a slightly or to a much different school in terms of social composition. Such an approach has two main limits. First, the threshold used is arbitrary and other thresholds would probably lead to different results. Second, this binary view is somewhat artificial in the sense that within a type of treatment, there is some variation. For instance, changes of one percentage point in the share of high-SES are considered as being the same treatment as changes of 14 percentage points, while it is likely that families do not react the same way to these two changes. This is especially important if one wants to simulate the impact of redrawing catchment areas. To have reliable results, it is necessary to have estimates for a large range of shocks rather than for two broadly defined treatment variables within each shock direction (positive or negative).[16]

I create new treatment variables where the treatment intensity can be low ($|\delta_{t_0-1,s,s'}| < 7.5$), medium ($7.5 < |\delta_{t_0-1,s,s'}| < 15$), high ($15 < |\delta_{t_0-1,s,s'}| < 22.5$), or very-high ($|\delta_{t_0-1,s,s'}| > 22.5$). Creating more categories for the treatment variables, the number of treated observations included within each of these categories is lower, implying a decrease in statistical power. I therefore only show estimates for before and after treatment, rather than estimates for each year.

Results for enrollment in the assigned school are displayed in Table A5. They suggest that high-SES families assigned to a worse school have negative but not statistically significant reactions when the treatment intensity is low. The treatment effects increase with the intensity of the treatment: −14 percentage points for medium intensity, −21 percentage points for high intensity, −42 percentage points for very-high intensity, all these coefficients being statistically significant at the 1 percent level. For low-SES families assigned to a worse school, post-treatment coefficients are very imprecise. Still, they display a pattern consistent with what has been ob-

[16]Still, constructing the treatment variables used so far had some advantages. First, it makes easier to read the results. Second, it allows to have a somewhat large number of events within each treatment variable and thereby, have more statistical power.

served so far: treatment effects, though not statistically significant, are larger for high intensity treatments than for lower intensity ones, and are smaller than for high-SES students.

When it comes to assignment to a better school, the coefficients displayed in Table A5 suggest that both high-SES and low-SES families do not react to the low-intensity treatment and slightly react to the medium intensity treatment by increasing their enrollment in the assigned school. The size of the reactions is much bigger, for both types of families, when the treatment intensity is high (+48 percentage points for high-SES students, +22 percentage points for low-SES students, both statistically significant at the 5 percent level) or very-high (+31 percentage points for high-SES students, +28 percentage points for low-SES students, both statistically significant at the 1 percent level). Still in line with the results commented so far, the size of the reactions are lower for low-SES families than for high-SES ones.

5.2.4 Additional Results

Indirectly treated students. As noted above, indirectly treated students live in streets which are assigned to the same middle school over years, but their assigned middle school experiences a change in its catchment area. While they are not required to enroll in another school, the school environment they face may change as a result of the change in the recruitment pool of their assigned school.

I analyze whether indirectly treated students react to the expected change in the social composition of the catchment area of their assigned school. Let $a^s_{t_0-1}$ be the catchment area of school s the year before the redrawing, and $a^s_{t_0}$ be the catchment area of school s the year of the redrawing. $\Delta^{a^s_{t_0-1},a^s_{t_0}}_{t_0-1}$ is the difference in the share of high-SES students between the previous and the new catchment area for school s, measured using the socioeconomic status of middle school students who lived in these catchment areas the last pre-treatment year. When focusing on directly treated students, I constructed four discrete treatment variables, depending on the direction of the shock, and on the size of that shock. For indirectly treated students, I cannot construct treatment variables depending on treatment intensity because the change in the social composition of catchment areas triggered by their redrawing is mostly quite small. Therefore, for indirectly treated students, I only have two treatment variables: one for negative shocks (the share of high-SES decreases at the catchment area level: $\Delta^{a^s_{t_0-1},a^s_{t_0}}_{t_0-1} < 0$), and one for positive shocks ($\Delta^{a^s_{t_0-1},a^s_{t_0}}_{t_0-1} > 0$).

Table A6 displays descriptive statistics for indirectly treated students. Changes in catchment areas affected 233 middle schools which resulted in a decrease in the share of high-SES at the catchment area level for 124 schools, and an increase in that share in the catchment area of 109 schools. However, these changes are of very limited size on average: -1.35 percentage point in case of a negative shock and +1.21 percentage point in case of a positive one.

Table 3 shows the results from the difference-in-differences estimation with two outcomes: being enrolled in the assigned school, and exposure to high-SES students at the school level. Whatever the the panel of interest (high-SES students or low-SES ones), or the direction of the shock (negative or positive), the coefficients suggest that changes in catchment areas have no effects on indirectly treated students regarding their enrollment behavior. Accordingly, their exposure to high-SES students is unaffected by the treatment. These results are in line with the fact that indirectly treated students only experience a marginal change in the share of high-SES students at the catchment area level, and are therefore not likely to react to this low-intensity treatment.

Effect on enrollment behavior in Grade 5. Changes in catchment areas in Grade 6 may also impact enrollment behaviors in former grade levels. In particular, French private schools often include a primary school, a middle school, and a high school. Therefore, enrolling in a private primary school may be a way of securing a seat in the corresponding middle school. While the data I use only contains students at the middle school level, there is a variable indicating the school where the student enrolled at the end of the previous school year.

Using the same estimation strategy as for the main outcomes, results for that outcome are displayed in Table 2. I find statistically significant effects only for high-SES students. They indicate that Grade 6 high-SES students are more likely to have been enrolled in a private primary school the year before when they are assigned to a worse middle school. This is particularly the case in case of assignment to a much worse school (nine percentage points increase in private primary school attendance, from a 23% baseline, statistically significant at the 5 percent level). This suggests that families react as soon as they know about the change in catchment area in order to secure a seat in a private middle school, and that private primary schools have enough seats to admit these students. By contrast, when assigned to a better school, treated high-SES students are less likely to have been enrolled in a primary school the year before (a nine percentage points decrease the second post-treatment year from a 39% baseline, statistically significant at the 5 percent level). These results are important in that they point out that changing catchment areas at the middle school level can also affect families attendance behaviors at the primary school level.

6 Conclusion

Using novel geocoded administrative data, I first show that residential segregation fails at fully explaining the level of segregation across schools' recruitment pools. In fact, middle schools close to each other sometimes greatly differ in terms of the social composition of their recruitment pool. It indicates that catchment areas could be redrawn between neighboring middle schools, in order to make their recruitment pool more diverse, without significantly altering students' travel time to their assigned school. Still, when opt-out options are available for parents unhappy with their assigned school, such a policy tool may prove ineffective in acting on school segregation. To assess the efficacy of that tool, I collected historical data on catchment areas from a sample of local authorities and examine how families reacted to past changes in school assignment boundaries using a difference-in-differences strategy where I compare over time enrollment decisions of families having a child entering Grade 6 and living in two types of streets: the ones which were part of different catchment areas over time and the ones which were associated to middle schools with stable catchment areas. Preliminary results indicate that both high-SES and low-SES families react to being assigned a different school in terms of social composition by resorting to opt-out options, but behavioral reactions are much stronger for high-SES families.

These findings are important in that delineating alternative neighborhoods to define school admission priorities may be regarded as an important tool to equalize the social intake of schools, and thereby favor low-SES students exposure to high-SES students. In line with previous studies (Bjerre-Nielsen and Gandil, 2020 ; Boutchénik, 2020) my results suggest that it is possible to act on exposure for low-SES students by changing their school assignment, while the same does not apply for high-SES students. Accordingly, changing catchment areas to make low-SES students attend better schools seems to be an effective policy for fighting against school segregation.

A limitation of this paper is the lack of statistical power when estimating the effect of changes in catchment areas for a large range of treatment intensity. That prevents from accurately simulating the effects of changing school assignment boundaries on school segregation. In ongoing research, I intend to clean newly collected data to enrich the current dataset. The next step will be to include in this working paper two policy simulations implemented through deferred acceptance algorithms (Gale and Shapley, 1962 ; Abdulkadiroğlu and Sönmez, 2003). The first one would consist in marginally changing catchment areas. More specifically, I plan to alter the catchment area of schools which are close to each other but have different recruitment pools in terms of social composition, and estimate the effects that would have on students' exposure. In the second policy simulation, I would simulate the closure of the schools with the highest share of low-SES students and the transfer of students assigned to these schools to other local schools.

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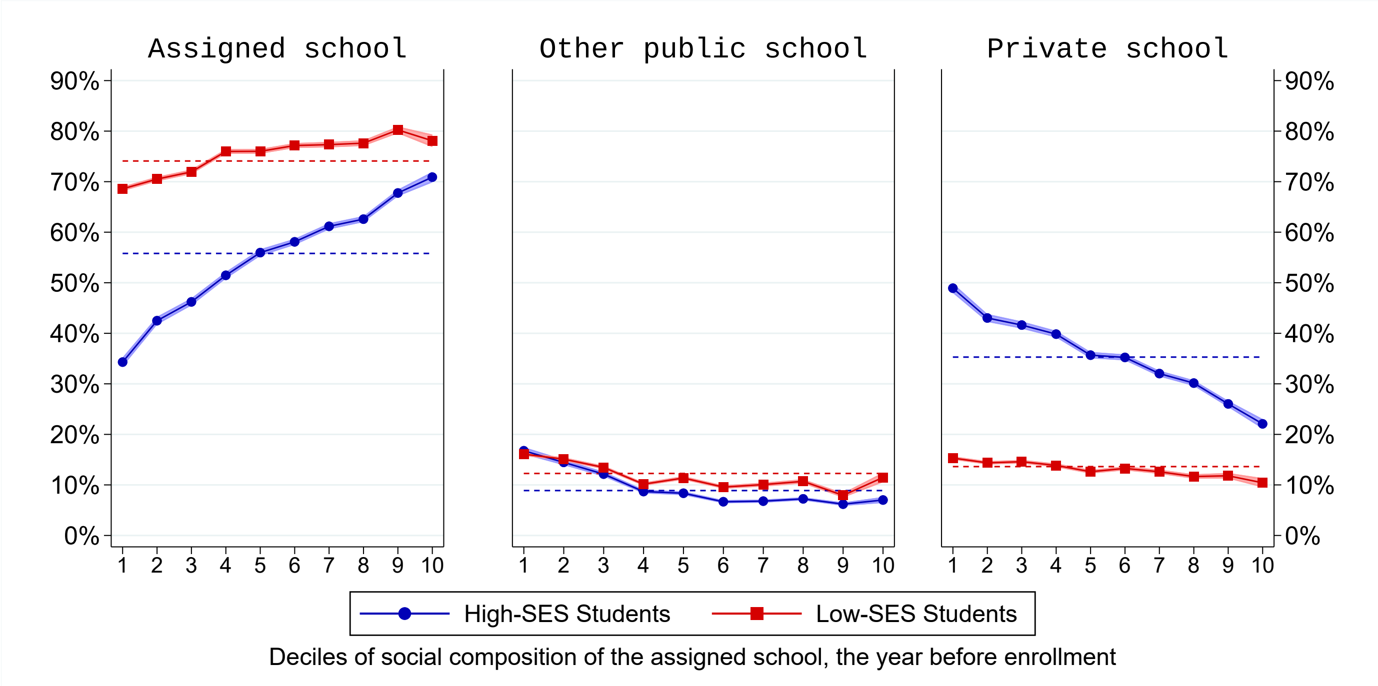
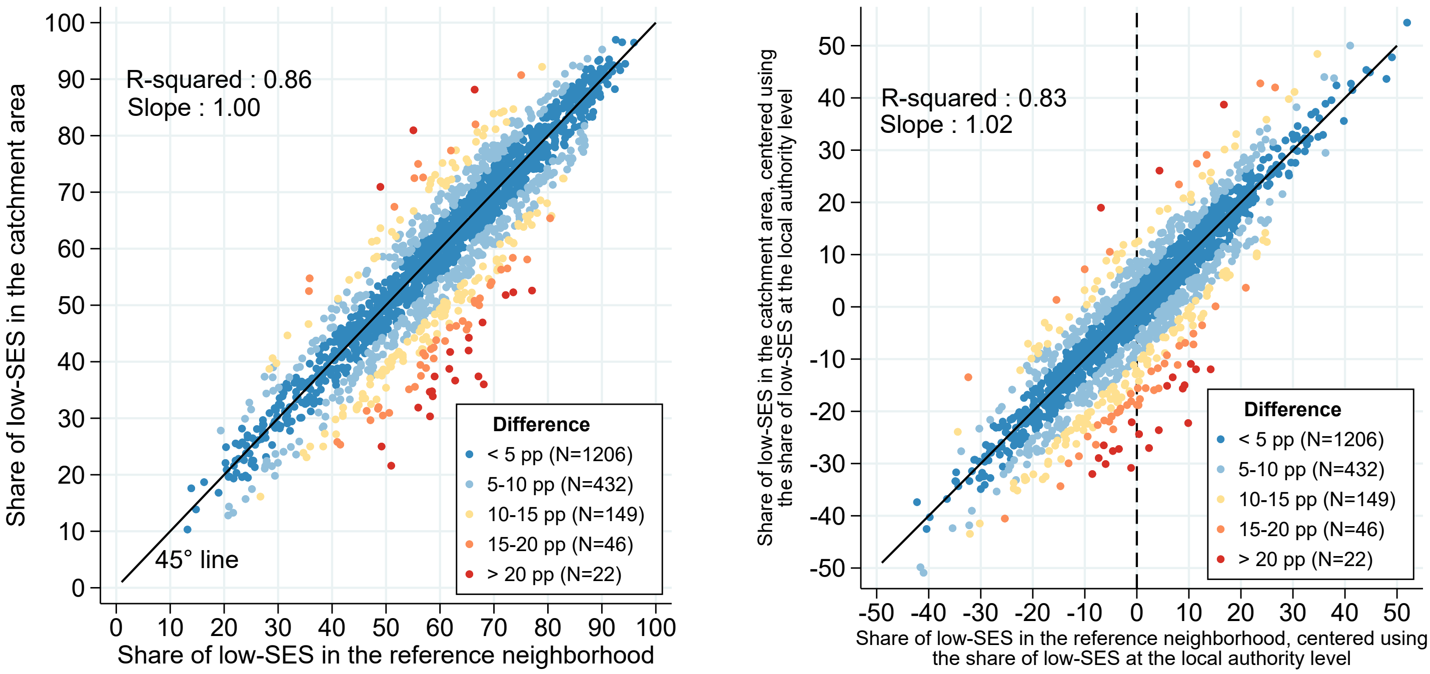
Figures and Tables

Figure 1: Share of Grade 6 Students Enrolled in Each Type of School, by Socioeconomic Status and Deciles of School Attractiveness (Year 2019)



Notes: This figure shows the relationship between type of enrollment and deciles of school composition of the assigned school, separately for high-SES and low-SES students. School composition is measured using the share of high-SES students in the school the year before students enter Grade 6. The area around the connected lines represents the 95% confidence interval around the mean, and the dashed lines indicate the average value of the outcome variable depending on students socioeconomic status. For instance, 69% of low-SES students living in catchment areas of the worst schools in terms of social composition actually enroll in that school, while only 34% of high-SES students do so. Overall, 73% of low-SES students and 57% of high-SES students enroll in their assigned school.

Figure 2: Statistical Relationship Between the Share of Low-SES Students in Schools' Catchment Area and in Schools' Reference Neighborhood (Year 2019)

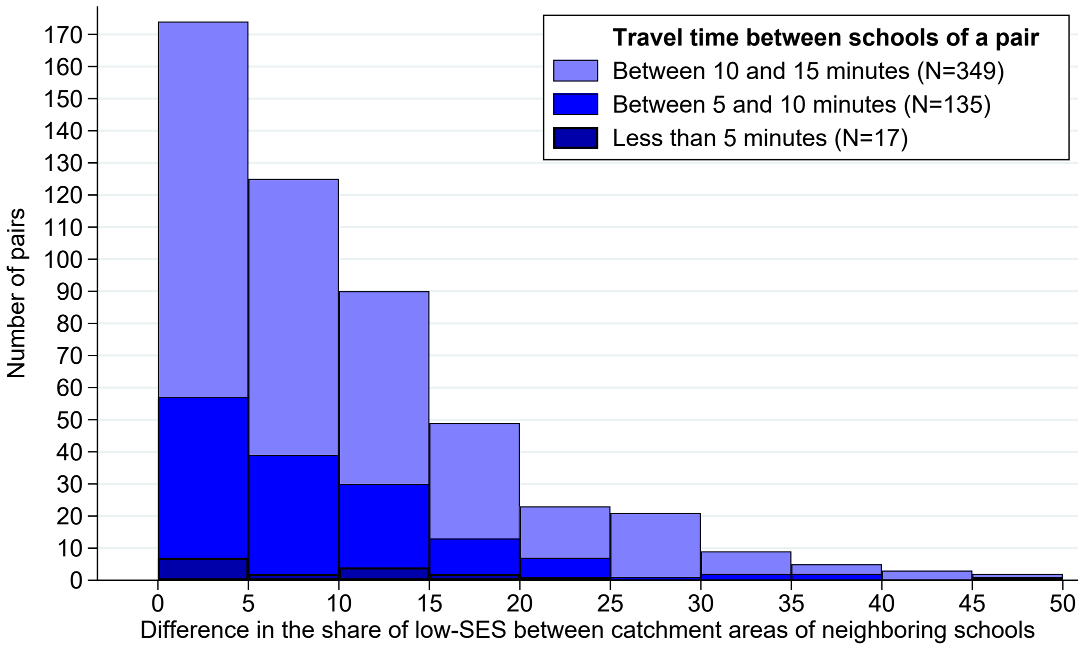


(a) Raw variables

(b) Variables centered using the share of low-SES at the local authority level

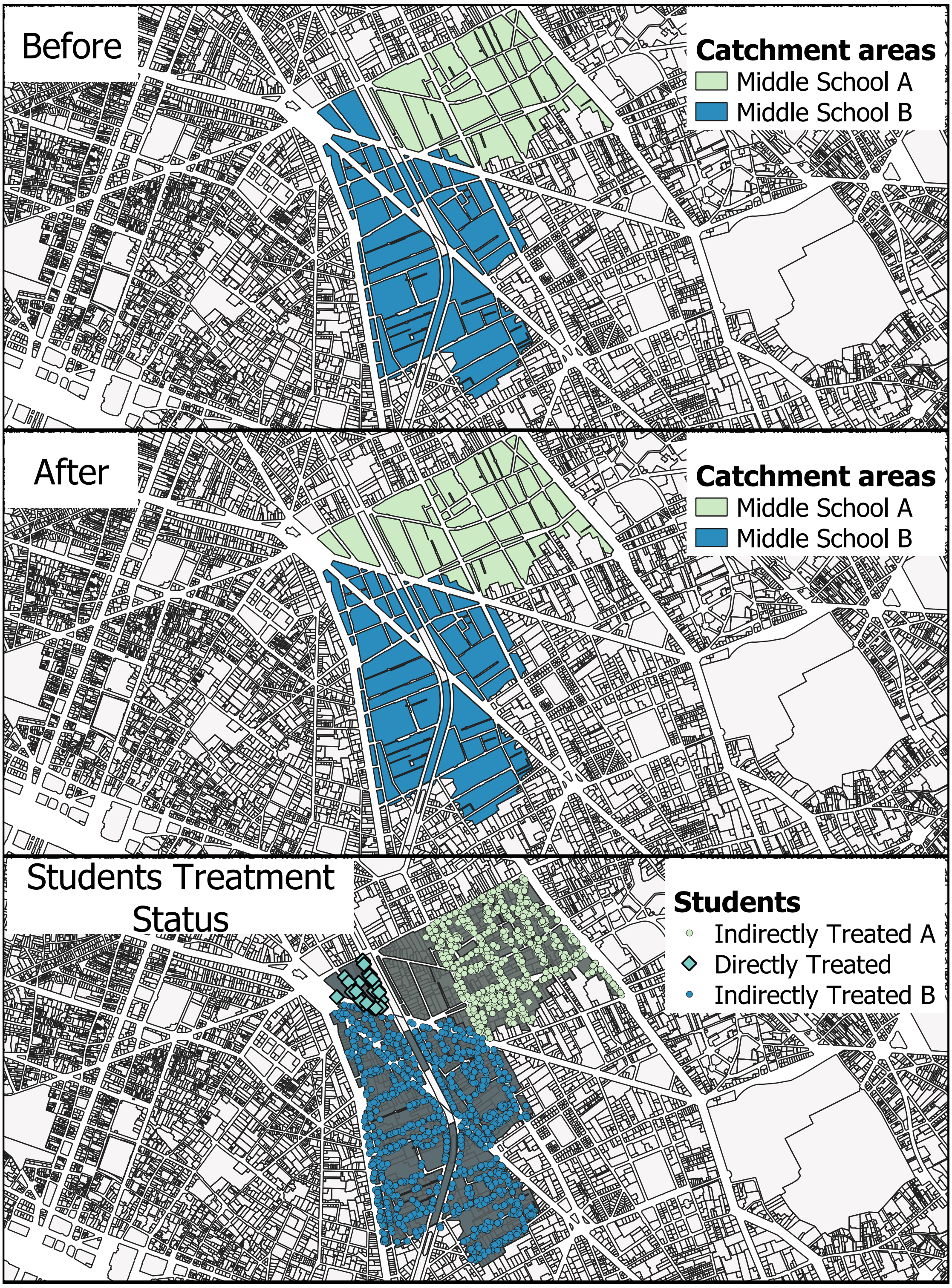
Notes: This figure shows two scatter plots at the middle school level. The position of each dot on the x-axis indicates the share of low-SES in the reference neighborhood of that middle school, as defined in Section 4. Its position on the y-axis indicates the actual share of low-SES students in the catchment area of that school. The black line represents the 45-degree line, while the R-squared and the slope coefficient from a regression of y on x are displayed at the top of the figure. On the left hand-side, raw variables are used. On the right-hand sides these raw variables are centered, by subtracting the share of low-SES at the local authority level. This accounts for the fact that the share of low-SES varies across local authorities, which make the standards regarding the deprivation of a neighborhood differ across them.

Figure 2: Distribution of the Difference in the Share of Low-SES Students Between Catchment Areas of Neighboring Schools



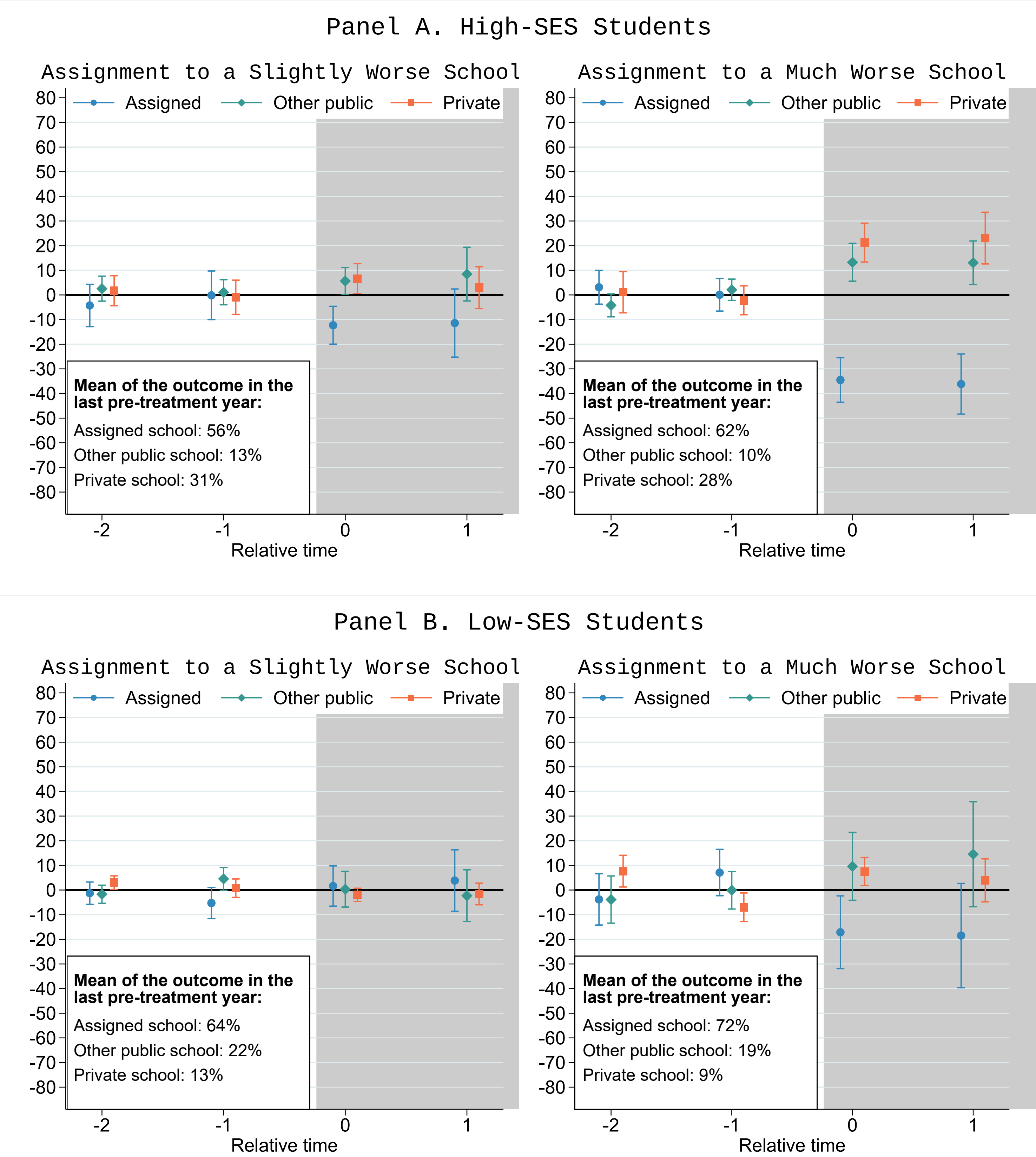
Notes: This figure shows the distribution of the difference in the share of low-SES students between catchment areas of neighboring schools. For instance, for two pairs of neighboring schools, there is a 45 to 50 percentage points difference in the share of high-SES of their catchment area. Among these pairs, there is one for which schools are less than five minutes walking time apart form eachother.

Figure 3: Example of a Change in Catchment Areas and How it Affects Students Treatment Status



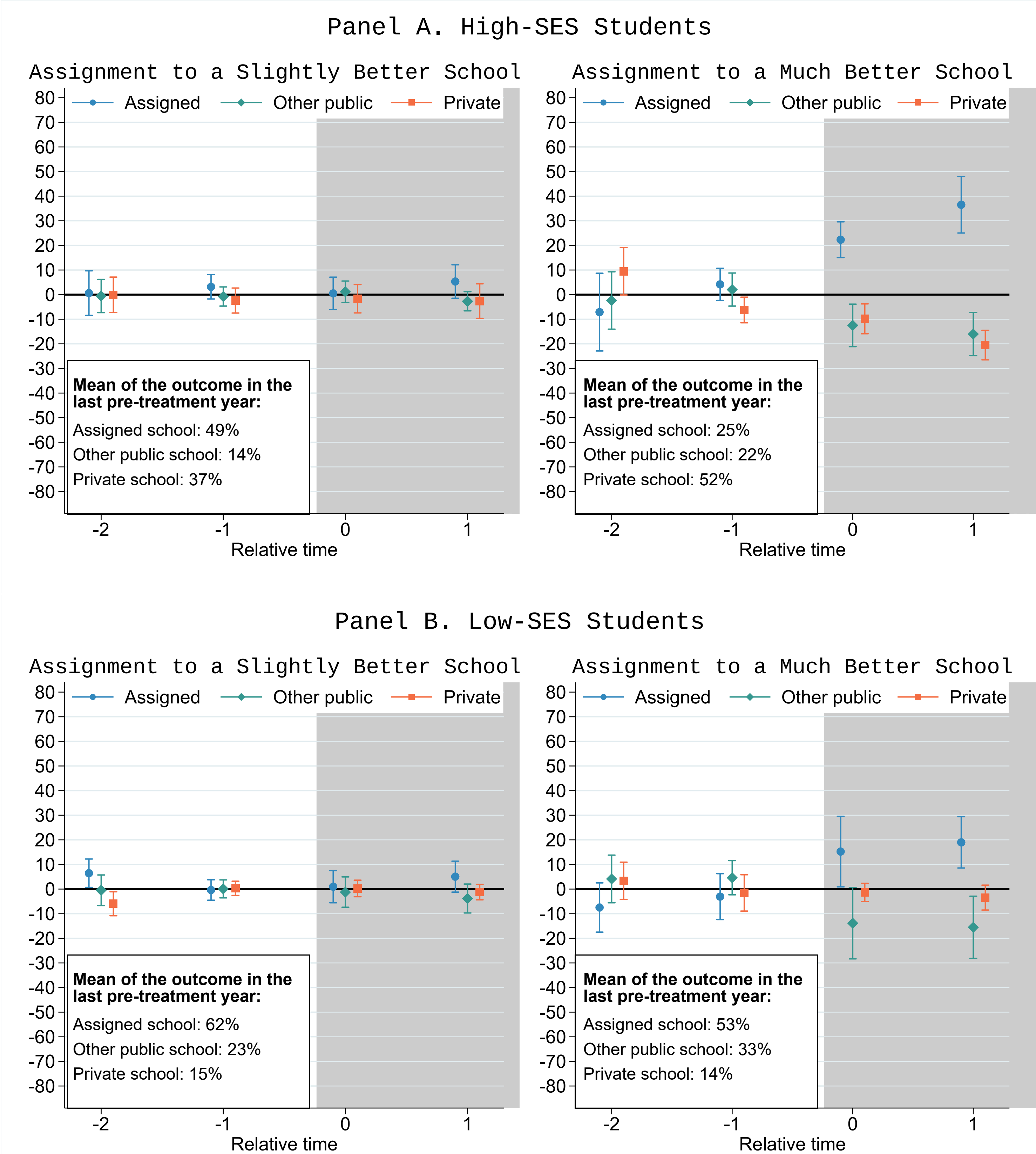
Notes: The top part of the figure shows the catchment areas of two middle schools before and after their redrawing. The bottom part of the figure focuses on the treatment status of students living within these catchment areas. Directly treated students are the ones who would be assigned to middle school B if they enter Grade 6 before the change in catchment areas but would be assigned to middle school A if they enter that grade level after the change. There are two types of indirectly treated students : those who would have been assigned to middle school A whatever the year they enter Grade 6, and those who would have been assigned to middle school B whatever the year they enter Grade 6.

Figure 4: Effect of Being Assigned to a Worse School in Terms of Social Composition on Enrollment Behavior (in Percentage Points)



Notes: These figures plot point estimates from the difference-in-differences setting, with 95% confidence intervals. These coefficients correspond to the estimation of dynamic treatment effects, as described in Section 5. These results are also displayed in Table A3.

Figure 4: Effect of Being Assigned to a Better School in Terms of Social Composition on Enrollment Behavior (in Percentage Points)



Notes: These figures plot point estimates from the difference-in-differences setting, with 95% confidence intervals. These coefficients correspond to the estimation of dynamic treatment effects, as described in Section 5. These results are also displayed in Table A3.

Table 1: Descriptive Statistics on Changes in Catchment Areas depending on Treatment Type

	Assignment to...					
	a worse school			a better school		
	All	*Slightly worse*	*Much worse*	*All*	*Slightly better*	*Much better*
Nb. of changes in catchment areas	101	66	35	89	70	19
Number of students						
Panel A. High-SES						
Treatment group	5,795	3,425	2,370	6,114	4,499	1,615
Control group	118,715	118,715	118,715	118,715	118,715	118,715
Panel B. Low-SES						
Treatment group	7,056	5,317	1,739	8,747	6,724	2,023
Control group	152,366	152,366	152,366	152,366	152,366	152,366
Characteristics of treated students						
Av. change in the % of high-SES in the assigned school (in pp)	-13.89	-8.03	-26.59	12.02	6.53	29.24
Av. change in distance to the assigned school (in meters)	284.35	210.36	444.85	-18.39	-59.89	107.65
N private schools less than 20 min away from home	4.33	3.74	5.63	4.47	3.83	6.46

Notes: This table shows descriptive statistics for changes in catchment areas, depending on whether they led streets to be reassigned to a worse or a better school in terms of social composition.

Table 2: Regression Coefficients on Auxiliary Outcomes using Social Composition as a Measure of School Attractiveness

	Assignment to a worse middle school in terms of social composition			
	Sligthly worse		**Much worse**	
	Share of high-SES in the attended school	*Enrollment in a private primary school*	*Share of high-SES in the attended school*	*Enrollment in a private primary school*
Panel A. High-SES				
Baseline mean	51.63	0.19	63.42	0.23
β_{-2}	-0.94	-0.01	0.35	0.03
	(1.43)	(0.03)	(2.09)	(0.05)
β_{-1}	-0.89	-0.01	-1.54	-0.01
	(1.31)	(0.02)	(1.10)	(0.03)
β_0	-1.69	0.07***	-2.04	0.09**
	(1.44)	(0.02)	(1.92)	(0.04)
β_1	-2.34	0.02	-2.45	0.12***
	(2.12)	(0.03)	(2.83)	(0.04)
N	121,963	121,917	120,930	120,882
Panel B. Low-SES				
Baseline mean	31.90	0.08	46.41	0.06
β_{-2}	0.62	0.02	1.99	0.03
	(1.07)	(0.01)	(1.86)	(0.03)
β_{-1}	0.13	0.00	-2.29	-0.03
	(1.06)	(0.01)	(2.39)	(0.03)
β_0	-3.22***	-0.01	-8.12***	0.01
	(1.03)	(0.01)	(3.04)	(0.03)
β_1	-2.90***	-0.00	-12.92***	0.04
	(0.97)	(0.02)	(2.65)	(0.03)
N	157,457	157,374	153,919	153,841

	Assignment to a better middle school in terms of social composition			
	Sligthly better		**Much better**	
	Share of high-SES in the attended school	*Enrollment in a private primary school*	*Share of high-SES in the attended school*	*Enrollment in a private primary school*
Panel A. High-SES				
Baseline mean	53.32	0.20	64.11	0.39
β_{-2}	0.02	0.01	5.32	0.04
	(1.50)	(0.02)	(3.38)	(0.06)
β_{-1}	-0.48	-0.06***	-3.90**	-0.03
	(0.89)	(0.02)	(1.88)	(0.04)
β_0	2.00*	-0.00	6.62***	-0.05
	(1.21)	(0.02)	(2.33)	(0.03)
β_1	-0.32	0.06***	3.76	-0.09**
	(1.26)	(0.02)	(2.74)	(0.04)
N	123,139	123,091	120,244	120,195
Panel B. Low-SES				
Baseline mean	30.85	0.09	32.93	0.08
β_{-2}	-1.21	-0.00	-0.10	0.04
	(1.15)	(0.02)	(1.63)	(0.04)
β_{-1}	-0.57	-0.00	-1.09	0.02
	(0.90)	(0.01)	(2.01)	(0.03)
β_0	1.96*	-0.00	17.20***	-0.00
	(1.01)	(0.01)	(2.27)	(0.02)
β_1	2.26**	-0.00	16.33***	0.00
	(0.93)	(0.01)	(2.29)	(0.03)
N	158,942	158,859	154,265	154,183

Notes: This table presents regression coefficients obtained from the difference-in-differences setting. These coefficients correspond to the estimation of dynamic treatment effects using the `csdid` Stata package, as described in Section 5. Standard errors clustered at the original catchment area level in parenthesis.
* $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$

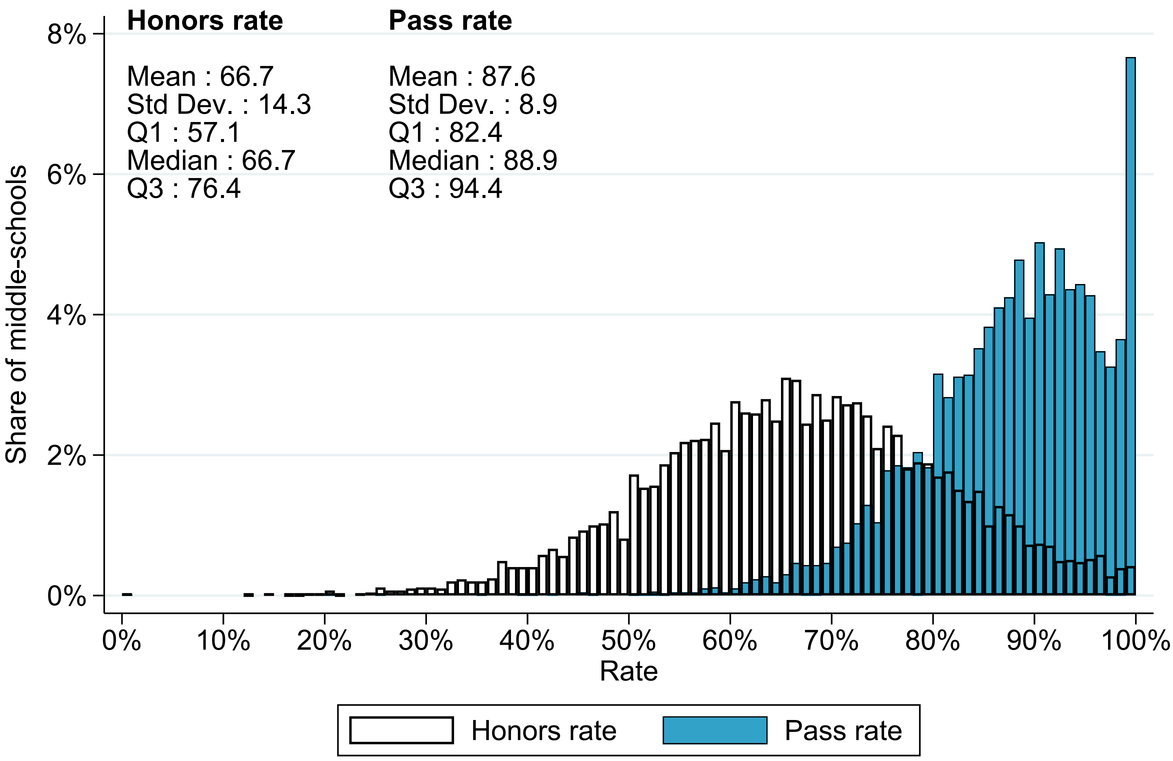
Table 3: Regression Coefficients on Enrollment Behavior and Exposure to High-SES Students for Indirectly Treated Students

	Enrollment in the assigned school				**Share of high-SES in the attended school**			
Direction of the shock	**Negative**		**Positive**		**Negative**		**Positive**	
Panel	*High-SES*	*Low-SES*	*High-SES*	*Low-SES*	*High-SES*	*Low-SES*	*High-SES*	*Low-SES*
Baseline mean	0.55	0.74	0.51	0.73	56.21	33.84	55.58	32.11
β_{-2}	-0.01	0.00	-0.00	-0.01	0.74	0.29	1.72**	-0.54
	(0.02)	(0.01)	(0.02)	(0.02)	(0.71)	(0.51)	(0.77)	(0.68)
β_{-1}	0.01	0.00	0.00	0.01	-0.30	-0.11	0.10	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.48)	(0.52)	(0.62)	(0.49)
β_0	0.00	0.00	0.01	0.00	0.22	-0.41	-1.12	-0.32
	(0.01)	(0.01)	(0.01)	(0.01)	(0.50)	(0.41)	(0.86)	(0.45)
β_1	0.01	-0.01	-0.00	-0.01	0.10	-0.07	0.93	0.59
	(0.01)	(0.01)	(0.02)	(0.01)	(0.43)	(0.41)	(0.64)	(0.43)
N	167,271	214,231	162,570	211,125	167,228	214,186	162,530	211,077

Notes: This table presents regression coefficients obtained from the difference-in-differences setting. These coefficients correspond to the estimation of dynamic treatment effects using the `csdid` Stata package, as described in Section 5. Standard errors clustered at the original catchment area level in parenthesis.
* $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$

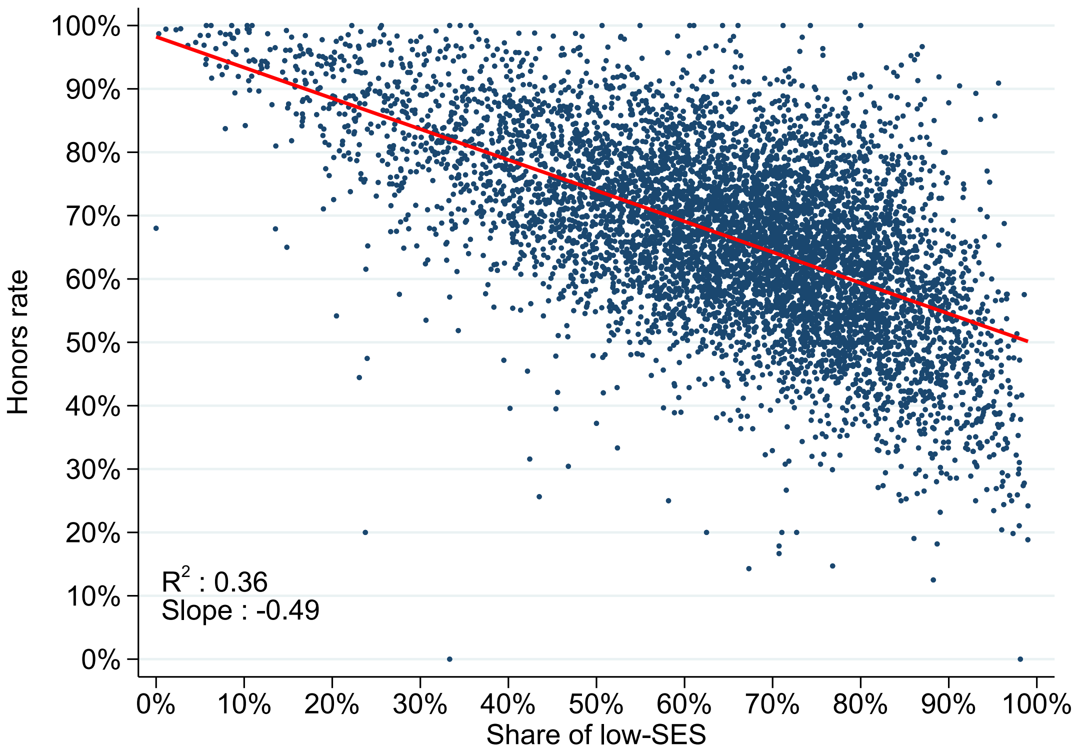
Appendix A Additional Figures and Tables

Figure A.1: Distribution of Honors Rate and Pass Rate at the Middle School Level for Year 2018



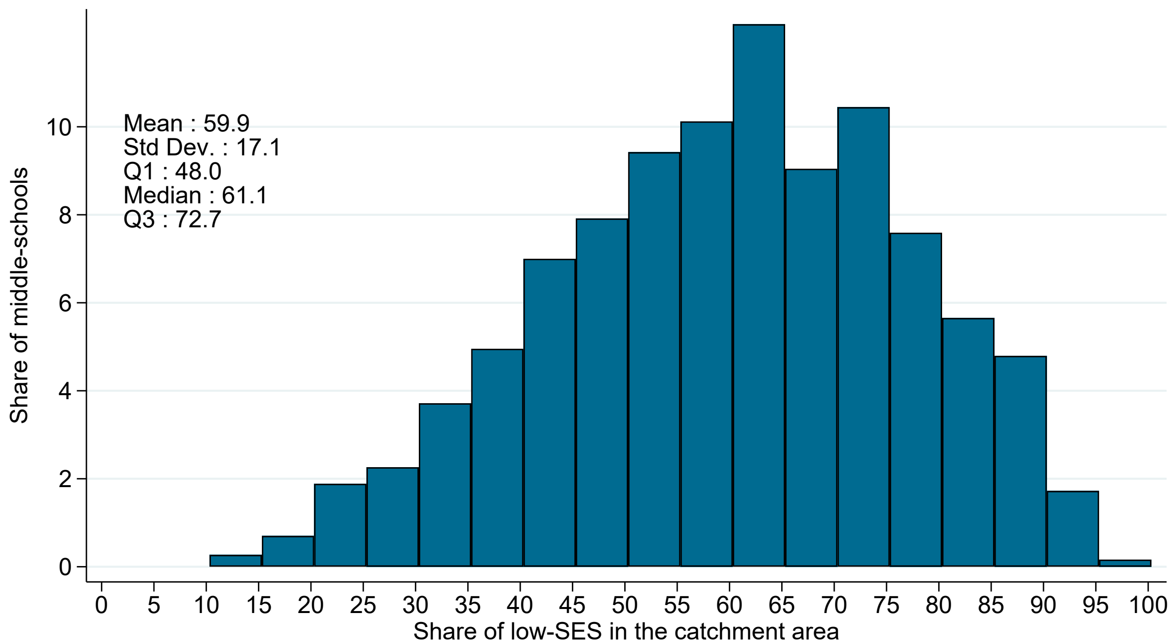
Notes: This graph shows the distribution of honors rate and pass rate at the middle school level for year 2018, based on a publicly available dataset. Honors rate is the indicator used in this paper to measure perceived school performance.

Figure A.2: Honors Rate and Share of low-SES Students at the Middle School Level for Year 2018



Notes: This figure shows a scatter plot at the middle school level, based on a publicly available dataset for year 2018. The position of each dot on the x-axis indicates the share of low-SES of that middle school. The position on the y-axis indicates the honors rate of that middle school. The R-squared and the slope coefficient from a regression of the honors rate on the share of low-SES are displayed at the top of the figure.

Figure A.3: Distribution of the Share of Low-SES Students Across Catchment Areas



Notes: This graph shows the distribution of the share of low-SES across catchment areas for year 2021. Descriptive statistics summarizing that distribution are displayed on the figure.

Table A1: Descriptive Statistics for the Total Number of Public Middle Schools and Grade 6 Students Covered in the Sample

	N middle schools		**N students**	
	France	Sample	France	Sample
Very large urban areas	1,832	1,247	337,432	230,014
	(35%)	(68%)	(41%)	(71%)
Large urban areas	1,684	454	286,558	77,301
	(32%)	(25%)	(35%)	(24%)
Small urban areas	841	81	119,034	12,405
	(16%)	(4%)	(14%)	(4%)
Rural areas	661	58	51,942	6,041
	(13%)	(3%)	(6%)	(2%)
Oversea territories	189	0	30,139	0
	(4%)	(0%)	(4%)	(0%)
N	5,207	1,840	825,105	325,761
	(100%)	(100%)	(100%)	(100%)

Notes: This table presents the distribution of middle schools and students across types of areas, both for France and for the sample of local authorities used in the first part of this paper.

Table A2: Socioeconomic Groups, Corresponding Occupations and Share of Students in Middle Schools in Each of these Groups in 2015

High-SES	Very-high	Company managers, executives, liberal professions, engineers, intellectual professions, art professions	21%
	Middle-high	Technicians and associate professionals	13%
Low-SES	Middle-low	Farmers, craft and trade workers, services and sales workers	29%
	Very-low	Manual workers and persons without employment	38%

Notes: This table lists the four socioeconomic groups defined by the Ministry of Education, and the corresponding occupations of the child legal's guardian. The last column shows the share of middle school students who can be found in each of these four groups in 2015. In this paper, we consider two broader categories: students are either from a high socioeconomic status (SES) or a low socioeconomic status.

Table A3: Regression Coefficients on Enrollment Behaviors using Social Composition as a Measure of School Attractiveness

	Assignment to a worse middle school in terms of social composition					
	Sligthly worse			**Much worse**		
	Assigned school	*Other public*	*Private school*	*Assigned school*	*Other public*	*Private school*
Panel A. High-SES						
Baseline mean	0.56	0.13	0.31	0.62	0.10	0.28
β_{-2}	-0.04	0.03	0.02	0.03	-0.04*	0.01
	(0.04)	(0.03)	(0.03)	(0.03)	(0.02)	(0.04)
β_{-1}	-0.00	0.01	-0.01	0.00	0.02	-0.02
	(0.05)	(0.03)	(0.04)	(0.03)	(0.02)	(0.03)
β_0	-0.12***	0.06**	0.07**	-0.34***	0.13***	0.21***
	(0.04)	(0.03)	(0.03)	(0.05)	(0.04)	(0.04)
β_1	-0.11	0.08	0.03	-0.36***	0.13***	0.23***
	(0.07)	(0.06)	(0.04)	(0.06)	(0.05)	(0.05)
N	121,997	121,997	121,997	120,963	120,963	120,963
Panel B. Low-SES						
Baseline mean	0.64	0.22	0.13	0.72	0.19	0.09
β_{-2}	-0.01	-0.02	0.03**	-0.04	-0.04	0.08**
	(0.02)	(0.02)	(0.01)	(0.05)	(0.05)	(0.03)
β_{-1}	-0.05	0.05*	0.01	0.07	-0.00	-0.07**
	(0.03)	(0.02)	(0.02)	(0.05)	(0.04)	(0.03)
β_0	0.02	0.00	-0.02	-0.17**	0.10	0.08***
	(0.04)	(0.04)	(0.01)	(0.08)	(0.07)	(0.03)
β_1	0.04	-0.02	-0.02	-0.18*	0.15	0.04
	(0.06)	(0.05)	(0.02)	(0.11)	(0.11)	(0.04)
N	157,494	157,494	157,494	153,957	153,957	153,957

	Assignment to a better middle school in terms of social composition					
	Sligthly better			**Much better**		
	Assigned school	*Other public*	*Private school*	*Assigned school*	*Other public*	*Private school*
Panel A. High-SES						
Baseline mean	0.49	0.14	0.37	0.25	0.22	0.52
β_{-2}	0.01	-0.01	-0.00	-0.07	-0.02	0.09*
	(0.05)	(0.03)	(0.04)	(0.08)	(0.06)	(0.05)
β_{-1}	0.03	-0.01	-0.02	0.04	0.02	-0.06**
	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
β_0	0.01	0.01	-0.02	0.22***	-0.12***	-0.10***
	(0.03)	(0.02)	(0.03)	(0.04)	(0.04)	(0.03)
β_1	0.05	-0.03	-0.03	0.37***	-0.16***	-0.20***
	(0.03)	(0.02)	(0.04)	(0.06)	(0.04)	(0.03)
N	123,173	123,173	123,173	120,278	120,278	120,278
Panel B. Low-SES						
Baseline mean	0.62	0.23	0.15	0.53	0.33	0.14
β_{-2}	0.06**	-0.00	-0.06**	-0.07	0.04	0.03
	(0.03)	(0.03)	(0.02)	(0.05)	(0.05)	(0.04)
β_{-1}	-0.00	0.00	0.00	-0.03	0.05	-0.02
	(0.02)	(0.02)	(0.01)	(0.05)	(0.04)	(0.04)
β_0	0.01	-0.01	0.00	0.15**	-0.14*	-0.01
	(0.03)	(0.03)	(0.02)	(0.07)	(0.07)	(0.02)
β_1	0.05	-0.04	-0.01	0.19***	-0.16**	-0.03
	(0.03)	(0.03)	(0.02)	(0.05)	(0.06)	(0.03)
N	158,979	158,979	158,979	154,302	154,302	154,302

Notes: This table presents regression coefficients obtained from the difference-in-differences setting. These coefficients correspond to the estimation of dynamic treatment effects using the `csdid` Stata package, as described in Section 5. Standard errors clustered at the original catchment area level in parenthesis.
* $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$

Table A4: Regression Coefficients on Enrollment Behaviors using Rate of Honors as a Measure of School Attractiveness

	Assignment to a worse middle school in terms of social composition					
	Sligthly worse			Much worse		
	Assigned school	*Other public*	*Private school*	*Assigned school*	*Other public*	*Private school*
Panel A. High-SES						
Baseline mean	0.54	0.13	0.33	0.59	0.09	0.32
β_{-2}	-0.03	-0.02	0.05	0.03	-0.02	-0.01
	(0.05)	(0.03)	(0.03)	(0.04)	(0.02)	(0.04)
β_{-1}	0.02	0.00	-0.03	-0.01	0.01	-0.00
	(0.04)	(0.02)	(0.03)	(0.04)	(0.02)	(0.03)
β_0	-0.10**	0.04	0.06**	-0.34***	0.12***	0.22***
	(0.05)	(0.03)	(0.03)	(0.05)	(0.04)	(0.04)
β_1	-0.08	0.06	0.02	-0.40***	0.09*	0.31***
	(0.07)	(0.05)	(0.04)	(0.07)	(0.05)	(0.06)
N	122,397	122,397	122,397	120,603	120,603	120,603
Panel B. Low-SES						
Baseline mean	0.62	0.24	0.14	0.77	0.16	0.07
β_{-2}	0.00	0.01	-0.01	-0.01	-0.05	0.06*
	(0.03)	(0.03)	(0.03)	(0.07)	(0.06)	(0.03)
β_{-1}	-0.02	0.03	-0.00	0.05	-0.02	-0.03
	(0.03)	(0.02)	(0.02)	(0.05)	(0.04)	(0.03)
β_0	-0.01	-0.00	0.01	-0.15**	0.08*	0.07**
	(0.04)	(0.04)	(0.02)	(0.06)	(0.05)	(0.03)
β_1	-0.02	0.02	0.00	-0.13	0.05	0.08
	(0.07)	(0.07)	(0.02)	(0.09)	(0.08)	(0.05)
N	157,895	157,895	157,895	153,480	153,480	153,480

	Assignment to a better middle school in terms of social composition					
	Sligthly better			Much better		
	Assigned school	*Other public*	*Private school*	*Assigned school*	*Other public*	*Private school*
Panel A. High-SES						
Baseline mean	0.51	0.15	0.34	0.29	0.21	0.51
β_{-2}	-0.05	0.05*	-0.00	-0.01	-0.05*	0.06
	(0.04)	(0.03)	(0.03)	(0.07)	(0.03)	(0.05)
β_{-1}	0.04	-0.01	-0.03	0.04	0.06	-0.10***
	(0.03)	(0.02)	(0.03)	(0.04)	(0.04)	(0.03)
β_0	-0.04	0.03	0.00	0.20***	-0.12**	-0.08**
	(0.04)	(0.02)	(0.03)	(0.04)	(0.05)	(0.04)
β_1	0.04	-0.02	-0.02	0.32***	-0.14***	-0.18***
	(0.04)	(0.02)	(0.03)	(0.07)	(0.04)	(0.04)
N	123,241	123,241	123,241	119,887	119,887	119,887
Panel B. Low-SES						
Baseline mean	0.63	0.23	0.15	0.56	0.30	0.14
β_{-2}	0.01	0.01	-0.02	0.04	-0.09**	0.05
	(0.03)	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)
β_{-1}	-0.02	0.02	0.00	-0.05	0.07**	-0.02
	(0.03)	(0.02)	(0.01)	(0.05)	(0.03)	(0.05)
β_0	0.02	-0.01	-0.00	0.13	-0.12	-0.02
	(0.03)	(0.03)	(0.01)	(0.10)	(0.11)	(0.02)
β_1	0.07**	-0.05	-0.03	0.20**	-0.18*	-0.02
	(0.03)	(0.03)	(0.02)	(0.09)	(0.10)	(0.04)
N	159,528	159,528	159,528	153,771	153,771	153,771

Notes: This table presents regression coefficients obtained from the difference-in-differences setting. These coefficients correspond to the estimation of dynamic treatment effects using the `csdid` Stata package, as described in Section 5. Standard errors clustered at the original catchment area level in parenthesis.
* $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$

Table A5: Regression Coefficients on Enrollment Behaviors using Social Composition as a Measure of School Attractiveness and Additional Treatment Intensity Variables

	Outcome: Enrollment in...											
	Assigned School				**Other Public School**				**Private School**			
Treatment intensity	Low	Medium	High	Very high	Low	Medium	High	Very high	Low	Medium	High	Very high
Treatment: Assignment to a worse school in terms of social composition												
Panel A.1: High-SES students												
Baseline mean	0.49	0.60	0.59	0.63	0.13	0.13	0.10	0.09	0.37	0.27	0.30	0.28
β_{pre}	0.01	0.01	-0.00	0.01	-0.00	0.01	-0.01	0.02**	-0.01	-0.02	0.01	-0.03
	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.03)	(0.02)
β_{post}	-0.06	-0.14***	-0.21***	-0.42***	0.06	0.08***	0.10**	0.14***	-0.00	0.07**	0.10*	0.28***
	(0.05)	(0.04)	(0.06)	(0.04)	(0.04)	(0.03)	(0.04)	(0.03)	(0.05)	(0.03)	(0.06)	(0.04)
N	119,953	120,902	119,543	120,257	119,953	120,902	119,543	120,257	119,953	120,902	119,543	120,257
Panel B.1: Low-SES students												
Baseline mean	0.61	0.67	0.70	0.75	0.26	0.19	0.20	0.17	0.13	0.14	0.09	0.08
β_{pre}	-0.02	-0.03	0.04	-0.01	0.02	0.01	-0.00	0.03	-0.00	0.01	-0.04**	-0.02
	(0.02)	(0.02)	(0.04)	(0.02)	(0.01)	(0.02)	(0.03)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
β_{post}	0.08	-0.02	-0.20	-0.13	-0.06	0.04	0.15	0.03	-0.01	-0.02	0.04	0.10***
	(0.06)	(0.07)	(0.13)	(0.08)	(0.04)	(0.06)	(0.12)	(0.08)	(0.03)	(0.02)	(0.04)	(0.03)
N	154,888	155,161	153,366	153,105	154,888	155,161	153,366	153,105	154,888	155,161	153,366	153,105
Treatment: Assignment to a better school in terms of social composition												
Panel A.2: High-SES students												
Baseline mean	0.49	0.49	0.20	0.29	0.12	0.19	0.35	0.25	0.39	0.33	0.44	0.46
β_{pre}	0.02	0.01	0.00	-0.03	-0.01	-0.00	0.02	0.02*	-0.01	-0.01	-0.03	0.01
	(0.02)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.04)	(0.01)	(0.02)	(0.02)	(0.05)	(0.03)
β_{post}	0.02	0.05	0.48***	0.31***	0.01	-0.04	-0.43***	-0.13***	-0.03	-0.01	-0.04	-0.18***
	(0.04)	(0.05)	(0.14)	(0.04)	(0.02)	(0.03)	(0.14)	(0.04)	(0.03)	(0.05)	(0.06)	(0.01)
N	121,830	120,099	119,178	120,070	121,830	120,099	119,178	120,070	121,830	120,099	119,178	120,070
Panel B.2: Low-SES students												
Baseline mean	0.63	0.60	0.52	0.43	0.23	0.22	0.39	0.35	0.14	0.17	0.09	0.22
β_{pre}	0.03	-0.03**	0.03	-0.02	-0.02	0.03***	0.00	0.01	-0.01	-0.00	-0.04***	0.00
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.03)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)
β_{post}	0.01	0.07**	0.22**	0.28***	-0.02	-0.04	-0.21**	-0.21***	0.01	-0.03*	-0.01	-0.07**
	(0.04)	(0.03)	(0.09)	(0.08)	(0.04)	(0.03)	(0.10)	(0.08)	(0.02)	(0.02)	(0.02)	(0.03)
N	156,768	154,688	153,275	153,863	156,768	154,688	153,275	153,863	156,768	154,688	153,275	153,863

Notes: This table presents regression coefficients obtained from the difference-in-differences setting. These coefficients correspond to the estimation of dynamic treatment effects using the `csdid` Stata package, as described in Section 5. Standard errors clustered at the original catchment area level in parenthesis.
* $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$

Table A6: Descriptive Statistics on Changes in Catchment Areas depending on Treatment Type for Indirectly Treated Students

	Catchment area is made...	
	Worse	Better
Nb. of redrawn catchment areas	124	109
Av. change in the % of high-SES in the cacthment area (in pp)	-1.35	1.21
Number of students		
Panel A. High-SES		
Treatment group	51,790	45,843
Control group	118,715	118,715
Panel B. Low-SES		
Treatment group	64,896	61,290
Control group	152,366	152,366

Notes: This table shows descriptive statistics for students indirectly treated by changes in catchment areas. These students live in streets which are always assigned to the same middle school, but the catchment area of that middle school changes over the period.