Centralized Admission, Access to Education and Academic Achievement:

Evidence from a School Admission Reform in Chile

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Abstract

In search of a more efficient and equal assignment procedure of students to educational institutions, an increasing number of countries around the world relies on centralized admission systems. In this paper I study whether a national centralized admission system for pre-tertiary education in Chile, the School Assignment System (SAS), affects the gaps in *i)* access to educational quality and *ii)* academic achievement between secondary school students of low and high socio-economic status (SES). To identify the effects of the SAS, I exploit its staggered implementation across the country in a (triple) Difference-in-Differences framework. I find that the SAS enables low SES students to access schools of higher quality in municipalities in which private schools have a high market share. This effect is explained by high SES students leaving for the private sector and, thereby freeing up seats at high quality non-private schools. However, I do not find that these changes in access to educational quality impact academic outcomes up to the second grade of secondary school.

Key words: centralized assignment, school quality, academic achievement, inequality

JEL Codes: I21, I24, I28

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1 Introduction

Concerns regarding socio-economic inequalities and equality of opportunity, particularly at a young age, have received increased attention in the past decade, both among policy makers and in the academic debate (Chetty and Hendren, 2018). The role of education has been identified as one of the key determinants for economic social mobility in a wide range of settings (Heckman and Karapakula, 2019, Laliberté, 2021). At the same time the access to schools that provide high quality education is unequally distributed in many countries around the world (OECD, 2018). An increasing number of countries have resorted to centralized admission systems to address the unequal access to education, among other issues. In these systems, students submit their preferences over available schools. Thereafter, an algorithm assigns students to schools taking the preferences of all applicants into account. In many of these systems, students and their families can access information about available schools in a centralized and systematic way and have reduced (time-based) application costs. Currently, more than 40 countries around the world use centralized assignment systems, mostly for admission to tertiary education (Neilson, 2021).

In this paper I analyze whether a centralized admission system for pre-tertiary education in Chile, the *Sistema de Admisión Escolar* (School Assignment System, SAS hereafter), improves low SES students' access to secondary schools in terms of educational quality. In particular, I analyze whether the SAS reduces the *school quality gap*, i.e. the average difference in the quality of schools attended by low vs. high SES students.[1] I then proceed to study whether these changes in the school quality gap also impact the students' academic achievement in later grades. I focus on first grade secondary school students and their academic results in the following years *i)* due to data limitations for an analogous analysis at the primary education level (see section 3.3) and *ii)* because almost 90% of applications to secondary schools are submitted for the first grade (see figure 3).

Various characteristics of the education system in Chile make it a particularly interesting setting to study these questions. First, returns to education and segregation are high by international standards (OECD, 2015, OECD, 2019). Second, the local school markets, here defined at the municipality level, are heterogeneous in characteristics, such as the level of competition between schools and proportion of different school types (public, voucher, private). Since the SAS is a national reform, its interactions with these characteristics can be analyzed. Lastly, the SAS is implemented in a context in which school choice, under which students choose the school they wish to apply to instead of being assigned to their neighborhood school, has existed for many decades. This allows me to isolate its effects from the impact of school choice itself (Campos and Kearns, 2021).

The SAS changes the admission system in various ways. Prior to the SAS students needed to apply to each school *individually* and schools decided themselves about admission decisions. In the SAS, students apply to schools in a *centralized* way, i.e. by submitting a preference list over available schools on an online platform, and admission decisions are *coordinated* through the use of an algorithm (see section A). Importantly, only public and voucher schools are part of the SAS, while admissions to the private sector are unaffected by the SAS. Since an

[1] Throughout the entire analysis each school's quality is kept fixed at the level prior to the implementation of the SAS (see section 3.3). This is due to the lack of data on standardized test scores in the post-implementation period. These tests could not be administered as a result of social unrest and COVID-19 in the years 2019 and 2020, respectively.

additional school can be added to the preference list with a few clicks and additional information about each school is provided on the same platform, this results in a decrease in costs and an increase in information for all students during the application process.

There are several reasons to expect that low SES students benefit relatively more from a centralized assignment mechanism than high SES students, although I am not able to disentangle them empirically. First, given that low SES students are less informed about the characteristics of schools that are available to them, an increase in information, even if it is available to all students, can benefit low SES students relatively more (Allende et al., 2019). Second, previous literature has shown that low SES students underestimate the returns to education leading to under-investment in education (Jensen, 2010). Thus, low SES students can also be expected to be more sensitive to (time-based) cost reductions in the application process. In contrast, there is mixed evidence on whether students value school quality (value added) or the quality of their peers more when choosing schools (Hastings and Weinstein, 2008, Abdulkadiroğlu et al., 2020). Whether the SAS affects the school quality gap is, thus, an empirical question.[2]

The empirical strategy exploits the fact that the SAS was implemented in 15 regions over four years. In the main part of the empirical analysis I employ a staggered triple Difference-in-Differences (DDD) model to estimate the effect of the SAS on the gap in outcomes between low and high SES students. Not (yet) treated municipalities serve as a control group. This estimation strategy relies on the assumption that the gap in outcomes between low and high SES students would have been constant in absence of the treatment. To corroborate the validity of this estimation strategy, I show that the trends are indeed parallel before the SAS is implemented.

I find that the SAS enables low SES students to access schools of higher quality (measured in value added) in areas with a high provision of private schools. This is driven by positive effects for low SES students rather than negative effects for high SES students. The explanation behind these results is that, in areas with a high provision of private schools, high SES students are more likely to transition to the private sector, thereby freeing up space for low SES students at high quality non-private schools. Since private schools do not participate in the SAS, they represent an outside option for students who are not financially constrained (Calsamiglia and Güell, 2018, Kutscher et al., 2020). Exploiting the design of the SAS, I show that high SES students who have a guaranteed secondary school seat for the following year - because their current primary school also offers secondary education - are not more likely to move to the private sector. This corroborates the interpretation that high SES students leave the non-private sector either in anticipation of an inflow of low SES students or because they are not satisfied with their assignment result of the SAS.

Once the structure of the local school market is taken into account, the SAS does not impact the school quality gap. Even in areas in which school competition is high, i.e. where many schools are available, the evidence for an effect on the school quality gap is limited. This points to limited roles for increases in information and decreases in application costs in the context of pre-tertiary education in Chile. A potential explanation for this

[2] Abdulkadiroğlu et al., 2017 find that coordinating admission decisions increases allocative efficiency, in particular for students who are most likely to remain unassigned in the main round of the uncoordinated admissions process. These students tend to be from areas with higher income.

result is that, already before the SAS, students were well-informed about available schools and application costs were low.[3]

To analyze whether low SES students benefit academically from attending higher quality schools as a result of the SAS, I analyze its impact on the students' GPA two years after the implementation and on their grade progression from second to third grade of secondary school. On average low-SES students have a 0.6 points lower GPA (on a scale of 1-7) and are 12.5pp less likely to proceed to third grade of secondary school (84.9% and 72.4% for high and low SES students, respectively). I do not find that the SAS affects these gaps in academic outcomes.

There are various potential explanations for why improved access to higher quality schools does not impact the gap in academic achievement between low and high SES students in the context of this study. First, school value added is a composite measure of quality that, among other factors, depends on peer quality. Since high SES students leave for the private sector, peer quality in the (ex-ante) higher quality schools, to which low SES students have gained access via the SAS, might have decreased. However, I do not find that the policy impacted the students' peer quality as measured by the peers' prior performance on standardized tests at the end of primary school.[4] Second, if low SES students have different schooling needs than high SES students, the standard value-added measure used in this analysis might not accurately reflect school quality for these two groups of students (Loviglio, 2020). Third, it is possible that the period of analysis is too short and effects might show up for academic outcomes in the long-run, e.g. in graduation or university entrance rates.

I perform a series of robustness checks to corroborate these findings. First, I use an alternative treatment definition that exploits detailed school-level data on vacancies in the SAS. Based on these data I compute the share of vacant seats in each municipality, which I take as a continuous measure of treatment intensity at the municipality level. I argue that this measure is exogenous because whether a given secondary school has a high share of vacancies or not depends, by and large, on whether this school also imparts primary education (see section A for more details). The results with this continuous treatment measure are qualitatively and quantitatively similar to the baseline findings. Second, to assess whether the baseline results depend on the school quality measure employed, I use the official (categorical) quality measure that is shown to applicants at the moment of application on the SAS platform. The results from this specification are less strong but qualitatively the same.[5] Third, I include municipality-level trends and show that the findings are unaffected.

This paper contributes to various strands of the literature. First, there is a large literature that studies how to improve access to education for low SES students. Allende et al., 2019 study the role of increased information about available primary schools during the application process in Chile and find that treated students attend schools of higher quality according to various measures, such as average test scores or value added. The evidence on how decreases in costs of applications affect application and enrollment decisions is rather limited. One

[3] Indeed, information about schools, such as different measures of school quality, was already available before the SAS. However, with the SAS the information is provided on the same platform that students use to apply, which arguably makes it more likely that students make use of that information.

[4] Unfortunately, I am not able to examine how school value added is affected by the introduction of the SAS, due to the lack of standardized test score data in the years after the SAS.

[5] This is likely due to the fact that the official measure is a categorical variable with only four levels. Thus, a lot of information about school quality is lost when compared to the continuous measure I use in the baseline specification.

exception is Knight and Schiff, 2022 who find that the Common Applications platform, which allows students to apply to multiple participating colleges in the United States at once, leads to a more racially diverse and higher income student body. In contrast, I study these two aspects, i.e. a uniform reduction in time-based costs and an increase in information, jointly. Empirical studies exploiting implementations or changes to centralized assignment systems as natural experiments remain relatively scarce. Exceptions with a focus on effects on educational equity are Terrier et al., 2021 and Mello, forthcoming.[6] The most closely related paper is Mello, forthcoming which finds that the introduction of a centralized assignment mechanism for colleges in Brazil crowds out low SES students from the least competitive degrees since they are less geographically mobile than high SES students.

I contribute to this literature by studying a context in which geographical mobility can be excluded as relevant margin of adjustment since the overwhelming majority of students attend a secondary school in their municipality of residence. Furthermore, since the SAS is implemented nationally, the structure of the affected schooling markets are very heterogeneous. This allows me to study how a centralized assignment mechanism interacts with the structure of the local schooling market, such as the availability of different school types (public, voucher and private) and the degree of competition between schools.

This paper also relates to the literature that studies the effects of segregation on academic achievement. The relation between the two is theoretically ambiguous. Being surrounded by better peers (e.g. in terms of achievement or higher SES) is often found to be beneficial for students (e.g. Garlick, 2018, Booij et al., 2016). On the other hand, Calsamiglia and Loviglio, 2019 find that having better peers can harm students because teachers take the class as a reference group in internal evaluations. Similarly, Denning et al., 2021 show that, conditional on ability, a student's *rank* has an impact on academic and later-life outcomes. In contrast, ability-based segregation (or tracking) might be beneficial for all students if teachers can teach a more homogeneous class better (e.g. Duflo et al., 2011). The effect of segregation on academic achievement (e.g. repetition rates, GPA, standardized test scores,..) has been analyzed in various settings. In the case of desegregation plans in the United States, studies in general find that decreases in segregation close the achievement gap between black and white students (Lutz, 2011, Billings et al., 2013). Arguably the most similar paper in this literature is Hsieh and Urquiola, 2006 who study the introduction of vouchers that allow students to attend voucher schools (mostly) free of charge. They find this policy to increase segregation by SES due to high SES students leaving the public sector. Contrary to what I find, this increase in segregation harms public schools, which have a high share of low SES students, in terms of academic achievement. I show that a similar increase in segregation does not necessarily lead to worse academic outcomes in the short run.

The paper is structured in the following way: context on the Chilean education system and details on the SAS are provided in section 2. The empirical strategy and the data are explained in section 3. In section 4 I present and discuss the results. My concluding remarks follow in section 5.

[6] Kutscher et al., 2020 analyze how the SAS affects SES-based segregation in schools.

2 Background

2.1 Primary and secondary education in Chile

Pre-tertiary education in Chile is divided into eight years of primary education and additional four years of secondary education.[7] Since the 1980s the pre-tertiary education market is characterized by a high degree of privatization. Three types of schools exist: public, voucher and private schools which make up 45%, 45% and 10% of the schools respectively. Thus, more than half of all students attend a non-public school. Since the 1980s public schools are administered at the local level, i.e. by their respective municipalities. Voucher institutions have to be accredited by the Ministry of Education. Upon approval voucher institutions receive funding based on the number of enrolled students and their attendance. Apart from this main funding source, a complex system with a large number of subsidies based on school characteristics, such as student composition (depending on SES) or academic performance, has been put in place over the last decades. [8] Additionally, voucher schools can charge tuition fees. Private schools serve majoritarily high SES students, do not receive any state subsidies and are financed through tuition fees. In terms of quality, private schools show higher average performance on standardized test scores than voucher schools than public schools (see figure 4). However, it is important to note that the voucher sector is itself heterogeneous, for example in terms of quality and size.

Free school choice, under which students can apply to any school irrespective of their location of residence, exists in Chile since the 1980s. It was introduced to improve the quality of schools via the demand side, assuming that families choose high quality schools, thereby driving low quality schools out of the market. In practice, various papers have shown negative side effects of this system, leading to more unequal outcomes for low SES compared to high SES students (e.g. Hsieh and Urquiola, 2006).

2.2 The reform: Sistema de Admisión Escolar

The School assignment system (SAS) was approved in 2015 as part of a larger education reform know as the Ley de Inclusión Escolar (LIE). The reform was designed to "improve the quality of the Chilean education system and to equalize the conditions such that all schools that receive state support [...] can provide high quality education" (MINEDUC, 2017). Importantly, while the SAS is implemented in four different regions over four years, the other parts of the LIE took effect in all regions in 2016. This feature of the LIE allows me to disentangle the effects of the SAS from the other aspects of the reform (see below for more details).

The SAS was implemented in order to establish a "transparent and non-discriminatory" admissions procedure

[7] Secondary education is composed of two tracks: an academic track, which grants access to tertiary education upon graduation, and a technical track, which mainly leads to vocational training. Approximately 65% and 35% of secondary school students are enrolled in the academic and technical tracks respectively. In more recent years an increasing number of students pursues further studies at the tertiary education level upon completion of the technical track.

[8] The most notable modification of the recent years occurred in 2008 when voucher schools started receiving additional funding for each enrolled low SES student. Low SES status is assigned to students by the MINEDUC and revised annually based on various criteria defined in the Law Nr. 20.248. Characteristics that are taken into account are being part of social security programs for vulnerable families (e.g. *Chile Solidario*, *Programa de Ingreso Etico Familiar*), being part of the bottom third in the *Social Registry of Households*, or a combination of household income, parental education, the municipal poverty rate and rurality. The share of priority students is approx. 50% in the sample used in this project, i.e. excluding private school students.

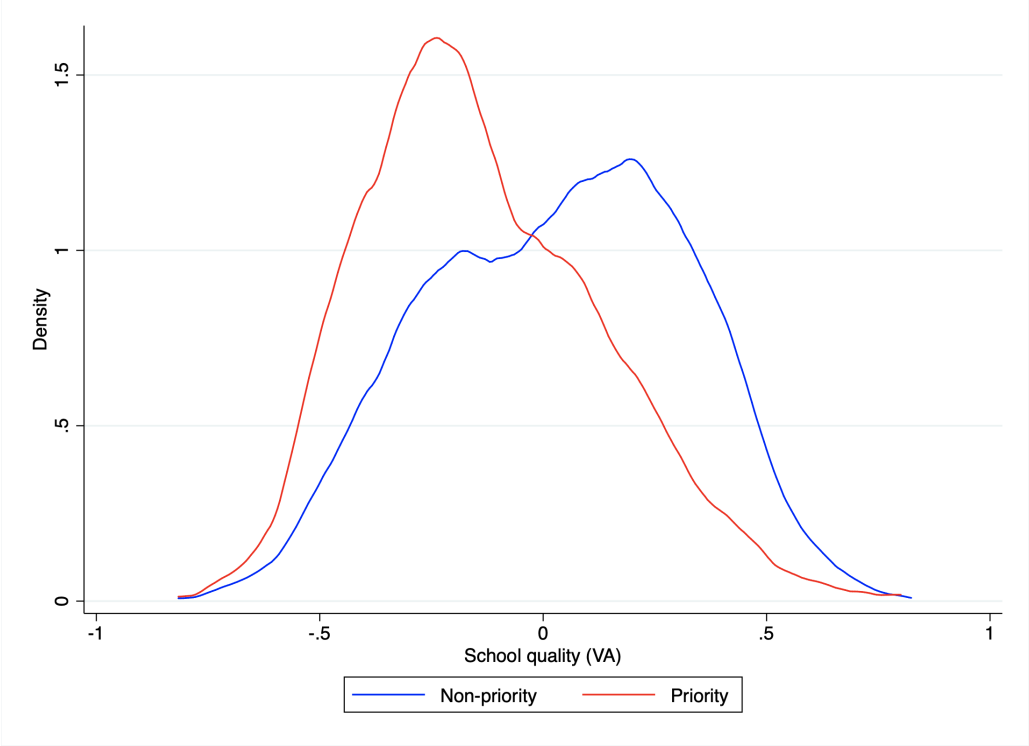


Figure 1: School quality by enrolled students' socio-economic status

that "allows parents to choose the [...] (school) that they like most for their children" (MINEDUC, 2017). To apply to public and voucher schools under the SAS students need to use an online platform, to which students log in with their credentials.[9] On this platform students can see available schools either in the form of a list or on a map and access a wide range of information about each school. The information includes an official school quality measure, past test-score results, tuition fee, the educational plan, teaching staff, extracurricular activities as well as photos of the school facilities. While much of this information was already available before the SAS, it had to be accessed on different websites. Thus, it is likely that students are more informed about their choices at the moment of application under the SAS. Students then submit a preference list over the available options. The time-based cost of applying to an additional school is very low since the latter simply needs to be added to the preference list, as compared to physically going to the school to hand in the application documents prior to the SAS. The assignment algorithm is based on the Deferred-Acceptance algorithm and does not take into account the location of residence or prior the academic achievement (see appendix section A for more details).

The implementation of the SAS was staggered across 15 regions over four years. Figure 2 shows how the implementation was rolled out starting in 2016. The staggered implementation design was likely chosen to gain experience with the administration of the SAS before its implementation in the capital, Santiago de Chile. As table A1 shows, the implementation regions are relatively heterogeneous in various characteristics such as, the number of students, the share of low SES students, enrollment patterns, the number of secondary schools and the number

[9] The SAS can be accessed under the following link: https://www.sistemadeadmisionescolar.cl/

of municipalities within each implementation region.[10] Additionally, the implementation was staggered at the grade level. In the first implementation year in each region only the 1st and 7th grade of primary school and the 1st grade of secondary school are integrated into the SAS, while the rest of the grades followed in the second year.

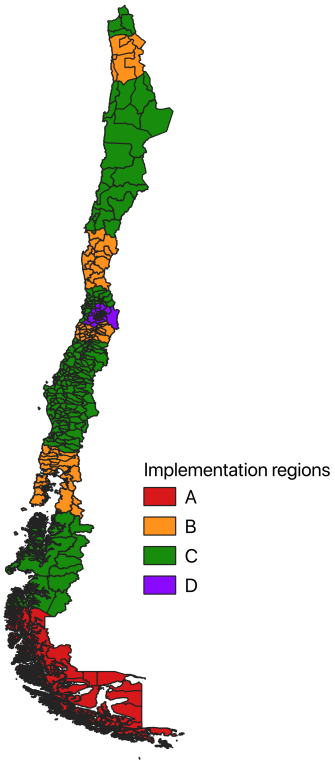


Figure 2: SAS implementation: rolled out over four years in 15 regions

The second component of the LIE requires all schools that receive state funding to gradually reduce tuition fees and to finally abolish them within the following ten years. In particular, schools are compensated by a gradual increase in subsidies and a bonus subsidy for schools that declare themselves tuition-free and non-profit. The objective of this component, also referred to as the end of copayment, was to make K12 education financially accessible to everyone. The end of copayment should not affect priority students because they were already exonerated from paying tuition fees previously. Since this reform component was implemented in all regions at once in 2016 its potential effect should not confound the effect of the SAS implementation, which was introduced in a regionally staggered way. As shown in table A8, using data at the school level I do not find any impact of the SAS on the probability that schools charge tuition fees.

The third component of the LIE prohibits any school that receives state-funding from making profit. In practice, this change obliges the for-profit schools within the voucher sector to change their statute to that of a non-profit organization within the following ten years and to reinvest any profit resulting from its activity, for example in its infrastructure or personnel. The objective of this policy, referred to as the end of profit, was to eliminate profit maximization from the education market, recognizing that it might not be conducive to the

[10] At the start of the observation period, Chile was organized in 15 regions, 56 provinces and 346 municipalities. A 16^{th} region (Ñuble) was created in 2018. Throughout this paper, the old territorial organization with 15 regions is used.

objective of providing high quality education for a large number of students. Previously, voucher schools could declare themselves as for-profit organizations and dispose of their profit as they wished. Financial incentives in the form of an additional subsidy are provided to schools that declare themselves non-profit. Identically to the end of copayment, this reform component also took effect in all regions in 2016.

It is important to note that private schools are not affected by these policies since they do not receive any state funding.

3 Empirical strategy and data

3.1 Empirical strategy

To analyze the effect of the SAS on the outcome variables of interest I exploit its regionally staggered implementation and use a triple Difference-in-Differences (DDD) specification. This amounts to comparing the gap between low SES and high SES students in regions where the SAS is already implemented to regions in which it is not yet in place. The exogenous variation across time and regions allows me to disentangle the causal effect of the SAS from potential confounders, such as other legal changes in the education system or broader trends in the outcome variable. The underlying assumption is that - in the absence of the treatment - the gap in the outcome variables between low SES and high SES students in the treated regions would evolve in the same way as in the control regions (Olden and Møen, 2022). I assess the plausibility of the parallel trends assumption by analyzing whether the trends in the outcome variables are parallel across regions before the SAS is implemented (see figure 5). Additionally, legal changes introduced at the same time as the SAS, namely the end of profit and the end of copayment, could bias the estimated effect if schools comply with those legal requirements differentially across implementation regions. For this reason I show that the compliance with these laws does not coincide with the staggered implementation scheme of the SAS. The baseline estimation model is specified as follows:

$$y_{ijt} = \alpha + \beta \cdot (SAS_{mt} \times lowSES_i) + (\phi_m \times \phi_t) + (\phi_m \times lowSES_i) + (\phi_t \times lowSES_i) + \delta \cdot lowSES_i + \phi_t + \phi_m + \epsilon_{imt}, \tag{1}$$

where y_{ijt} is the outcome of interest of student i at school j at time t, SAS_{mt} is a dummy for whether municipality m is treated at time t (interaction of treatment status dummy and post-reform dummy), $lowSES_i$ indicates whether student i is a priority student, ϕ_m is a set of roughly 300 municipality fixed effects and ϕ_t is a set of year fixed effects.

Additionally, to examine changes at the municipal level I estimate a simple Difference-in-Differences (DD) model, comparing treated to untreated municipalities. Analogously to the DDD case, the identifying assumption is that the differences in the outcome variable between treated and untreated municipalities would have remained constant in absence of the treatment.

$$y_{mt} = \alpha + \beta \cdot SAS_{mt} + \phi_t + \phi_m + \epsilon_{mt} \tag{2}$$

3.2 Data

The data for this study come from administrative records of the Chilean Ministry of Education (MINEDUC), which provides individual and school-level panel data of all students and schools in Chile. In these data I observe each students' enrollment decision, academic performance (e.g. gpa, grade progression,...) and school preference list submitted via the SAS. These data sources also provide rich information at the school-level, such as available seats (vacancies) in the SAS and the level of tuition fees. The *Quality in Education Agency* provide individual-level test scores for primary and secondary school as well as surveys on household characteristics answered by the parents. These data are used to estimate each school's educational quality (value added) and to identify low-SES students (see section 3.3 for details).

The sample is restricted to the years 2014 - 2019, allowing me to assess whether the trends in the outcome variables are parallel in the pre-reform period as well as the effect of the reform thereafter. Furthermore, only students in the first grade of primary school, i.e. 9th grade overall, are included in the final sample for the following reasons: first, information on the students' SES status come from surveys on household characteristics answered by the students' parents before their children enter secondary school, i.e. in the final grades of primary school. Since there is no equivalent information before students enter primary school, access to primary education cannot be analyzed with the same methodology. Second, approximately 85% of all preference submissions at the secondary school level are made for the first grade as shown in figure 3. Thus, the impact of the SAS can be expected to be largest in first grade of secondary school. Additionally, the first region in which the SAS is implemented in 2017 is also dropped because the official school quality variable was not yet available for applicants at that time.[11] These restrictions result in a sample of approximately 160'000 students per year.

3.3 Key variables

SES status - It is crucial to have a reliable indicator of each students' SES status for the purpose of this paper. I follow previous research that takes the mothers' educational attainment as a proxy for a student's SES status (McLanahan, 2004, Kutscher et al., 2020). More precisely, I classify students whose mothers have less than a high school degree as low SES. Summary statistics by SES status are reported in table 1.

School quality (VA) - The official quality measure, which students see when applying via the SAS, is a *discrete* variable coded in four levels and is, thus, relatively insensitive to quality differences across schools. To obtain a more precise *continuous* measure, I estimate I estimate each school's Value Added using the following standard regression specification:

[11] The official quality measure, published yearly by the *Quality in Education Agency*, is a categorical variable with four levels and part of the information that is provided about all schools in the SAS.

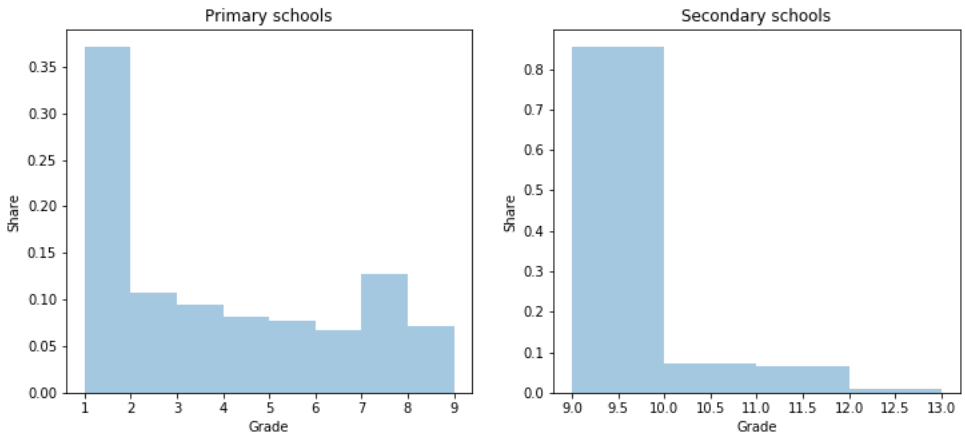


Figure 3: SAS usage by grade

$$s_{it}^{10th} = \alpha + q_{jt} + s_{it}^{8th} + \gamma \cdot X_{it} + \epsilon_{it}, \tag{3}$$

where s_{it}^{10th} and s_{it}^{8th} are student i's test scores in 10_{th} (second secondary) and s^{8th} grade respectively, q_j is a school fixed effect and X_{it} is a vector of student and household characteristics. X_{it} contains the student's gender, the mother's and father's educational attainment, household income, and a dummy for rural schools. In this regression q_j captures contribution of school j to each student's score in $9th$ grade, which is commonly used as a proxy for school quality. Angrist et al., 2020 show that value added models that control for past achievement deliver reliable estimates of the causal effect of school quality. Figure A1 shows that the estimated value added closely matches the official quality measure for the available years.[12]

Competition - To measure school competition at the municipality level I rely on the Herfindahl-Hirschmann-Index (HHI), which is widely used to measure market concentration. The HHI at the municipality level is defined as:

$$HHI_m = \sum_{j=1}^{J} \sqrt{\left(\frac{\#students_j}{\#students_m}\right)^2}, \tag{4}$$

where $\#students_j$ and $\#students_m$ are the number of students at school j and in municipality m respectively. Thus, $HHI = 1$ corresponds to a market in which a single school has a monopoly and $HHI = 0$ to the case where atomistic schools compete for students.

Segregation - The Duncan Index was first introduced in the sociological literature to study gender-based segregation across occupations and has thereafter been applied in many papers in economics (O. D. Duncan and B. Duncan, 1955, Cutler et al., 2008). To measure segregation segregation by SES at the municipality level, the

[12] In figure A1 the continuous value added estimated in equation 3 is discretized into four categories in the same way as the official quality measure (see section A for more details).

Duncan Index is defined as follows:

$$DI_m = \frac{1}{2} \cdot \sum_{j=1}^{J} \left| \frac{h_{jm}}{H_m} - \frac{l_{jm}}{L_m} \right|, \tag{5}$$

where l_{jm} (h_{jm}) is the number of low SES (high SES) students at school j in municipality m and L_m (H_m) is the total number of low (high) SES students in municipality m. Thus, $DI[0,1]$ and $DI = 1$ in a municipality with a perfectly segregated school market, while $DI = 0$ if the school market is not segregated at all.

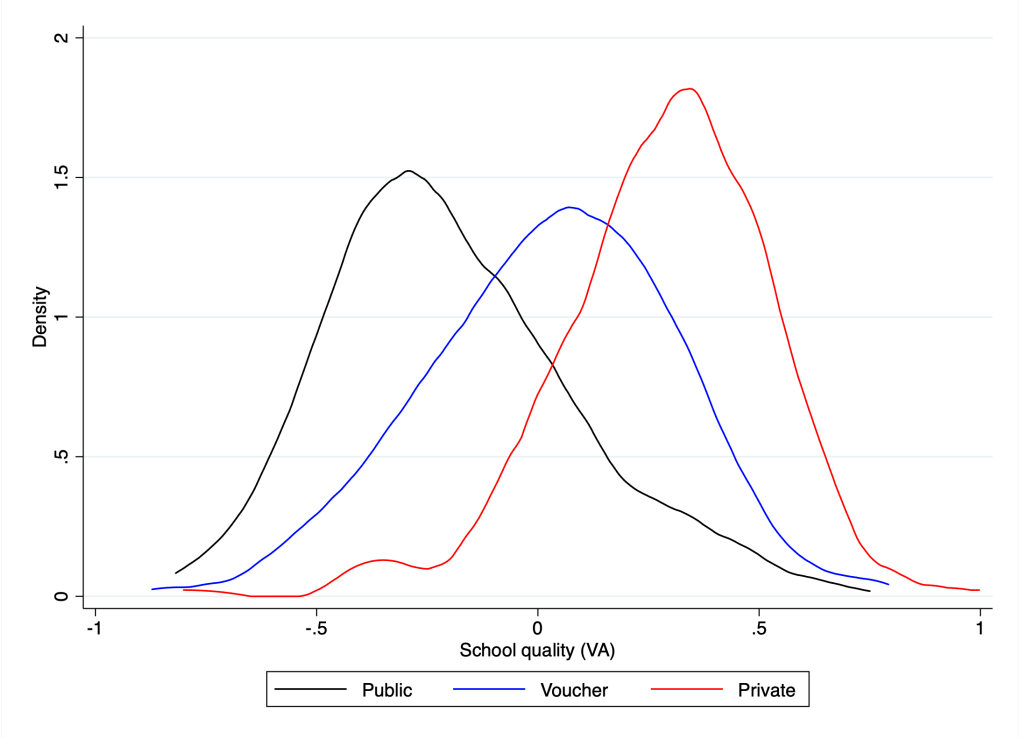


Figure 4: School quality (value added) by school type

4 Results

4.1 Descriptive statistics

Table 1 reports descriptive statistics of the final sample by SES status according to the definition used in this paper. Low SES students attend schools of 0.17 standard deviations lower quality and almost exclusively attend public or voucher schools. They score significantly worse in terms of academic achievement across a variety of measures, such as grade progression, grades standardized test scores and attendance. In terms of socio-economic background, low SES students come from families with $\approx$ 1000 USD PPP less household income than high SES students on average. The absolute level of household income roughly corresponds to the level of the Chilean minimum wage, emphasizing the disadvantaged economic situation. While 80% of high SES students' fathers

have a high school degree, this is only true for 28% of fathers in the case of low SES students.[13] Furthermore, low SES students are slightly older than high SES students. The age is balanced across the two groups.

Variable	High SES	Low SES	Diff
School quality (VA)	0.03	-0.14	-0.170***
Public	0.27	0.51	0.237***
Voucher	0.62	0.49	-0.125***
Private	0.11	0.00	-0.112***
Academic track	0.70	0.46	-0.248***
Passing 2nd grade (secondary)	0.88	0.78	-0.100***
GPA	5.32	4.84	-0.487***
Attendance	90.09	84.73	-5.357***
Reading 8th grade	0.15	-0.29	-0.434***
Mathematics 8th grade	0.21	-0.41	-0.624***
Household income (monthly, USD PPP)	1687.66	674.33	-1013.329***
Father has HS degree	0.80	0.28	-0.518***
Age	14.38	14.63	0.252***
Female	0.49	0.50	0.005

Table 1: Obervables of high vs. low SES students before implementation

4.2 Main results

Figure 5 shows the effect of the SAS implementation on the difference in quality between schools attended by high and low SES students relative to the region-specific implementation year. Importantly, there does not seem to be any effect in the years prior to the implementation, lending credibility to the identifying assumption of parallel trends between high and low SES students. After its implementation, the SAS leads to a reduction in the school quality gap of $\approx$ 0.01 - 0.02 standard deviations (sd).

The effects of the SAS on the school quality gap between low and high SES students are reported in table 2. On average low SES students attend a school that has 0.17 sd lower value added during the study period. Column (1) shows that the SAS reduces this gap by 5% on average. Columns (2) to (4) explore heterogeneities of the SAS introduction with the local school market structure, of which I examine two characteristics at the municipal level: the share of students enrolled in each school type (public, voucher and private) and the school market concentration proxied by the Herfindahl-Hirschmann-Index (HHI). Column (2) shows that the effect of the SAS on school quality is significantly lower in areas with higher public and voucher enrolment. The estimates show that a 1 sd increase in private school enrolment (which is equivalent to a 1 sd decrease in public *or* voucher school enrolment *separately* all else equal), increases the effect of the SAS by 0.035 sd. This is equivalent to closing the school quality gap by $\approx$ 21%. As column (3) reports, the effect of the SAS is 0.009 sd higher in municipalities that are 1 sd more competitive ($\approx$ 5% of school quality gap). The estimates in column (4) show that, once the model is fully interacted, the positive main effect of the SAS is driven by positive effects in municipalities with higher private school enrollment (rows 2 and 3) and higher competition among schools (row 4). Furthermore, the

[13] By definition of my measure of low SES students, all (none of the) mothers of high (low) SES students have a high school degree.

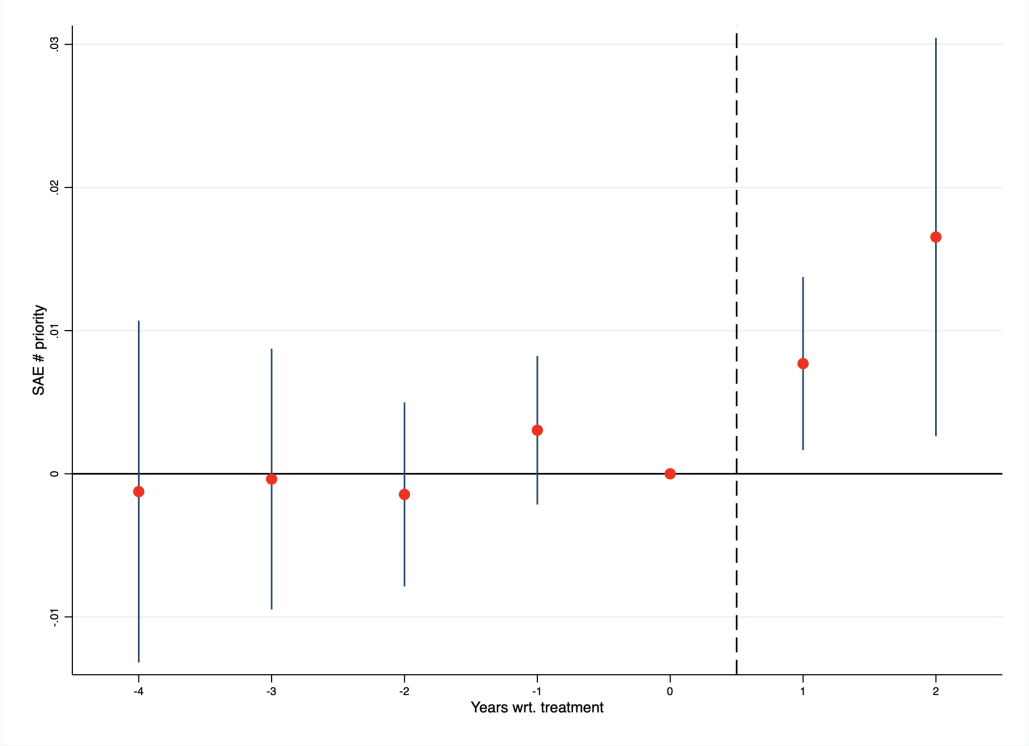


Figure 5: Effect of SAS on school quality.[14]

point estimates of the interactions are very similar when interacted one at a time or jointly (columns 2 and 3 vs. 4). Table A2 shows that the change in the school quality gap in municipalities with a high private enrollment share is driven by low SES students being able to access higher value added schools rather than high SES downgrading to lower value added schools. In contrast, the reduction in the school quality gap in school districts with high school competition appears to be driven by high-SES students accessing schools of lower quality.

Turning to academic outcomes, the effects on GPA (at the end of second grade of secondary school) and grade progression (enrolling in third grade) are reported in table 3. The descriptive statistics show that low-SES students on average have a 0.6 points lower GPA at the end of second grade. To estimate the effect of the SAS on academic outcomes the empirical analysis follows the same strategy as in the previous table, i.e. the main effect of the SAS and its complementarities with the local school market structure are studied. In the case of GPA, the main effect in column (1) is slightly negative which is driven by the municipalities' school type structure (columns 2 and 4). The negative interaction coefficient of voucher schools suggests that the SAS closes the GPA gap by 0.145 points for each standard deviation increase in a municipality's private school enrollment share. To assess whether this relatively small impact on the GPA translates into changes in the grade progression, I analyze enrollment in third grade as an outcome in columns 5 - 8. On average low-SES students are roughly 13pp less likely to enroll in third grade - conditional on attending the first grade of secondary school. Furthermore, columns 5 - 8 of table 3 reveal that the gap in third grade enrollment is not affected by the SAS as all coefficients are insignificant. The yearly effects on academic outcomes relative to the implementation period are shown in figure A2.

To corroborate these findings I exploit an institutional feature of the SAS: for each student enrolled in grade g

Table 2: Effect of SAS on school quality: main effect and market structure heterogeneity.

	Dependent: school quality			
	(1)	(2)	(3)	(4)
SAS=1 × lowSES=1	0.008**	0.009**	0.001	0.004
	(0.004)	(0.004)	(0.003)	(0.003)
SAS=1 × lowSES=1 × public enrol.		-0.035**		-0.027*
		(0.015)		(0.015)
SAS=1 × lowSES=1 × voucher enrol.		-0.034**		-0.031**
		(0.014)		(0.014)
SAS=1 × lowSES=1 × HHI			-0.009**	-0.010*
			(0.003)	(0.005)
Mean SES-gap in outcome	-0.168	-0.168	-0.168	-0.168
SD of SES-gap in outcome	0.39	0.39	0.39	0.39
Municipality FEs	Yes	Yes	Yes	Yes
Sample size	965321	965321	965321	965321
Number of clusters	301	301	301	301

Note: the outcome variable in all columns is the quality (value added) of the school attended by student i in year t. The school quality is fixed at the 2016 academic year and standardized s.t. mean = 0 and standard deviation = 1. The reported coefficients correspond to OLS estimates of the Triple Difference-in-Differences model's main effect (row 1) and its interactions with schooling market characteristics at the municipality level (rows 2-4). These interactions are standardized s.t. mean = 0 and standard deviation = 1. Summary statistics on the gap between low and high SES students in the outcome variables are reported in the bottom panel. Standard errors are clustered at the municipality level and reported in parentheses. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

the SAS reserves a seat in grade $g + 1$ at the same establishment for the following year. This ensures that students with a regular grade progression do not need to apply via the SAS each year if they wish to stay at the same establishment. Consequently, students in their last year of primary school do not need to apply via the SAS if they would like to enroll in the first grade of secondary school at the *same* establishment. This feature of the SAS is illustrated in figure 6, which shows the fraction of last-grade primary school students who use the SAS to submit preference lists to apply for the first grade of secondary school. The sample is split into establishments that impart both primary and secondary education (left side) and establishments that offer only secondary education (right side). The figure shows that while less than 10% of last-grade primary school students at establishments *with* secondary education apply via the SAS, this number is almost 80% for students at establishments *without* secondary education. Thus, I expect the effect of the SAS to be more pronounced among students who, in the year in which they apply to the first grade of secondary school, are enrolled at a primary school without secondary education.

To exploit this feature, I split the sample by whether the students were enrolled at a primary school *with* or *without* secondary school. Table 4 reports these results for the school quality attended by the students. The school quality gap between high and low SES is roughly three times as large in the subsample of students who come from schools with both primary and secondary education (-0.191 sd, column (5)) when compared to students

Table 3: Effect of SAS on academic performance

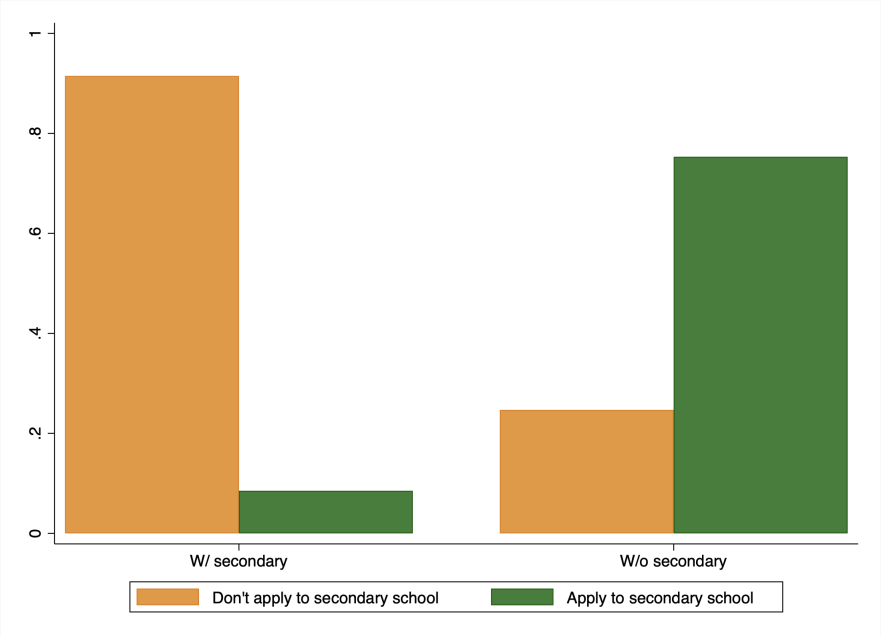
	Dep.: GPA in 2nd grade				Dep.: enrolled in 3rd grade			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SAS=1 × lowSES=1	-0.033*	0.011	0.016	0.031	-0.008	-0.006	-0.002	0.001
	(0.020)	(0.033)	(0.037)	(0.038)	(0.005)	(0.008)	(0.008)	(0.008)
SAS=1 × lowSES=1 × public enrol.		-0.110		-0.130		-0.017		-0.019
		(0.087)		(0.095)		(0.020)		(0.023)
SAS=1 × lowSES=1 × voucher enrol.		-0.145*		-0.145*		-0.017		-0.014
		(0.084)		(0.086)		(0.020)		(0.020)
SAS=1 × lowSES=1 × HHI			0.042	0.038			0.004	0.013
			(0.035)	(0.047)			(0.008)	(0.012)
Mean SES-gap in outcome	-0.644	-0.644	-0.644	-0.644	-0.125	-0.125	-0.125	-0.125
SD of SES-gap in outcome	2.50	2.50	2.50	2.50	0.57	0.57	0.57	0.57
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	965321	965321	965321	965321	965321	965321	965321	965321
Number of clusters	301	301	301	301	301	301	301	301

Note: The reported coefficients correspond to OLS estimates of the Triple Difference-in-Differences model's main effect (row 1) and its interactions with schooling market characteristics at the municipality level (rows 2-4). These interactions are standardized s.t. mean = 0 and standard deviation = 1. The outcome variables in columns 1-4 and 5-8 are student i's GPA at the end of second grade and a dummy for enrolling in 3rd grade of secondary school respectively. Summary statistics on the gap between low and high SES students in the outcome variables are reported in the bottom panel. Standard errors are clustered at the municipality level and reported in parentheses. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

from schools that only offer primary education (-0.066 sd, columns (1) - (4)). A comparison of columns (1) - (4) to column (5) also shows that the closing of the school quality gap in municipalities with relatively more private school enrollment is primarily driven by the subset of students who come from primary schools without secondary education ath the same establishment. This can be seen in columns (2) and (4) in which the interaction of public and voucher school enrollment with the main effect of the SAS is significantly negative. However, the coefficients in the subsample of students from schools with both primary and secondary education in column (5) are not significant. These findings confirm that the observed effects of the SAS on the school quality gap are indeed causal.

Similarly, in 5 I analyze the same subsamples of students for the academic outcomes previously analyzed as outcome variables. For both the GPA at the end of second grade of secondary school (columns 1 - 3) and enrollment in third grade (columns 4 - 6) I analyze the full sample (columns (1) and (4)) the sample of students from primary schools *without* and *with* secondary schools (columns (2), (5) and (3), (6) respectively). If the SAS impacts academic outcomes its effect should be particularly notable in the subsample of students from primary schools without secondary schools. However, both for the GPA and grade progression there are no notable differences between the school type interactions of students from primary schools with and without secondary

Figure 6: SAS usage by availability of secondary school



Note: this figure shows the share of students in the last grade of primary school that apply to secondary school via the SAS. *W/ secondary* (*W/o secondary*) refers to primary schools that (don't) have a secondary school at the same establishment. Students who are enrolled at a primary school *with* a secondary school do not need to apply to transition from their current primary school to the secondary school at the same establishment.

schools.[15]

In sum, the main results show that the SAS enables low SES students to access schools of higher quality relative to high SES students. This effect is concentrated in two subsamples, namely *i)* in municipalities with a relatively high level of private enrollment and *ii)* among students who come from schools at which they cannot proceed to secondary school. These students are more reliant on the SAS to enroll in secondary school, since they do not have a reserved seat at the same school at *secondary* level. However, I do not find a consistent impact of the SAS on academic outcomes.

4.3 Mechanism

In this section I assess the mechanisms that could give rise to the findings presented so far. The narrowing in the school quality gap is observed in municipalities with higher levels of private school enrollment. It is important to note that private schools are not part of the SAS, i.e. private schools have their own entry criteria and the SAS does not assign students to them based on submitted preferences. For this reason, they can respresent an outside option for students that are not willing to apply to schools via the SAS or are not satisfied with their assignment result. Due to tuition fees that tend to be substantially higher in private than in voucher schools, this outside option is likely more relevant for high SES students, who are less financially constrained.

To test this mechanism I first analyze the impact of the SAS on segregation proxied by the Duncan Index.

[15] While the main effect of the SAS in column 2 of table 5 is positive, there is no impact on grade progression in the corresponding subsample.

Table 4: Effect of SAS on school quality by availability of secondary school

	Primary w/o secondary				Primary w/ secondary
	(1)	(2)	(3)	(4)	(5)
Dependent: school quality					
SAS=1 × lowSES=1	0.002	0.006	0.001	0.004	0.001
	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)
SAS=1 × lowSES=1 × public enrol.		-0.060**		-0.054*	-0.036
		(0.030)		(0.031)	(0.023)
SAS=1 × lowSES=1 × voucher enrol.		-0.064**		-0.061**	-0.030
		(0.030)		(0.030)	(0.021)
SAS=1 × lowSES=1 × HHI			-0.002	-0.005	-0.005
			(0.005)	(0.008)	(0.008)
Mean SES-gap in outcome	-0.066	-0.066	-0.066	-0.066	-0.191
SD of SES-gap in outcome	0.37	0.37	0.37	0.37	0.39
Municipality FEs	Yes	Yes	Yes	Yes	Yes
Sample size	319867	319867	319867	319867	474232
Number of clusters	299	299	299	299	301

Note: the outcome variable in all columns is the quality (value added) of the school attended by student i in year t. The school quality is fixed at the 2016 academic year. The reported coefficients correspond to OLS estimates of the Triple Difference-in-Differences model's main effect (row 1) and their interactions with schooling market characteristics at the municipality level (rows 2-4). The sample is split into students that, in the year before applying to secondary school, are enrolled at a primary school *without* and *with* a secondary school at the *same* establishment (columns 1-4 and 5 respectively). Summary statistics on the gap between low and high SES students in the outcome variables are reported in the bottom panel. Standard errors are clustered at the municipality level and reported in parentheses. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6 reports the corresponding results. Since the unit of observation are municipalities I use a Difference-in-Differences estimation strategy (see section 3.1). Column (1) shows that the main effect of SAS has a significantly negative coefficient i.e. it lowers segregation. In columns (2) to (4) I separately interact municipality-level market structure characteristics. Column (5) reports the estimates of the joint interactions. This last column shows that the effect on segregation is zero on average but that segregation increases/decreases in municipalities with high/low private school enrollment. This means that, in areas with a relatively high provision of private schooling high and low SES students increasingly go to separate schools as a result of the SAS.

To provide further evidence on the relevant mechanism I assess whether SAS affects the likelihood of switching from a *public* primary school to a *private* secondary school. Due to financial costs that are associated with switching to a private secondary school, I expect high SES students to move to the private sector disproportionately more often than low SES students with the introduction of the SAS. Additionally, switches to private schools can be expected to happen relatively more frequently for students who do not have a reserved seat when transitioning from primary school to secondary school. This is the case for students who attend a primary school that does not offer secondary education at the same establishment.

Table 7 reports the results of this analysis. In these regressions the sample is restricted to students who attend either a public or a voucher school in the last grade of primary school. The outcome variable is a binary

Table 5: Effect of SAS on academic outcomes by availability of secondary school

	Dep.: GPA in 2nd grade			enrolment in 3rd grade		
	All	W/o second.	W/ second.	All	W/o second.	W/ second.
SAS=1 × lowSES=1	0.031	0.108**	-0.020	0.001	0.010	0.004
	(0.038)	(0.049)	(0.072)	(0.008)	(0.012)	(0.013)
SAS=1 × lowSES=1 × public enrol.	-0.130	0.020	-0.106	-0.019	-0.017	-0.036
	(0.095)	(0.109)	(0.130)	(0.023)	(0.038)	(0.029)
SAS=1 × lowSES=1 × voucher enrol.	-0.145*	-0.100	-0.049	-0.014	-0.037	-0.019
	(0.086)	(0.099)	(0.116)	(0.020)	(0.034)	(0.026)
SAS=1 × lowSES=1 × HHI	0.038	0.021	0.043	0.013	-0.002	0.018
	(0.047)	(0.056)	(0.073)	(0.012)	(0.019)	(0.015)
Mean SES-gap in outcome	-0.644	-0.345	-0.864	-0.125	-0.073	-0.154
SD of SES-gap in outcome	2.50	2.36	2.60	0.57	0.58	0.55
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	965321	319867	474232	965321	319867	474232
Number of clusters	301	299	301	301	299	301

Note: the outcome variables are a dummy for passing 2nd grade (columns 1-3) and the students' GPA in second grade (columns 4-6). The reported coefficients correspond to OLS estimates of the Triple Difference-in-Differences model's main effect (row 1) and their interactions with schooling market characteristics at the municipality level (rows 2-4). Columns 1 and 4 are based on the full sample. In columns 2 and 5 (3 and 6) the sample is split into students that, in the year before applying to secondary school, are enrolled at a primary school *without* (*with*) a secondary school at the *same* establishment. Summary statistics on the gap between low and high SES students in the outcome variables are reported in the bottom panel. Standard errors are clustered at the municipality level and reported in parentheses. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

dummy variable for enrolling in a private secondary school. Columns (1) - (4) show that low SES students who attend a school that only offers primary education (i.e. without reserved seat at secondary level) are 0.6pp less likely to move from a non-private primary to a private secondary school than high SES students. This gap almost doubles to 1pp for students at schools that offer both primary and secondary education (i.e. with reserved seat at secondary school). Furthermore, a comparison of these two subsamples shows that the SAS only affects the differential likelihood of switching to a private secondary school in the case of primary school students who do not have a reserved seat at the secondary level at the same establishment. In this subsample of students the gap in switching to private schopol between low and high SES students further widens. Column (4) shows that this differential likelihood is *i*) negatively affected at mean levels of enrollment patterns and school competition (row 1) and *ii*) further widens in the municipalities' private school enrollment (rows 2 and 3). On the contrary, column (5) shows that the differential likelihood of switching to a private option for secondary education is not affected in the subsample of students from schools that impart both primary and secondary education.

I interpret these findings in the following way: primary school students from schools that do not provide secondary education necessarily have to look for secondary education at a different establishment - both before and after the introduction of the SAS. However, after the introduction of the SAS, high SES students are more likely to switch to the private sector - either because they are unsatisfied with their assignment result obtained via the SAS or because they believe to have less chances to be admitted to their desired school under the SAS.

Table 6: Effect of SAS on segregation

	(1)	(2)	(3)	(4)	(5)
SAS=1	-0.008*	-0.014***	-0.012**	-0.029***	-0.006
	(0.004)	(0.005)	(0.006)	(0.007)	(0.006)
SAS=1 × public enrol.		-0.113***			-0.058*
		(0.039)			(0.032)
SAS=1 × voucher enrol.		-0.106***			-0.062**
		(0.039)			(0.030)
SAS=1 × HHI			-0.004		-0.011
			(0.005)		(0.008)
SAS=1 × nr. schools				0.018***	-0.009**
				(0.006)	(0.005)
Mean of outcome	0.214	0.214	0.214	0.214	0.214
Standard deviation of outcome	0.16	0.16	0.16	0.16	0.16
Region FEs	Yes	Yes	Yes	Yes	Yes
Sample size	1944	1944	1944	1944	1944
Number of clusters	324	324	324	324	324

Note: the outcome variable is the Duncan Index, a measure of segregation ranging from 0 (no segregation) to 1 (full segregation). The reported coefficients correspond to OLS estimates of the Difference-in-Differences model's main effect (row 1) and interactions with schooling market characteristics at the municipality level (rows 2-5). Summary statistics on the gap between low and high SES students in the outcome variables are reported in the bottom panel. Standard errors are clustered at the municipality level and reported in parentheses. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Since private schools charge tuition fees this outside option is more relevant for high SES students who are less financially constrained. There is no evidence for this mechanism in the subsample of primary school students at schools that offer both primary and secondary education since they can continue secondary education at the same establishment.

4.4 Robustness checks

In this section I perform a series of robustness checks in the baseline specification.

Continuous treatment - Within each region he SAS is implemented for all public and voucher schools at once. However, students can only be assigned to a given school if the latter has available seats (see appendix section A for details on how vacancies are created in the SAS). As figure **??** demonstratesthere is a large variety in the number of vacant seats as a share of total capacity at the school level. It can be expected that the impact of the SAS is larger in municipalities with a larger fraction of vacancies. To examine to what extent the main results depend on the constant treatment definition used in the baseline specification, I define an alternative treatment as $SAS^{alt}_{t,j} = \frac{vacancies_j}{students_j}$ if the SAS is implemented in municipality m at time t and 0 otherwise. The variables $vacancies_m$ and $students_m$ are kept constant at the level prior to the implementation the SAS. The corresponding results are similar to the ones obtained in the baseline estimation and are reported in table A5.

Municipality-level trends - To ensure that the results are not driven by trends at the municipality level instead

Table 7: Effect of SAS on transitions from *public* primary to *private* secondary school

	Primary w/o secondary				Primary w/ secondary
	(1)	(2)	(3)	(4)	(5)
Dependent: private secondary school					
SAS=1 × lowSES=1	-0.005*	-0.004***	-0.002	-0.004**	-0.001
	(0.003)	(0.002)	(0.001)	(0.002)	(0.003)
SAS=1 × lowSES=1 × public enrol.		0.044**		0.041*	0.021
		(0.020)		(0.023)	(0.028)
SAS=1 × lowSES=1 × voucher enrol.		0.041**		0.040*	0.021
		(0.019)		(0.021)	(0.024)
SAS=1 × lowSES=1 × HHI			0.004*	0.002	0.009
			(0.002)	(0.004)	(0.008)
Mean SES-gap in outcome	-0.006	-0.006	-0.006	-0.006	-0.010
SD of SES-gap in outcome	0.09	0.09	0.09	0.09	0.12
Municipality FEs	Yes	Yes	Yes	Yes	Yes
Sample size	319440	319440	319440	319440	344769
Number of clusters	299	299	299	299	294

Note: the outcome variable in all columns is a dummy for switching from *public* primary school to *private* secondary school. The reported coefficients correspond to OLS estimates of the Triple Difference-in-Differences model's main effect (row 1) and their interactions with schooling market characteristics at the municipality level (rows 2-4). In columns 1-4 (column 5) the sample is split into students that, in the year before applying to secondary school, are enrolled at a primary school *without* (*with*) a secondary school at the *same* establishment. Summary statistics on the gap between low and high SES students in the outcome variables are reported in the bottom panel. Standard errors are clustered at the municipality level and reported in parentheses. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

of by the implementation of the SAS, I include municipality-level trends in the main specification. Specifically, I add the following terms to equation 1: $trend_t$, $trend_t \times \phi_m$ and $trend_t \times \phi_m \times lowSES_i$, where $trend_t$ is a linear trend and the other terms are defined as before. The results are reported in table A6. The coefficients are qualitatively and qualitatively very similar with one exception: the point estimate of the interaction of the HHI with the main effect is slightly lower and no longer signficant. However, the role of the municipality-level enrollment patterns by school type is virtually unchanged.

Official school quality data - The baseline estimates for the effects of the SAS on access to school quality (e.g. in table 2) rely on my own estimations of school value added. To ensure that the baseline results are not driven by differences in my estimation of value added and the official quality information provided to students on the SAS platform I repeat the main analysis with the official quality measure as dependent variable. Note that the latter is only available as categorical variable with four levels. The results reported in table A7 are relatively similar to the baseline results. In particular, the school quality gap shrinks with the introduction of the SAS (column (1)) and this effect is driven by municipalities with a relatively higher private school enrollment (column 2) and higher competition between schools (column 3). However, once these variables are interacted in column (4) the coefficients are less precisely estimated and not significant. Likely this is due to the fact that the official school quality measure is a categorical variable with only four levels. In comparison with the continuous measure that I

use in the baseline analysis, a lot of information about school quality is lost. This is the case because the quality levels in the official measure are created by discretizing the estimated value added at predefined thresholds, namely at the 12^{th}, 35^{th} and the 85^{th}. Thus, in terms of quality there is no distinction between a school at the 40^{th} and the 80^{th} percentile in the quality distribution.

5 Conclusion

In this paper I study whether centralizing the applications and admissions process of students to secondary schools impacts the access to educational quality and the students' subsequent academic achievement. Analyzing the staggered introduction of the School Assignment System (SAS), a national centralized assignment mechanism for pre-tertiary education in Chile, I show that low SES students are able to access higher value added schools under the new system. Moreover, I find important interactions with the structure of the local schooling market. In particular, access to higher value added schools is concentrated in municipalities in which the private sector has a high enrollment share. This is explained by high SES students being more likely to enroll in private secondary schools, which have their own admissions policies and are not administered within the SAS. This highlights the importance of outside options in the design of centralized assignment systems (Calsamiglia and Güell, 2018, Kutscher et al., 2020). Somewhat surprisingly, the evidence for the impact of SAS on educational quality is very limited in once the size of the private sector is taken into account (e.g. in municipalities where school competition is high). A potential explanation is that (time-based) application costs were low and students were well-informed already before the implementation of the SAS.

In terms of academic outcomes, I do not find consistent evidence that the observed changes in access to educational quality impact the GPA or the grade progression in the first two years of secondary school. Potential explanations for the absence of an effect are: *i)* a too short study period, *ii)* different schooling needs for low and high SES students that are not captured in the standard value added model and *iii)* unobserved changes in school value added after the implementation of the SAS driven by the outflow of high SES peers from the non-private sector.

Bibliography

Abdulkadiroğlu, Atila, Nikhil Agarwal, and Parag A. Pathak (2017). "The Welfare Effects of Coordinated Assignment: Evidence from the New York City High School Match". In: *American Economic Review* 107.12, pp. 3635–89.

Abdulkadiroğlu, Atila, Parag A. Pathak, Jonathan Schellenberg, and Christopher R. Walters (2020). "Do Parents Value School Effectiveness?" In: *American Economic Review* 110.5, pp. 1502–39.

Allende, Claudia, Francisco Gallego, and Christopher Neilson (2019). *Approximating the Equilibrium Effects of Informed School Choice*. Working Papers 628. Princeton University, Department of Economics, Industrial Relations Section.

Angrist, Joshua, Peter Hull, Parag A. Pathak, and Christopher R. Walters (2020). *Simple and Credible Value-Added Estimation Using Centralized School Assignment*. NBER Working Papers 28241. National Bureau of Economic Research, Inc.

Billings, Stephen B., David J. Deming, and Jonah Rockoff (2013). " School Segregation, Educational Attainment, and Crime: Evidence from the End of Busing in Charlotte-Mecklenburg *". In: *The Quarterly Journal of Economics* 129.1, pp. 435–476.

Booij, Adam S, Edwin Leuven, and Hessel Oosterbeek (2016). "Ability Peer Effects in University: Evidence from a Randomized Experiment". In: *The Review of Economic Studies* 84.2, pp. 547–578.

Calsamiglia, Caterina and Maia Güell (2018). "Priorities in school choice: The case of the Boston mechanism in Barcelona". In: *Journal of Public Economics* 163, pp. 20–36.

Calsamiglia, Caterina and Annalisa Loviglio (2019). "Grading on a curve: When having good peers is not good". In: *Economics of Education Review* 73, p. 101916.

Campos, Christopher and Caitlin Kearns (2021). "The Impacts of Neighborhood School Choice: Evidence from Los Angeles' Zones of Choice". In.

Chetty, Raj and Nathaniel Hendren (2018). "The Impacts of Neighborhoods on Intergenerational Mobility I: Childhood Exposure Effects". In: *The Quarterly Journal of Economics* 133.3, pp. 1107–1162.

Cutler, David M., Edward L. Glaeser, and Jacob L. Vigdor (2008). "When are ghettos bad? Lessons from immigrant segregation in the United States". In: *Journal of Urban Economics* 63.3, pp. 759–774.

Denning, Jeffrey T., Richard Murphy, and Felix Weinhardt (2021). "Class Rank and Long-Run Outcomes". In: *The Review of Economics and Statistics*, pp. 1–45.

Duflo, Esther, Pascaline Dupas, and Michael Kremer (2011). "Peer Effects, Teacher Incentives, and the Impact of Tracking: Evidence from a Randomized Evaluation in Kenya". In: *American Economic Review* 101.5, pp. 1739–74.

Duncan, Otis Dudley and Beverly Duncan (1955). "A methodological analysis of segregation indexes". In: *American sociological review*.

Garlick, Robert (2018). "Academic Peer Effects with Different Group Assignment Policies: Residential Tracking versus Random Assignment". In: *American Economic Journal: Applied Economics* 10.3, pp. 345–69.

Hastings, Justine S. and Jeffrey M. Weinstein (2008). "Information, School Choice, and Academic Achievement: Evidence from Two Experiments*". In: *The Quarterly Journal of Economics* 123.4, pp. 1373–1414.

Heckman, James J. and Ganesh Karapakula (2019). *Intergenerational and Intragenerational Externalities of the Perry Preschool Project*. Working Papers 2019-033. Human Capital and Economic Opportunity Working Group.

Hsieh, Chang-Tai and Miguel Urquiola (2006). "The effects of generalized school choice on achievement and stratification: Evidence from Chile's voucher program". In: *Journal of Public Economics* 90.8-9, pp. 1477–1503.

Jensen, Robert (2010). "The (Perceived) Returns to Education and the Demand for Schooling*". In: *The Quarterly Journal of Economics* 125.2, pp. 515–548.

Knight, Brian and Nathan Schiff (2022). "Reducing Frictions in College Admissions: Evidence from the Common Application". In: *American Economic Journal: Economic Policy* 14.1, pp. 179–206.

Kutscher, Macarena, Shanjukta Nath, and Sergio Urzua (2020). *Centralized Admission Systems and School Segregation: Evidence from a National Reform*. eng. IZA Discussion Papers 13305. Bonn.

Laliberté, Jean-William (2021). "Long-Term Contextual Effects in Education: Schools and Neighborhoods". In: *American Economic Journal: Economic Policy* 13.2, pp. 336–77.

Loviglio, Annalisa (2020). *Schools and Their Multiple Ways to Impact Students: A Structural Model of Skill Accumulation and Educational Choices*. working paper.

Lutz, Byron (2011). "The End of Court-Ordered Desegregation". In: *American Economic Journal: Economic Policy* 3.2, pp. 130–68.

McLanahan, Sara (2004). "Diverging Destinies: How Children Are Faring under the Second Demo- graphic Transition". In: *Demography*.

Mello, Ursula (forthcoming). "Affirmative Action, Centralized Admissions and Access of Low-income students to Higher Education". In: *AMERICAN ECONOMIC JOURNAL: ECONOMIC POLICY*.

MINEDUC (2017). "Ley de Inclusión Escolar: el primer gran debate de la reforma educacional". In: *MINEDUC*.

Neilson, Christopher (2021). *The Rise of Centralized Assignment Mechanisms in Education Markets Around the World*. Working Papers.

OECD (2015). *Education at a Glance 2015*, p. 564.

— (2018). *Equity in Education*, p. 192.

— (2019). "PISA 2018: Insights and Interpretations". In: *OECD Library*.

Olden, Andreas and Jarle Møen (2022). "The triple difference estimator". In: *The Econometrics Journal*. utac010.

Terrier, Camille, Parag A. Pathak, and Kevin Ren (2021). *From Immediate Acceptance to Deferred Acceptance: Effects on School Admissions and Achievement in England*. NBER Working Papers 29600. National Bureau of Economic Research, Inc.

A Appendix

The assignment algorithm

Below I describe the application and assignment process including the specific tiebrakers, that give priority to students in case of over-demand:

1. Family submits a preference list containing a minimum of one or two schools.[16] There is no maximum amount of schools that can be listed.
2. If demand is higher than supply at the grade-school level, priority is given to students based on the pre-defined characteristics listed in order below:
   (a) Siblings of enrolled students.
   (b) Priority students until the share of priority students at the establishment level reaches 15%.
   (c) Children of permanent staff.
   (d) Non-expelled ex-students of the establishment.
3. Family accepts or rejects the assignment.
4. Complementary round: if the family rejects the assignment, it can submit a new preference list over schools with available seats.
5. After the same assignment algorithm is run, families can accept/reject the assignment result of the complementary round.

It is important to note that neither the location of residence nor prior academic achievement are taken into account in the assignment mechanism.

Table A1: Characteristics of municipalities by implementation region.

Region	Students	Priority (%)	Private (%)	Voucher (%)	Public (%)	Schools	Municip.
A	733	29	9	41	50	9	3
B	583	39	4	53	42	7	72
C	605	36	5	53	42	7	177
D	1829	28	12	64	23	20	52
Total	810	34	8	57	35	9	129

[16] Families are required to list a minimum of one school if the student is currently enrolled at a school at which she/he could continue her/his studies or the family is applying to a rural establishment. The minimum of two schools applies to families that are entering the Chilean K12 education system or the student's school does not offer the appropriate grade, e.g. if a student needs to apply for the 1st grade of secondary school but her/his current school only offers primary education.

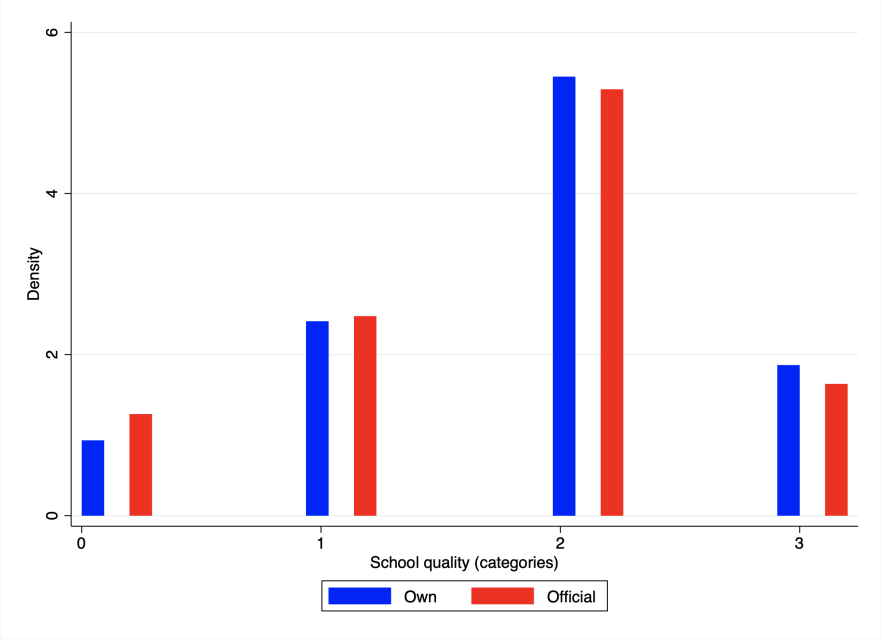


Figure A1: Comparison of quality measures: baseline (own) and official

Details on data

Quality measure: Performance Category (*Categoría de Desempeño)*

The official quality measure, which is computed by the *MINEDUC* and publicly available, is a categorical variable with four quality levels: insufficient, medium-low, medium and high. Importantly, the quality measure is publicly available on the SAE platform, i.e. families can check every school's quality category since 2016 for primary schools and since 2017 for secondary schools. MINEDUC constructs and publishes the Performance Category for two reasons: first, it monitors the quality provided by schools and provides technical and financial support to schools that fall in the lowest category (insufficient). The MINEDUC can revoke the accreditation of schools that are repeatedly categorized in the lowest category. The second goal is to inform families about the quality of available schools, such that this information can be taken into account accordingly. The measure is constructed and made available for primary and secondary schools separately (even if an establishment provide both education levels), however, no distinction is made for secondary school tracks. It is constructed by creating an index based on the students' performance on standardized evaluation and - to a lesser extent - on the students' personal and social development at each school, before being adjusted for the SES of the school's enrolled students. It is, thus, a value-added measure. However, to make it impossible to rank schools by quality, the MINEDUC discretizes the continuous measure into four quality categories according to three predefined cutoffs, namely the 12th, 35th and 85th percentile. Below the variables and the respective weights that are used to compute the index are reported:

- Learning standards (67%)
- Average scores on standardized tests

Table A2: Effect of SAS on quality by SES status

	High SES				Low SES			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent: school quality								
SAS=1	-0.003	-0.007	0.006*	0.005	0.004	0.008**	0.006**	0.009***
	(0.003)	(0.005)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
SAS=1 × public enrol.		-0.015		-0.019		-0.039**		-0.036**
		(0.011)		(0.012)		(0.017)		(0.018)
SAS=1 × voucher enrol.		-0.009		-0.007		-0.037**		-0.033*
		(0.011)		(0.011)		(0.017)		(0.017)
SAS=1 × HHI			0.008**	0.017***			-0.001	0.002
			(0.003)	(0.006)			(0.003)	(0.005)
Mean gap in outcome	0.037	0.037	0.037	0.037	-0.132	-0.132	-0.132	-0.132
SD of gap in outcome	0.29	0.29	0.29	0.29	0.27	0.27	0.27	0.27
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	636721	636721	636721	636721	328600	328600	328600	328600
Number of clusters	301	301	301	301	301	301	301	301

Note: the outcome variable in all columns is the quality (value added) of the school attended by student i in year t. The reported coefficients correspond to OLS estimates of the Difference-in-Differences model's main effect (row 1) and its interactions with schooling market characteristics at the municipality level (rows 2-4). These interactions are standardized s.t. mean = 0 and standard deviation = 1. The school quality is fixed at the 2016 academic year and standardized s.t. mean = 0 and standard deviation = 1. The sample is split into high SES (columns 1 - 4) and low SES (columns 5 - 8) students. Summary statistics on the gap between low and high SES students in the outcome variables are reported in the bottom panel. Standard errors are clustered at the municipality level and reported in parentheses. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A3: Effect of SAS on peers' performance on mathematics test

- Evolution in standardized tests
- Personal and social development (academic motivation, environment,...

Additional results

	Dep.: peers' maths score				Dep.: peers' reading score			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SAS=1 × lowSES=1	-0.004	-0.017	0.007	0.016	-0.011	0.005	0.015	0.024
	(0.026)	(0.024)	(0.022)	(0.019)	(0.021)	(0.024)	(0.025)	(0.022)
SAS=1 × lowSES=1 × public enrol.		-0.030		-0.046		-0.029		-0.000
		(0.111)		(0.117)		(0.120)		(0.137)
SAS=1 × lowSES=1 × voucher enrol.		0.028		0.041		-0.007		0.031
		(0.112)		(0.114)		(0.115)		(0.121)
SAS=1 × lowSES=1 × HHI			-0.008	0.061*			0.004	0.030
			(0.029)	(0.036)			(0.024)	(0.044)
Mean SES-gap in outcome	-0.616	-0.616	-0.616	-0.616	-0.496	-0.496	-0.496	-0.496
SD of SES-gap in outcome	1.21	1.21	1.21	1.21	1.24	1.24	1.24	1.24
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	917857	917857	917857	917857	917971	917971	917971	917971
Number of clusters	301	301	301	301	301	301	301	301

Note: The reported coefficients correspond to OLS estimates of the Triple Difference-in-Differences model's main effect (row 1) and its interactions with schooling market characteristics at the municipality level (rows 2-4). These interactions are standardized s.t. mean = 0 and standard deviation = 1. The outcome variables in columns 1-4 and 5-8 are the grade-level average test scores of student i's peers in mathematics and reading respectively. Summary statistics on the gap between low and high SES students in the outcome variables are reported in the bottom panel. Standard errors are clustered at the municipality level and reported in parentheses. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A4: Effect of SAS on peer quality

Details of robustness checks

Alternative treatment: vacancies in the SAS

This section briefly explains how vacancies are generated in the SAS.

1. Before students submit their preferences, schools declare:

- maximum capacity, which cannot be modified through the following academic year.
- Estimate of number of students who will repeat each grade (between 0 and median number of last three years)

2. SAS computes vacancies:

$$vacancies = capacity^{max} - enrollment^{grade-1} - retained^{net}.$$

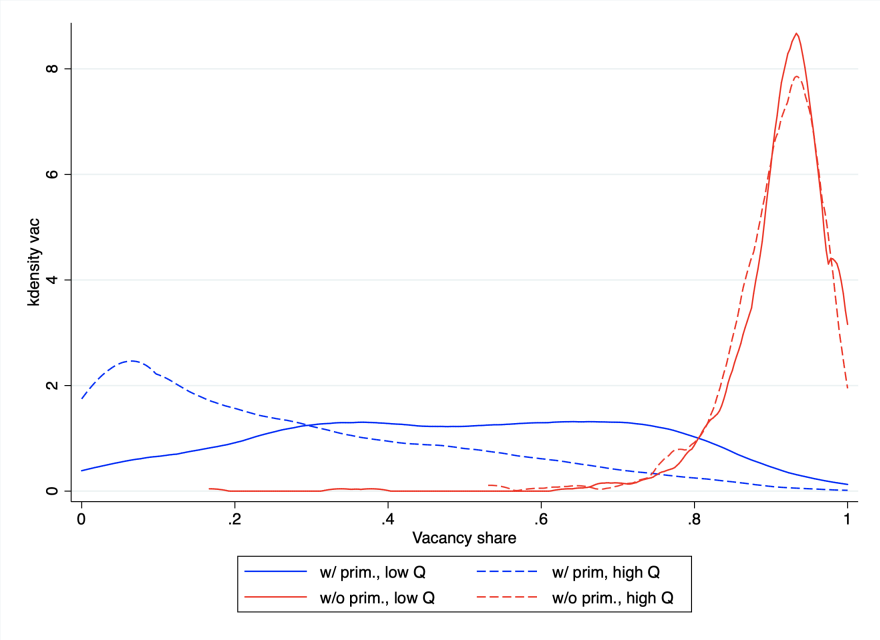


Figure A3: Distribution of vacancies by: *i)* secondary schools with/without primary education and *ii)* quality

	Dependent: school quality			
	(1)	(2)	(3)	(4)
lowSES=1 × SAS (cont.)	0.008*	0.011**	0.002	0.007*
	(0.005)	(0.005)	(0.004)	(0.004)
lowSES=1 × SAS (cont.) × public enrol.		-0.079***		-0.065**
		(0.029)		(0.029)
lowSES=1 × SAS (cont.) × voucher enrol.		-0.073***		-0.066**
		(0.028)		(0.027)
lowSES=1 × SAS (cont.) × HHI			-0.011***	-0.011*
			(0.004)	(0.006)
Mean SES-gap in outcome	-0.168	-0.168	-0.168	-0.168
SD of SES-gap in outcome	0.39	0.39	0.39	0.39
Municipality FEs	Yes	Yes	Yes	Yes
Sample size	965321	965321	965321	965321
Number of clusters	301	301	301	301

Note: The reported coefficients correspond to OLS estimates of the Triple Difference-in-Differences model's main effect (row 1) and its interactions with schooling market characteristics at the municipality level (rows 2-4). These interactions are standardized s.t. mean = 0 and standard deviation = 1. The outcome variable in all columns is the quality (value added) of the school attended by student i in year t. The school quality is fixed at the 2016 academic year and standardized s.t. mean = 0 and standard deviation = 1. Summary statistics on the gap between low and high SES students in the outcome variables are reported in the bottom panel. Standard errors are clustered at the municipality level and reported in parentheses. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A5: Alternative treatment: effects on school quality gap

Municipality-level trends

	School quality (VA)			
	(1)	(2)	(3)	(4)
SAE=1 × priority=1	0.004	0.004	-0.001	0.000
	(0.003)	(0.004)	(0.003)	(0.003)
SAE=1 × priority=1 × public enrol.		-0.039**		-0.031*
		(0.016)		(0.018)
SAE=1 × priority=1 × voucher enrol.		-0.039**		-0.035**
		(0.016)		(0.017)
SAE=1 × priority=1 × HHI			-0.006**	-0.008
			(0.003)	(0.005)
Mean of outcome	-0.168	-0.168	-0.168	-0.168
Standard deviation of outcome	0.39	0.39	0.39	0.39
Municipality FEs	Yes	Yes	Yes	Yes
Sample size	965321	965321	965321	965321
Number of clusters	301	301	301	301

Standard errors in parentheses

Notes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the outcome variable in all columns is the quality (value added) of the school attended by student i in year t. The school quality is fixed at the 2016 academic year and standardized s.t. mean = 0 and standard deviation = 1. The reported coefficients correspond to OLS estimates of the Triple Difference-in-Differences model's main effect (row 1) and its interactions with schooling market characteristics at the municipality level (rows 2-4). These interactions are standardized s.t. mean = 0 and standard deviation = 1. The regression additionally includes linear municipality-level trends. Summary statistics on the gap between low and high SES students in the outcome variables are reported in the bottom panel. Standard errors are clustered at the municipality level and reported in parentheses. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A6: Municiaplity level trends: effects on school quality gap

Official school quality measure

	Dependent: school quality (categorical)			
	(1)	(2)	(3)	(4)
SAS=1 × lowSES=1	0.018*	0.007	-0.004	0.001
	(0.010)	(0.011)	(0.011)	(0.010)
SAS=1 × lowSES=1 × public enrol.		-0.074*		-0.058
		(0.043)		(0.046)
SAS=1 × lowSES=1 × voucher enrol.		-0.054		-0.047
		(0.043)		(0.042)
SAS=1 × lowSES=1 × HHI			-0.026**	-0.014
			(0.011)	(0.017)
Mean gap in outcome	-0.408	-0.408	-0.408	-0.408
SD of gap in outcome	1.14	1.14	1.14	1.14
Municipality FEs	Yes	Yes	Yes	Yes
Sample size	965321	965321	965321	965321
Number of clusters	301	301	301	301

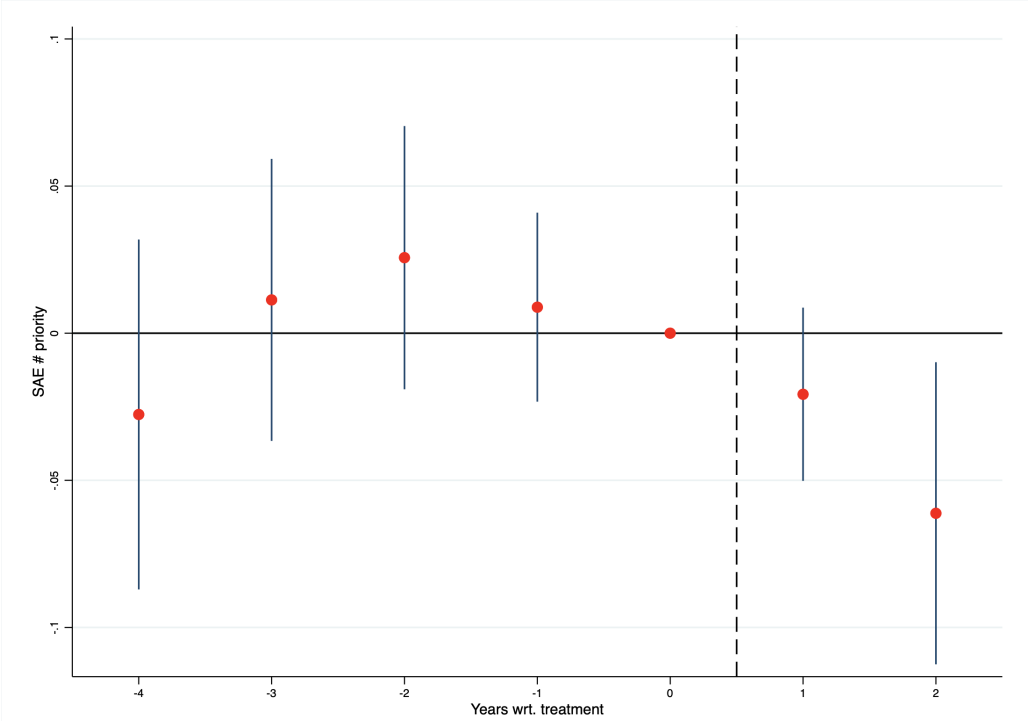
Note: the outcome variable in all columns is the quality (official) of the school attended by student i in year t, measured as categorical variable in four levels. The school quality is fixed at the 2016 academic year. The reported coefficients correspond to OLS estimates of the Triple Difference-in-Differences model's main effect (row 1) and its interactions with schooling market characteristics at the municipality level (rows 2-4). These interactions are standardized s.t. mean = 0 and standard deviation = 1. Summary statistics on the gap between low and high SES students in the outcome variables are reported in the bottom panel. Standard errors are clustered at the municipality level and reported in parentheses. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A7: Official quality measure: effects on school quality gap

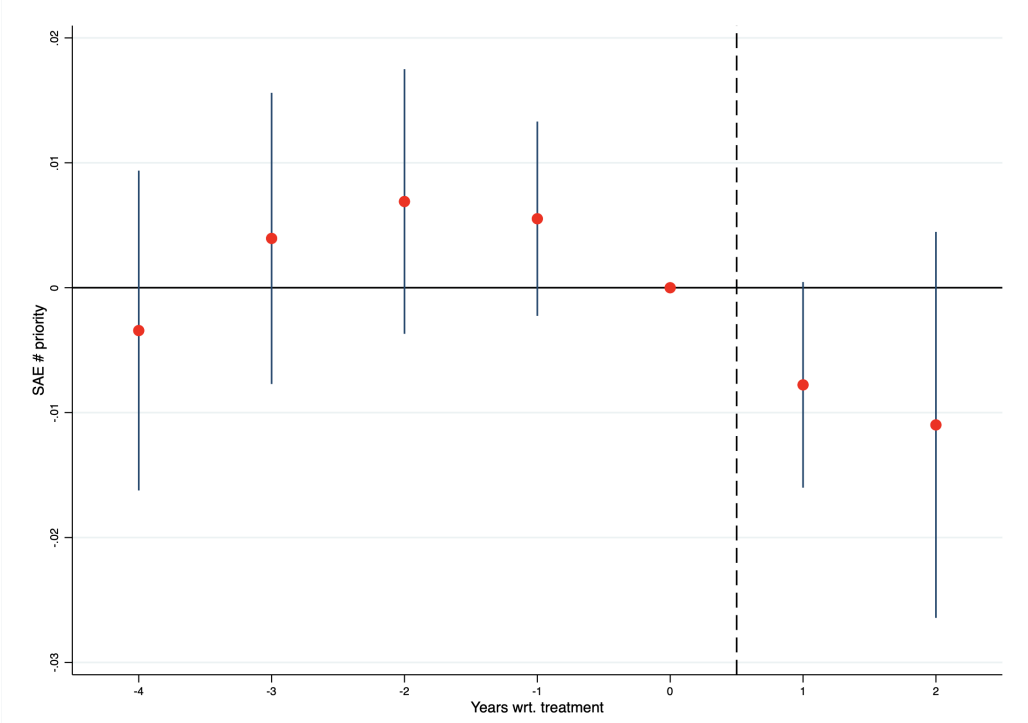
	Dependent: tution fee (0/1)			
	(1)	(2)	(3)	(4)
SAS=1	0.030	0.018	0.011	0.020
	(0.020)	(0.017)	(0.017)	(0.016)
SAS=1 × public enrol.		0.015		0.006
		(0.057)		(0.059)
SAS=1 × voucher enrol.		-0.003		-0.007
		(0.061)		(0.060)
SAS=1 × HHI			-0.004	0.006
			(0.022)	(0.028)
Mean outcome	0.379	0.379	0.379	0.379
SD in outcome	0.49	0.49	0.49	0.49
Municipality FEs	Yes	Yes	Yes	Yes
Sample size	11380	11380	11380	11380
Number of clusters	301	301	301	301

Note: the outcome variable in all columns is a dummy indicating whether a school charges tuition fees in a given year. The regressions are estimated at the school-year level. The reported coefficients correspond to OLS estimates of the Difference-in-Differences model's main effect (row 1) and its interactions with schooling market characteristics at the municipality level (rows 2-4). These interactions are standardized s.t. mean = 0 and standard deviation = 1. Summary statistics of outcome variable are reported in the bottom panel. Standard errors are clustered at the municipality level and reported in parentheses. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A8: Official quality measure: effects on school quality gap



(a) GPA



(b) Grade promotion

Figure A2: Effect of SAS on academic achievement in 2^{nd} grade of secondary school