Bringing the schools back in: the stratification of educational achievement in the Chilean voucher system☆

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ABSTRACT

This paper analyzes the socioeconomic stratification of achievement in the Chilean voucher system using a census of 4th and 8th graders, a multilevel methodology, and accounting for unobserved selectivity into school sector. Findings indicate that the association between the school's aggregate family socioeconomic status (SES) and test scores is much greater in the private-voucher sector than in the public one, resulting in marked socioeconomic stratification of test scores in the Chilean voucher system. We also find that the amount of tuition fees paid by parents in private-voucher schools has no bearing on test scores, after controlling for the socioeconomic makeup of the school. Implications of these findings for educational inequality in the context of a universal voucher system are discussed.

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1. Introduction

Among the diverse policies to improve the quality of schooling, educational vouchers are one of the most debated. Proponents highlight that, by expanding educational choice and stimulating competition among schools, vouchers will provide alternatives to low-resource families trapped in underperforming public schools and will improve learning (Coons and Sugarman, 1978; Neal, 2002; Nechyba, 2000; Chubb and Moe, 1990; Hoxby, 2003). Critics worry that voucher schools will skim off students with higher perform- ance and more socioeconomic resources, furthering segregation without improving overall educational outcomes (Ladd, 2002; Fiske and Ladd, 2000; Levin, 1998; Henig, 1994). Empirical evaluation of experimental voucher programs in the US is not conclusive. Evaluation of programs such as the Milwaukee Parental Choice Program (Rouse, 1998; Greene et al., 1998) and the New York City school voucher experiment (Howell and Peterson, 2002; Krueger and Zhu, 2004) report a range of estimated effects from no improvement to small gains, with effects sensitive to sample decisions, and varying across students' gender and race.

Evaluation of these small-scale, short-term voucher experiments leaves unanswered, however, the important question about the general equilibrium outcomes of a universal voucher system (McEwan, 2004; McEwan et al., 2008; Hsieh and Urquiola, 2006). Chile provides a unique case to explore this question. In 1981, in the context of a market transformation of the Chilean economy, a universal voucher mechanism was implemented. In the new system, the government grants a per-student subsidy to all public and private schools provided that they do not charge tuition; and all families are allowed to use their voucher in the school of their choice (Cox and Lemaitre, 1999; Mizala and Romaguera, 2000). The reform led to a massive reallocation of students from the public to the newly established private-voucher sector. Public sector enrollment dropped from 78% in 1981 to 53% of the total enrollment in 2002 and 50% in 2004.

Several studies have examined the educational outcomes of the Chilean voucher system. Lacking experimental evidence, researchers have used observational data, concentrating on two questions: (1) Do voucher schools yield higher educational achievement than public ones, net of the characteristics of their student bodies? and (2) has the competition in local educational markets promoted by voucher schools improved educational outcomes? Virtually all studies of the Chilean voucher system focus on the differences across school sector – public vis-a-vis private-voucher – implicitly assuming that the variance in achievement *between sectors* is more relevant than the variance *across schools within* sector, thereby inadvertently neglecting the school as a unit of analysis. The reason is understandable as, as we will document, there are significant differences in educational achievement across sectors. However, if substantial variation in

achievement between schools exists, students' outcomes may be more closely related to the characteristics of the *school* they attend than to whether the school is private-voucher or public. No study to date examines differences in attainment between and within schools across educational sector in the Chilean voucher system, and their determinants.

This paper attempts to fill this gap. Using a multilevel formulation, and controlling for unobserved selectivity in the allocation of students into school sectors, we examine the socioeconomic distribution of achievement within and between schools in the public and private-voucher schools. We find that the Chilean voucher system has given rise to a particular form of stratification. Contrary to a simplified vision of sorting, in which voucher schools homogeneously skim-off the "best" public school students, we find that, as *a sector*, voucher schools serve a broad cross-section of the population, but *each individual voucher school* is characterized by high homogeneity in the socioeconomic status (SES) of its student body. This configuration, we suggest, is contingent on the institutional design of the Chilean voucher system. Until recently, the Chilean voucher was flat, i.e. it did not vary with family socioeconomic resources; and voucher schools were allowed to select students at will. This configuration, we argue, provides the incentives and the means for private-voucher schools to specialize in different market niches. We then address the question about socioeconomic distribution of achievement between and within schools in the private-voucher and public sectors. We find that the association between individual SES and test scores is slightly stronger in the private-voucher than in the public sector—signaling a slightly more unequal distribution of achievement in the former sector. In contrast, the association between *the school's aggregate family SES of the student body* and achievement is *more than twice as strong* in the private-voucher sector, resulting in pronounced socioeconomic stratification. In other words, the educational achievement of a child attending the private-voucher sector depends considerably more on the aggregate SES of her school than on her own family's SES.

A final piece of this analysis examines the influence of a financing reform introduced in the Chilean voucher system in 1993. This reform allowed private-voucher primary and high schools (and public high schools) to charge add-on fees to parents to complement the government voucher. While supporters of the parental tuition fees argue that they contribute needed funds to education, critics warn that they may exacerbate educational stratification. If private-voucher schools use add-on fees to select economically advantaged families, and use tuition resources to offer education of better quality, add-on fees may explain the strong association between aggregate family SES at the school level and achievement in the private-voucher sector. We analyze the influence of tuition funds levied on parents on educational outcomes in private-voucher schools. We find virtually no association between parental add-on fees and test scores after the school-level SES is accounted for. In other words, the economic resources contributed by families to voucher schools reflect the ability to pay of the student body, but they do not appear to translate into higher achievement.

Our paper proceeds as follows. The next section describes the Chilean voucher system, evaluates extant research on the Chilean case, and introduces the question about the socioeconomic stratification of achievement within and between schools. Section three introduces the data, variables, and methods. Section four presents the multilevel analysis of the social distribution of achievement between and within schools in the public and private-voucher sectors and of the role of add-on tuition in the private-voucher system. The final section concludes and discusses implications of the findings.

2. Stratification and achievement in the Chilean voucher system

Beginning in the early 1980s, far-reaching reforms were implemented in the Chilean educational system by an authoritarian regime that came to power in 1973. The reforms involved the decentralization of the public school system and the handing over of school administration to local governments (municipalities). The most important component of the reform was a new financing mechanism for public and private schools through a nationwide per-student subsidy, which allowed families to select the school, private or public, of their choice.

Before the reform, three types of schools existed in Chile: public schools (accounting for 80% of the enrollment), private subsidized (14%) and private fee-paying schools (6%). Both public and private-subsidized schools were free and funded by the government. The latter type of school received a lump-sum subsidy, substantially smaller than the per-student spending in the public sector. Most of them were Catholic and operated as a form of charity (Aedo, 2000). Fee-paying private schools charged high tuition fees and served the Chilean elite. The 1981 reform sparked the emergence of a new sector, which we will call "private-voucher" to distinguish it from the private-subsidized institutions that existed before. In the new system, a per-pupil subsidy is paid by the government to all schools – public or private – participating in the voucher system. In contrast to US experiences, in which the subsidy is given directly to the family, in the Chilean design funds are allocated directly to the school selected by the family based on the number of students enrolled, a system known as "funds follow the student" (Mizala and Romaguera, 2000). It is important to note that a given private-voucher school receives the same per-pupil voucher payment as a municipal school of similar characteristics. Public schools can receive subsidies from municipalities, with the amount transferred varying according to the financial capacity of the municipality.

As a result of the voucher reform, a substantial migration from the public sector to this new type of school ensued. By 2002 private-voucher schools reached 38% of the enrollment, at the expense of the public sector, which dropped to 53%, by 2004 private-voucher enrollment had reached 41%. Students who migrated to the private-voucher sector were, on average, of higher socioeconomic status than those who remained in the public sector, suggesting that sorting followed the voucher reform (Torche, 2005; Hsieh and Urquiola, 2006).

Private-paid schools were conspicuously unaffected by this transformation. Their fees were, on average, five times the per-student voucher. As a result these schools did not enter the competitive educational market created by the reform. They remained serving a small group of high-income families and do not constitute a reachable alternative for the large majority of Chileans. For this reason, we do not include this type of school in our analysis, concentrating instead on the public and private-voucher sectors that serve more than 90% of the Chilean population.[1]

Public schools are everywhere in the country; however, the distribution of private-voucher schools is uneven throughout the country. In 10% of municipalities, private-voucher enrollment stands at more than 50% but nearly 63 out of 345 municipalities, mostly rural and poor, have no private-voucher schools at all. Voucher schools are allowed to operate as for-profit institutions, and about 70% of them do so. In terms of religious differentiation, 35% of them are religious, mostly Catholic, institutions (Elacqua, 2006).

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[1] As a robustness check we reproduce all analyses including students in private non-voucher schools. The results for private-voucher and public schools are nearly identical to those presented here.

Since 1990, after the reestablishment of democracy, the Chilean government has devoted substantial resources to improving the quality and equity of educational outcomes, and has implemented targeted programs focused on the poorest, lowest-performing schools (Garcia-Huidobro, 2000). The main principles of the voucher system – ability to choose and competition between schools – have, however, remained intact for the last quarter-century.

2.1. Institutional arrangements and educational stratification in the Chilean voucher system

The notion of "a" voucher system is misguided insofar as institutional arrangements shape the outcomes of the specific system in place (West, 1997; Patrinos, 2002; Gauri and Vawda, 2003). Four institutional features are relevant in the Chilean case: the amount of the per-student voucher, rules about admission and expulsion of students, teachers' regulations, and alternative sources of school financing.

Since its inception, the Chilean voucher has provided a flat per-student subsidy without adjustments for students' socioeconomic resources (González et al., 2004). Secondly, private-voucher schools can establish their own admission and expulsion policies, whereas public schools have to accept all applicants unless they are oversubscribed and constitute, effectively, suppliers of last resort. Evidence shows that private-voucher schools intensively use selection mechanisms such as entry exams and parental interviews to shape their student bodies (Gauri, 1998). A survey of 4th grade parents found that 44% of voucher schools give admission exams, and 36% request parental interviews, indicating that many, but not all voucher schools select their students (SIMCE, 2006).

Thirdly, there are differences across school sector in terms of teachers' contracts and regulations. Public school teachers are governed by special legislation (the Teacher Statute), involving centralized collective-bargaining, with wages based on uniform pay-scales independent of merit, making it nearly impossible to dismiss under-performing educators. Private-voucher schools, in contrast, operate as private firms with flexible criteria for personnel recruitment, dismissal and promotion.

Finally, public and private-voucher schools differ in the ability to raise additional funds. A 1993 reform allowed primary and secondary private-voucher schools (but only secondary public schools) to charge "add-on" fees to parents to supplement the government voucher, under a withdrawal schedule that reduces the subsidy as parental fees increase. This system – known as "shared financing" (*financiamiento compartido* in Spanish) – expanded rapidly from 16% of the voucher sector enrollment in 1993 to about 80% in 1998, stabilizing thereafter.[2] Private-voucher schools differ in the amount of fees they charge. In 2002, 20% of them were free, 44% charged less than nine dollars per month, 29% charged between 9 and 17 dollars, and the remaining 27% charged between 17 and 68 dollars (the government subsidy is fully withdrawn at 68 dollars). Furthermore, the supply of fee-charging voucher schools varies across the country. Based on the Ministry of Education's school directory, 2% of municipalities have only fee-paying voucher schools, 57% have both free and fee-paying, and 41% have only free voucher schools. Supporters of the "shared financing" system claim that it brings badly needed resources to education, allows targeting public resources to the poorest schools, and promotes parental involvement (Vial, 1998); critics worry that it furthers socioeconomic sorting in an already unequal system (Valenzuela et al., 2008).

These institutional features of the Chilean voucher system likely promote socioeconomic stratification. The literature indicates that low-SES students have, on average, lower educational performance and are usually more demanding in terms of resources (Ducombe and Yinger, 2000; Reschovsky and Imazeki, 2001). As a result, a flat voucher provides strong incentives for private-voucher schools to select socioeconomically advantaged students to lower their costs, while regulations about student selection allow them to do so. Furthermore, rigid regulations in the public sector prevent dismissing low-performing educators and school principals, providing incentives for high-resource, motivated families to search for alternatives in the voucher sector. The "shared financing" system may contribute to stratification by providing an additional avenue for voucher schools to select students based on their socioeconomic resources and preventing access of low-income students to private-voucher schools that charge fees. Even though by law schools that charge fees must provide scholarships for low-income students, the law requires only between 5% and 10% of the amount of the fees charged to be devoted to such scholarships (Anand et al., 2009).

In 2008, a law was passed that implemented two important changes to the Chilean voucher system. The law established an extra per-student subsidy for economically disadvantaged students (as determined by the Ministry of Education), and for schools with a high concentration of disadvantaged students. This change emerges from the recognition that it is more expensive to educate low-resource students and it effectively implies transforming the flat voucher system into a means-tested one. In addition, the law prohibited the use of parental interviews and admission tests to select students among participating schools. Although it is too early to examine the consequences of these recently implemented changes, we discuss their potential effect for the stratification of educational achievement in light of our findings.

2.2. Extant research on the Chilean voucher system

Evaluations of the Chilean voucher system have focused on two issues: the relative effectiveness of private-voucher vis-à-vis public schools, and the effect of school competition on student academic outcomes. Lacking randomized designs, researchers have addressed the first question by comparing the achievement of students who attend public and private schools with controls for their observed and (more tentatively) unobserved characteristics. Given that achievement data was available at the school but not the individual level until 1997, early studies of relative effectiveness across school sector used aggregate school averages. McEwan and Carnoy (2000) concluded that voucher schools did not perform better than public schools given similar resources. Mizala and Romaguera (2000) found that when sufficient control variables are added, there are no consistent differences in achievement between the public and private-voucher sectors. Moreover, Tokman (2002) found that public schools have advantages in educating students from disadvantaged family backgrounds.

Availability of individual-level data since 1997 induced a new generation of studies which include controls for students' resources and attempt to account for selection into different school sectors. Most studies using individual-level data found that students attending voucher schools have slightly higher educational outcomes (about 0.15–0.2 standard deviations in test scores) than those from public schools, net of individual attributes (Mizala and Romaguera, 2001; Sapelli and Vial, 2002, 2005; Anand et al., 2009). More recently, Lara et al. (2009), using new data on Chilean students and a novel identification strategy, found that private-voucher education leads to small (4–6% of one standard deviation in test scores), sometimes not statistically significant differences in academic performance.

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[2] Even though public high schools are allowed to charge parental fees, very few do and the amounts are very small.

The second line of research has attempted to identify the effect of competition between schools on students' achievement. McEwan and Carnoy (2000) and Hsieh and Urquiola (2006) found that private-voucher schools skim-off more advantaged families while relegating disadvantaged ones to the public sector, and that the net aggregate effect of competition on student performance is negligible. On the other hand, Gallego (2002, 2006) and Auguste and Valenzuela (2003) found that greater competition significantly raises test scores, although the endogenous entry of voucher schools into local markets is a lingering concern.

In sum, the most recent estimated effects of private-voucher education on academic achievement are much lower than those obtained by the previous literature on Chile. The influence of competition on students' achievement remains very much an open question.

2.3. Socioeconomic stratification across school sector in Chile

With this background information, we now provide introductory information about differences in economic status and educational achievement across school sector. Table 1 presents the distribution of school sector by household SES decile for Chilean 4th graders. SES combines standardized measures of mother's years of schooling, father's years of schooling and total family income to provide a comprehensive description of family resources. Table 1 shows the profound socioeconomic stratification in the Chilean educational system. Private fee-paying schools serve the upper class, with 94% of enrollment coming from the two wealthiest deciles. Public schools mostly serve the lower and the lower-middle class, with two-thirds of their students coming from the bottom half of the SES distribution. Private-voucher schools recruit broadly from the middle and upper-middle strata. There is, however, substantial socioeconomic overlap between the public and private-voucher sectors—both sectors recruit about two-thirds of their students from the middle six SES deciles.

The second panel in Table 1 compares educational achievement across sector. The metric is math and language test scores in a national standardized test (Sistema de Medicion de la Calidad de la Educacion SIMCE, in Spanish) administered by the Ministry of Education to 4th graders in 2002. The test scores are standardized to have a mean of 250 and a standard deviation of 50. As expected given the different socioeconomic makeup of their student bodies,

achievement substantially varies across school sector. Scores are lowest in the public sector – the average of 235 is almost a half standard deviation lower than in the private-voucher sector (254) – while private fee-paying schools serving a small number of elite families average scores of 298 places them at a far distance from both public and private-voucher institutions.

A less-explored dimension of socioeconomic stratification is that which occurs *across schools within each sector*. As a preliminary examination of the role of schools as units of stratification in the Chilean voucher system, we partition the total variance in family SES into its between-school and within-school components. When we consider the total population of 4th graders, the proportion of SES variation that occurs *between* schools is extremely large in Chile, reaching 62%. This indicates that the school is a pivotal unit of stratification. However, when we examine the variance within and between schools across *school sectors*, substantial differences emerge. First, the amount of variance between schools substantially drops—an expected finding insofar as sector organizes socioeconomic inequality in the Chilean educational system. In addition, substantial differences across sectors emerge. The SES variance that is between-schools is only 24% in the public sector but it reaches 47% in the private-voucher one. In other words, while the voucher *sector* serves a diverse population, voucher *schools* are socioeconomically homogeneous—some of them appear to concentrate better-off families, while others focus on poor communities. This descriptive evidence qualifies the claim that private-voucher schools uniformly skim off more advantaged students, and suggests a more complex configuration in which private-voucher schools specialize in distinct niches of the market in order to accomplish their diverse economic and educational objectives.

This evidence introduces a central question of our study: what is the association between individual-level and school-level socioeconomic resources and students' achievement across school sector? While much research explores the association between individual-level SES and achievement, the aggregate level of SES resources in the school may strongly shape test scores, contributing to the socioeconomic stratification of achievement. The association between school-level SES and achievement is described as a *contextual* or *compositional* effect, to highlight the fact that it emerges from the socioeconomic makeup of the school body, net of the influence of individual socioeconomic resources.

An important US-based literature has explored contextual effects of SES on educational achievement and its variation across school sectors. This literature is mostly concerned with the difference between Catholic and secular public schools. Early work by Coleman found that Catholic schools have a higher mean and a more equitable distribution of achievement within schools (Coleman et al., 1982; Coleman and Hoffer, 1987). Subsequent analyzes support this result, which suggests that the "Catholic advantage" is accounted for by aspects of the normative environment and academic organization such as a better disciplinary climate and less differentiation in course taking (Lee and Bryk, 1989; Lee et al., 1998). Other studies qualify this finding, indicating that differences across sectors are negligible (Alexander and Pallas, 1985; Willms, 1985).

The literature comparing Catholic and public schools in the US has also found that the association between aggregate school-level SES and achievement is relatively similar in Catholic and public schools (Raudenbush and Bryk, 1986: 12; Lee and Bryk, 1989: 183). We hypothesize that, in contrast to the US case, the *association between school-level SES and test scores may be stronger in the private-voucher than in the public sector in Chile, resulting in an overall stronger stratification of achievement in the former sector*. We base this hypothesis on the institutional characteristics of the Chilean voucher system. The "shared financing" system allows

Table 1
Enrollment in school sector by family SES decile (percent distribution) and test scores across school sector. 4th graders, Chile 2002.[a]

Household SES decile	Public	Private-voucher	Private fee-paying
1	14.5	5.7	0.0
2	14.7	5.4	0.0
3	13.1	7.5	0.1
4	12.8	7.9	0.2
5	11.3	9.9	0.4
6	10.9	10.5	0.5
7	8.4	13.7	0.9
8	7.0	15.1	3.9
9	5.3	15.8	13.1
10	1.9	8.5	80.8
Total	100.0	100.0	100.0

Mean test scores	Public	Private-voucher	Private fee-paying	All schools
Math	235	254	298	247
Language	239	259	300	251

Source: Authors' calculations, based on the SIMCE standardized test and SIMCE parental questionnaire, 4th grade students, 2002.

[a] Family SES obtained from a factor analysis of mother's years of schooling, father's years of schooling and total family income.

private-voucher schools to extract resources from families, potentially inducing a strong association between mean family SES and students' outcomes. The more flexible regulations in the private-voucher sector may enhance these schools' capacity to translate the economic advantage of the families they serve into achievement. For example, private-voucher schools serving wealthier families may be able to attract better teachers than schools serving more deprived populations, successfully capitalizing on the resources of their student body. Importantly, the ability and incentives of private-voucher schools to select their student body may also result in a strong contextual effect of SES. If private-voucher schools recruit students based on attributes correlated with SES such as ability, cultural capital, or motivation, their selection of students may result in a stronger contextual effect of SES, driven by these attributes.

In general, we expect a closer association between the socioeconomic composition of the students' body and achievement in the private-voucher sector than in the public one insofar as institutional regulations leave ample room for sorting and impose less redistributive constraints on private-voucher schools. In what follows we examine whether schools are important units of stratification in the Chilean voucher system. We test the hypothesis that the contextual effect of SES is more pronounced in the private-voucher sector, and examine whether this is accounted for by the amount of parental add-on funds charged and other school-level characteristics.

3. Data and methods

The analysis is based on merged data from three sources. The first one is the SIMCE (*Sistema Nacional de Medición de la Calidad de la Educación*—Educational Quality Measurement System), standardized tests in math and language. We utilize the 4th grade (2002) and 8th grade (2004) SIMCE dataset to evaluate our hypotheses in different grades, years and subject matters. The dataset is compiled by the Chilean Ministry of Education and it includes the entire population of public and private-voucher schools and their students (5204 schools and 196,212 students in 2002; 4888 schools and 173,907 students in 2004). The second data source is a survey of parents of the students who took the SIMCE tests. This questionnaire provides information about the socioeconomic characteristics of students, including family income and parents' education. The third source of data is administrative records from the Ministry of Education, which we used to produce several school-level characteristics, including school sector, school enrollment, teachers' years of experience, the religious affiliation of schools, and the amount of add-on tuition charged by private-voucher schools, which were merged to the SIMCE datasets.

The dependent variables are the math and language SIMCE standardized test scores. The independent variables include characteristics of students and schools. The central predictor at the student level is family socioeconomic status (SES), obtained from a factor analysis of mother's education, father's education and family income, and standardized to have a mean of zero and a standard deviation of unity. In addition, we control for students' gender (female = 1), number of books at home – a proxy for cultural capital and the value of scholarly culture – parental expectations (a dummy coded 1 if parents expect that the child will attain post-secondary education). The SIMCE tests do not track students over time, so it is not possible to assess school effects on achievement gains. In order to control for children's prior achievement, indicator variables for whether the students attended preschool (preschool = 1), and whether they have repeated a grade (repeat = 1) are also included.

The central predictors at the school level are school sector – public and private-voucher schools – and school-level socioeco-nomic resources. School-level SES is obtained by averaging individual-level SES within school. Given that the SIMCE is a census rather than a sample of schools, this variable provides a very precise measure.[3] We add school-level controls based on the educational production function literature (Hanushek, 1996, 1997). They include urban/rural location of the school, teachers' years of experience, student-teacher ratio, school size (natural log of the number of students enrolled in the school), the standard deviation of family SES within school as a measure of diversity in the socioeconomic resources of the student body, and a dummy for religious private-voucher schools. Unfortunately, no variables capturing schools' normative environment or organizational practices exist to date in the data. Tables A1 and A2 present descriptive statistics at the individual and the school levels across school sectors.

3.1. Methods

The analysis is based on a two-level hierarchical linear model (HLM). The first-level units are students (within-school model), and each student's outcome is represented as a function of a set of individual characteristics. In the second level (school-level model) the regression coefficients in the level-1 model are treated as outcome variables hypothesized to depend on specific school characteristics. The HLM methodology explicitly recognizes the clustering of students within schools and allows simultaneous consideration of the association between school factors and average school achievement; the relationships between individual characteristics and outcomes, and the variation across schools in the relationships between individual characteristics and outcomes (Seitzer, 1995; Raudenbush and Bryk, 1992; Rumberger and Palardy, 2004).

But the allocation of students to school sector is not random and depends on unobserved attributes, such as motivation, ability, and ambition, which are correlated with educational outcomes. We control for unobserved selectivity into school sector by estimating a two-step model (Heckman, 1979). The first step is a choice model in which the dependent variable is the type of school attended by the student. The model considers that each student has two choices—to attend a private-voucher school or a public school. In order to be correctly identified, the choice model must contain at least one variable that is uncorrelated with the error term of the achievement model (e.g. Goldhaber and Eide, 2003). In order to satisfy the exclusion restriction, we use the supply of schools of different sectors in the municipality where the family lives, i.e. the number of public and private-voucher schools per squared-kilometer in the students' municipality (for a similar strategy see McEwan, 2001). As it is conventional, the inverse mills-ratio obtained from the choice model is added to the achievement equations to correct for potential selectivity.

3.2. Analytical steps

The analysis is organized in four steps. The first step in any HLM is the decomposition of the variance in the outcome of interest into its between- and within-group parts. This step estimates a fully unconditional ANOVA model, and allows us to compute the proportion of the total variance in math and language test scores that is between schools across school sector. The second step is the within-school model. It estimates how student characteristics affect test scores within schools. We evaluate the influence of family SES, gender, books at home, parental expectations,

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[3] This is a major advantage over alternative databases such as TIMSS and PISA, whose smaller sample sizes of students and, particularly, schools result in limited power to test school-level effects.

Table 2
ANOVA model. Percent of total variance in SIMCE test scores between schools. 4th grade 2002 and 8th grade in 2004, Chile.

	Variance between schools	Variance within schools	Percent of variance between schools
Panel 1. 4th grade 2002			
Language			
All	585.408	2129.779	21.6%
Public sector	376.140	2238.975	14.4%
Voucher sector	733.957	2000.184	26.8%
Math			
All	589.920	2166.449	21.4%
Public sector	396.252	2289.767	14.8%
Voucher sector	734.859	2009.744	26.8%
Panel 2. 8th grade 2004			
Language			
All	489.446	2039.670	19.4%
Public sector	280.422	2064.224	12.0%
Voucher sector	639.593	1999.005	24.2%
Math			
All	514.039	1736.995	22.8%
Public sector	302.043	1725.755	14.9%
Voucher sector	691.376	1756.926	28.2%

preschool attendance, repetition history, and the selectivity terms on test scores. The third step presents the between-school model, which adds school-level characteristics to the previous specification. This step allows us to address three questions: what is the relationship between individual-level and school-level SES and educational achievement? Do the individual and the contextual effect of SES vary across school sector? And, is the contextual effect of SES accounted for by school-level characteristics and resources? The final step of our analysis evaluates the association between parental add-on tuition fees and students' test scores in the private-voucher sector. It examines whether, net of individual and contextual effect of SES on achievement, parental fees contribute to higher educational achievement.

4. Results

4.1. Partitioning the variance in math and language test scores

Calculations indicate that about 20% of the variance in students' test scores is between-schools, a proportion virtually identical across test subjects and grades. Central to our question, the proportion of test score variance that is between-schools differs substantially across school sector. It reaches approximately 27% in the private-voucher sector, but only 14% in the public sector, consistently across subject matter and grade. Put another way, it is much more common that the worst student at a "good" school will score lower than the best student at a "bad" school in the public sector than in the private-voucher one. This renders the school a crucial unit of stratification of achievement in the private-voucher sector (Table 2).

4.2. Within school model

Tables 3A and 4A display models predicting language and math test scores for 4th graders and 8th graders, respectively. Model 1 presents the coefficients for the individual-level model capturing the association between students' SES and test scores. This and the following models account for non-random selection of students into school sector by adding the inverse-mills ratio (IMR) terms obtained from the choice equation, (reported in Tables A3 and A4 for 4th and 8th grade, respectively). All independent variables are centered at their grand means, except for indicator variables that use the natural metric. As Table 1 suggests, students who attend private-voucher schools differ from those who attend the public sector in terms of socioeconomic status. Given that our research

questions focus on comparing schools across sector, we need to control for all independent variables across the entire sample. Grand-mean centering accomplishes this objective (e.g. Raudenbush and Bryk, 1992). We performed chi-square tests of the variation in individual-level coefficients across school sector. We find significant variation across sector for family SES and parental expectations ($p < .001$) only, and allow for such variability by adding cross-level interaction terms.

Each student-level characteristic is significantly related to the outcome in the expected direction and results are strikingly similar across grades. Boys perform better in math and worse in language, signaling a "gender division of learning" similar to most countries in the world (e.g. Ma, 2008), which increases from 4th to 8th grade. Books at home and parental expectations display a positive correlation with achievement, with a larger influence of expectations found at public than at private-voucher schools in 4th grade, and no differences across school sector in 8th grade. Having repeated a grade has an expected substantial negative association with test scores. Note that with the exception of gender, the patterns of effects are nearly identical for math and language, indicating that the results are not an artifact of a particular subject matter.

4.3. School-effects model

We now consider the association between school-level and individual-level SES and test scores across sectors. The first school-level model (Model 2 in Tables 3A and 4A) evaluates the gross association between the mean school SES and achievement across sector, without controls for school-level characteristics. The second one (Model 3) adds school-level characteristics. We first note that adding indicators for school sector and mean SES at the school level in Model 2 results in a large decrease in the between-school variance in the test scores. As reported by Tables 3B and 4B the decline in unexplained variance in test scores is about 20% (as measured by the decline in β_0 between Models 1 and 2). When additional school characteristics are included in Model 3, only a slight additional reduction is obtained (of about 5%). In brief, school sector and socioeconomic composition of the student body accounts for a substantial portion of the test scores variance. Net of sector and socioeconomic status, school resources and demographic characteristics account for little additional variation in achievement.

Moving to the central question of our study, we examine the relationship between individual-level and school-level SES and

Table 3A
HLM model of achievement, language and math 4th grade, 2002. Fixed effects.

Variables	Language				Math			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
β_0 (adj. school mean test score)	238.846**	237.822**	219.681**	219.930**	237.627**	237.426**	215.347**	215.645**
	(0.605)	(1.069)	(3.316)	(3.313)	(0.611)	(1.070)	(3.571)	(3.571)
$\beta_0 \times PV$		5.185**	8.858**	7.539*		4.209**	9.050**	6.324
		(1.535)	(3.022)	(3.193)		(1.502)	(3.191)	(3.361)
School SES		5.081**	9.433**	9.511**		6.129**	7.287**	7.374**
		(0.962)	(1.110)	(1.112)		(0.985)	(1.173)	(1.174)
School SES × PV		15.866**	12.321**	11.661**		14.595**	13.367**	11.495**
		(1.222)	(1.283)	(1.504)		(1.270)	(1.370)	(1.633)
Standard dev. school SES			5.987*	6.017*			6.443*	6.478*
			(2.511)	(2.512)			(2.574)	(2.574)
SD school SES × PV			−2.527	−1.914			−3.152	−2.044
			(4.048)	(4.090)			(4.397)	(4.415)
Rural school			11.219**	11.244**			7.733**	7.746**
			(0.922)	(0.923)			(0.967)	(0.969)
Student–teacher ratio			−0.029*	−0.028*			−0.033**	−0.033**
			(0.014)	(0.014)			(0.012)	(0.012)
Teachers' years experience			0.310**	0.313**			0.326**	0.331**
			(0.050)	(0.050)			(0.054)	(0.054)
Ln enrollment			1.019**	0.967**			1.624**	1.555**
			(0.383)	(0.383)			(0.403)	(0.403)
Religious school × PV			6.046**	6.228**			4.752**	5.223**
			(0.900)	(0.922)			(0.989)	(1.011)
No fees (omitted category)								
Parental fees LT $9				0.683				2.089
				(1.109)				(1.189)
Parental fees $9–17				3.071*				4.277**
				(1.296)				(1.439)
Parental fees $17–68				0.171				2.869
				(1.574)				(1.720)
Student SES	10.039**	7.241**	7.078**	7.077**	9.364**	6.548**	6.464**	6.461**
	(0.206)	(0.419)	(0.419)	(0.419)	(0.213)	(0.419)	(0.420)	(0.420)
Student SES × PV		1.668**	1.799**	1.838**		2.017**	2.106**	2.161**
		(0.577)	(0.574)	(0.575)		(0.575)	(0.575)	(0.575)
Parental expectations	13.222**	13.770**	13.684**	13.684**	12.841**	13.890**	13.850**	13.849**
	(0.282)	(0.415)	(0.415)	(0.414)	(0.280)	(0.414)	(0.414)	(0.414)
Expectations × PV		−3.452**	−3.341**	−3.350**		−4.429**	−4.391**	−4.392**
		(0.628)	(0.627)	(0.627)		(0.622)	(0.621)	0.621
Female	6.770**	6.690**	6.636**	6.638**	−4.995**	−5.087**	−5.129**	−5.127**
	(0.243)	(0.242)	(0.242)	(0.242)	(0.244)	(0.243)	(0.243)	(0.243)
Number books at home	0.074**	0.067**	0.067**	0.067**	0.073**	0.066**	0.066**	0.066**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Repeated grade	−26.045**	−25.679**	−25.521**	−25.515**	−26.583**	−26.242**	−26.136**	−26.132**
	(0.448)	(0.450)	(0.451)	(0.451)	(0.440)	(0.441)	(0.442)	(0.442)
Preschool	1.507**	−0.023	0.597	0.594	3.515**	2.008**	2.221**	2.223**
	(0.466)	(0.469)	(0.471)	(0.472)	(0.478)	(0.481)	(0.485)	(0.485)
IMR PU	−4.617**	−7.098**	−5.567**	−5.574**	−3.369**	−8.172**	−7.379**	−7.397**
	(0.689)	(2.017)	(1.955)	(1.955)	(0.708)	(1.873)	(1.834)	(1.833)
IMR PV	2.626**	5.578**	3.215	3.253	2.661**	4.038**	2.593	2.850
	(0.571)	(1.813)	(1.790)	(1.823)	(0.583)	(1.772)	(1.776)	(1.800)

Notes: Standard errors in parenthesis. References dummy: urban schools, non-religious schools, male students, parents expect the student will only finish high school, no add-on fees. PV: private vouchers schools. IRM is the inverse-mills ratio obtained from the choice equation (Table A3).
* $p < .05$.
** $p < .01$.

test scores. We find that the positive association between student SES and test scores is slightly stronger in the private-voucher sector than the public one. In other words, a student's achievement is less determined by his/her socioeconomic status in the public than in the private-voucher sector. The difference is statistically significant but small in 4th grade and statistically insignificant in 8th grade. Net of students' SES, the association between school SES and test scores is positive in both sectors but it is much stronger in the private-voucher sector. Among 4th graders, a 1-unit increase in average school SES results in an increase in test scores of five points in the public sector, and about 20 points in the private-voucher sector. Given that the standard deviation of SIMCE test scores is around 50; this implies an improvement of 10% of a standard deviation in the public sector, but a high 40% in the private-voucher sector. Among 8th graders, the comparable increases

associated with a 1-unit increase in school-level SES are less than 10% in the public sector and approximately 35% in the voucher sector. These differences are substantial, and they signal a pronounced stratification of achievement in the private-voucher schools: ceteris paribus, students who attend a high-SES voucher school will perform much better than those in low-SES voucher schools.

The sizable socioeconomic stratification of achievement in the private-voucher sector may emerge from school-level resources and characteristics. To address this possibility, we include school-level attributes in Model 3 of Tables 3A and 3B, including rurality, student-teacher ratio, teachers' experience, SES standard deviation, school size, and religion. The answer is clear: these factors do not account for the large contextual effects of SES in voucher schools. The contextual effect remains almost twice as large in the

Table 3B
HLM model of achievement, 4th grade, 2002, random effects.

Random effects	Variance component	df	Chi-squared	Reliability
Panel A: Language				
Model 1				
Intercept, β_0	290.783	5203	27520.802[**]	0.697
Level-1 effects	1968.270			
Model 2				
Intercept, β_0	232.158	5143	17410.844[**]	0.535
SES slope	12.331	5145	5605.971[**]	0.065
Level-1 effects	1962.401			
Model 3				
Intercept, β_0	215.426	5136	16628.877[**]	0.523
SES slope	12.514	5145	5605.033[**]	0.065
Level-1 effects	1962.324			
Model 4				
Intercept, β_0	215.170	5133	16601.914[**]	0.523
SES slope	12.186	5145	5604.826[**]	0.064
Level-1 effects	1962.434			
Panel B: Math				
Model 1				
Intercept, β_0	314.959	5203	28958.512[**]	0.707
Level-1 effects	2011.208			
Model 2				
Intercept, β_0	258.176	5143	18512.200[**]	0.550
SES slope	14.840	5145	5628.652[**]	0.075
Level-1 effects	2004.042			
Model 3				
Intercept, β_0	247.677	5136	17996.671[**]	0.543
SES slope	14.869	5145	5628.565[**]	0.075
Level-1 effects	2004.129			
Model 4				
Intercept, β_0	247.464	5133	17963.670[**]	0.543
SES slope	14.652	5145	5628.661[**]	0.074
Level-1 effects	2004.182			

[**] $p < .01$.

voucher sector as in the public one, net of school characteristics. This finding holds for both grades and both test subjects. The comparison between Model 2 (without school-level controls) and Model 3 (adding school-level controls) gauges the extent to which the contextual effect of SES is accounted for by school-level attributes. The answer varies across sector. In the private-voucher sector, the contextual effect of SES declines only by about 20% after controlling for the influence of school size, rurality, student–teacher ratio, teachers' years of experience and religious school. In the public sector, in contrast, the contextual effect of SES *increases* by about 50%. This increase suggests that one or more school-level variables work as suppressors of the socioeconomic stratification across public schools. Step-wise regression models (not shown, available from the authors upon request) indicate that the variable operating as a suppressor is the indicator for rural school. Rural schools display much higher achievement than expected given their SES levels, so controlling for rural residency results in a stronger influence of aggregate SES resources at the school level on achievement in the public sector in the Chilean educational system. Consistently, holding socioeconomic and other characteristics of the students constant, rural schools perform better than their urban counterparts by 20% of a standard deviation, a finding that is consistent across the public and private-voucher sector. This is likely accounted for by the government programs in place since the mid-1990s, which provide substantial additional financial and pedagogical assistance to public rural schools (Garcia-Huidobro, 2000).

In line with previous research on the Chilean voucher system, we find that religious private-voucher schools feature higher achievement than secular ones with an average advantage of 10% of a standard deviation in test scores (McEwan, 2001). Schools with lower teacher–student ratios and more experienced teachers perform better, a pattern that is uniform across school sector

(although teacher–student ratio is not significant among 8th graders). Interestingly, the standard deviation of family SES within the school has a positive influence on achievement in the public sector—this suggests that socioeconomic diversity within the school is not detrimental, and it may even be beneficial for learning. We speculate that this may result from the advantageous effects of having a group of high-resource students in disadvantaged schools, probably driven by the influence of these students and their families on teachers' expectations and peer interactions.

The main finding of this analysis indicates that contextual effect of SES is much stronger in the private-voucher as in the public sector. Based on Model 3 in Table 3A the contextual effect of SES in the public sector is about 20% of a standard deviation of test scores—slightly stronger that the influence of individual-level SES. In contrast, in the private-voucher sector the contextual effect of SES reaches 40% of a standard deviation, almost twice as much as the individual-level SES. This benefit is substantial—it compares with a four-decile increase in family-level SES, or to almost 300 additional books at home. Among students attending the private-voucher sector, the aggregate socioeconomic resources of their school are much more consequential for achievement than their own family SES. This finding supports the hypothesis that voucher schools are more able than their public counterparts to "convert", unmodified, the socioeconomic advantages of their student bodies into achievement gains. Rather than leveling the playing field, private-voucher schools produce a distribution of educational achievement that closely mirrors the socioeconomic resources of their student bodies.

4.4. The role of parental add-on fees

The substantial association between school-level SES and test scores in the private-voucher sector may be accounted for by add-on tuition fees paid by parents. The strong contextual effect of SES in the private-voucher sector may reflect the ability of schools to extract additional resources from better-off parents via add-on tuition and translate these resources into higher educational achievement. If this hypothesis is true we should observe that the contextual effect of SES diminishes or disappears altogether after controlling for the amount of add-on tuition charged by the school. Alternatively, tuition fees and school-level SES may have independent beneficial effects on achievement, indicating that the resources provided by tuition add to the benefits associated with the socioeconomic makeup of each school. This hypothesis will result in significant achievement gains associated with higher tuition, without decline in the influence of school-level SES. A third alternative suggests that private-voucher schools that charge higher tuition may be able to select higher-SES families, but tuition fees may not have a positive influence on achievement *net* of the average socioeconomic resources of the families selected by the school. If this third hypothesis is true, we should observe that the positive association between tuition fees and achievement declines or disappears after controlling for school-level SES.

To examine these alternative hypotheses, the last columns in Tables 3A and 4A (Model 4) add tuition fees to the model. We measure parental add-on tuition as a set of dummies, distinguishing four ordered categories: no tuition fees, monthly fee of less than nine dollars, 9–17 dollars, and 17–68 dollars, with "no tuition" as the reference category. This formulation allows us to capture potential non-linearities in the association with test scores.[4]

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[4] Alternative models were estimated with a linear formulation of add-on tuition fees. Results are substantively identical to those presented here.

Table 4A
HLM model of achievement, language and math 8th grade, 2004. Fixed effects.

Variables	Language				Math			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
β_0 (adj. school mean test score)	238.136**	238.165**	224.901**	225.067**	248.751**	249.120**	237.521**	237.504**
	(0.571)	(1.231)	(3.386)	(3.393)	(0.553)	(1.105)	(3.712)	(3.714)
$\beta_0 \times$ PV		−6.517*	2.266	2.512		−3.848**	2.709	4.241
		(2.772)	(3.677)	(3.803)		(2.637)	(3.836)	(3.938)
School SES		4.134**	6.721**	6.744**		3.964**	7.749**	7.729**
		(0881)	(1.055)	(1.056)		(0.979)	(1.202)	(1.203)
School SES × PV		11.384**	9.369**	9.692**		11.723**	8.890**	9.747**
		(1.087)	(1.197)	(1.416)		(1.218)	(1.347)	(1.599)
Standard dev. × school SES			5.389*	5.396*			1.510	1.499
			(2.243)	(2.243)			(2.434)	(2.433)
SD school SES × PV			−7.668*	−8.117*			−5.481	−5.973
			(3.657)	(3.671)			(4.082)	(4.078)
Rural school			8.359**	8.347**			9.528**	9.497**
			(0.780)	(0.781)			(0.838)	(0.840)
Student–teacher ratio			0.002	0.001			−0.003	−0.004
			(0.009)	(0.009)			(0.008)	(0.008)
Teachers' years experience			0.227**	0.226**			0.181**	0.179**
			(0.048)	(0.048)			(0.052)	(0.052)
Ln enrollment			0.340	0.322			0.686	0.702
			(0.393)	(0.395)			(0.432)	(0.432)
Religious school × PV			6.826**	6.713**			6.359**	6.040**
			(0.885)	(0.913)			(1.043)	(1.070)
No fees (omitted categories)								
Parental fees LT $9				−0.975				−2.278
				(1.192)				(1.323)
Parental fees $9–17				1.021				−0.276
				(1.305)				(1.509)
Parental fees $17–68				−1.195				−2.373
				(1.584)				(1.818)
Student SES	7.927**	6.438**	6.104**	6.110**	6.939**	5.816**	5.479**	5.476**
	(0.178)	(0.476)	(0.473)	(0.473)	(0.175)	(0.423)	(0.418)	(0.418)
Student SES × PV		0.914	0.793	0.843		0.102	0.065	0.013
		(0.702)	(0.696)	(0.703)		(0.665)	(0.660)	(0.663)
Parental expectations	15.618**	14.876**	14.765**	14.768**	13.265**	12.672**	12.556**	12.555**
	(0.279)	(0.388)	(0.388)	(0.388)	(0.255)	(0.351)	(0.350)	(0.350)
Expectations × PV		0.884	0.711	0.723		0.449	0.324	0.285
		(0.751)	(0.749)	(0.750)		(0.686)	(0.685)	(0.685)
Female	7.646**	7.560**	7.462**	7.466**	−10.518**	−10.615**	−10.692**	−10.694**
	(0.233)	(0.236)	(0.236)	(0.236)	(0.215)	(0.218)	(0.218)	(0.218)
Number books at home	0.078**	0.075**	0.074**	0.074**	0.074**	0.072**	0.071**	0.070**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	((0.002)	(0.002)	(0.002)
Repeated grade	−23.951**	−23.885**	−23.743**	−23.745**	−22.032**	−21.948**	−21.815**	−21.813**
	(0.304)	(0.306)	(0.307)	(0.307)	(0.277)	(0.280)	(0.281)	(0.281)
Preschool	−1.067*	−2.342**	−1.945**	−1.946**	0.040	−1.094**	−0.746	−0.746
	(0.422)	(0.430)	(0.431)	(0.431)	(0.387)	(0.396)	(0.397)	(0.398)
IMR PU	−6.350**	−1.122	0.407	0.374	−6.952**	−2.777	−1.308	−1.287
	(0.752)	(2.001)	(1.989)	(1.989)	(0.777)	(1.752)	(1.731)	(1.732)
IMR PV	2.420**	7.682**	5.913**	6.114**	1.970**	4.421*	2.896	2.680
	(0.497)	(1.932)	(1.910)	(1.939)	(0.480)	(1.907)	(1.880)	(1.890)

Notes: Standard errors in parenthesis. References dummy: urban schools, non-religious schools, male students, parents expect the student will only finish high school, no add-on fees. PV: private vouchers schools. IRM is the inverse-mills ratio obtained from the choice equation (Table A4).
* $p < .05$.
** $p < .01$.

After controlling for tuition fees, the contextual effect of SES declines marginally for 4th graders and remains unmodified for 8th graders, indicating that parental fees do not account for the beneficial effect of school-level SES on test scores. This result is consistent with previous research, which has reported no differences in performance between students in private-voucher schools that charge add-on fees and those that are free (Anand et al., 2009). Furthermore, the association between tuition fees and test scores, net of school-level SES is very small and statistically insignificant except for one category ($9–17 monthly fees) in 4th grade.

This evidence is consistent with the third hypothesis. It suggests that financial contributions by parents are not associated with gains in students' achievement after the aggregate socioeco-nomic makeup of the student body selected by each school has been accounted for.[5] Our finding is all the more striking if we consider that, net of their socioeconomic resources, families who are willing to pay fees may be positively selected on unobservables (if they hold education in higher value or are more motivated), which will result in our *overestimating* the association between parental tuition fees and achievement.

[5] Note that parental fees charged by private-voucher schools do not fully translate into school revenue because the amount of government is reduced as tuition add-on tuition fees increase. This reduction is, however, very small—it is 0% of the subsidy up to U$9 of add-on fees, 10% between U$ 9 and 17 and 25% between U$ 17 and 68.

Table 4B
HLM model of achievement, 8th grade, 2004, random effects.

Random effects	Variance component	df	Chi-squared	Reliability
Panel A: Language				
Model 1				
Intercept, β_0	211.494	4887	25910.589[**]	0.711
Level-1 effects	1835.208			
Model 2				
Intercept, β_0	176.796	4845	16285.149[**]	0.551
SES slope	7.251	4847	5115.858[**]	0.056
Level-1 effects	1831.066			
Model 3				
Intercept, β_0	166.663	4835	15710.219[**]	0.540
SES slope	7.116	4844	5109.602[**]	0.055
Level-1 effects	1830.990			
Model 4				
Intercept, β_0	166.396	4832	15701.772[**]	0.540
SES slope	7.068	4844	5109.703[**]	0.055
Level-1 effects	1831.014			
Panel B: Math				
Model 1				
Intercept, β_0	279.318	4887	37471.966[**]	0.781
Level-1 effects	1564.578			
Model 2				
Intercept, β_0	236.869	4845	21736.191[**]	0.630
SES slope	10.255	4847	5255.901[**]	0.088
Level-1 effects	1560.085			
Model 3				
Intercept, β_0	224.471	4835	20982.065[**]	0.621
SES slope	10.457	4844	5251.828[**]	0.089
Level-1 effects	1559.726			
Model 4				
Intercept, β_0	224.136	4832	20972.708[**]	0.621
SES slope	10.448	4844	5251.785[**]	0.089
Level-1 effects	1559.724			

[**] $p < .01$.

5. Conclusions and discussion

Virtually all research on the Chilean voucher system focuses on differences between school sectors—in particular, the relative effectiveness of private-voucher versus public schools. In contrast, this paper addresses the socioeconomic distribution of achievement *within and between schools across school sectors*. We examine educational achievement measured by standardized math and language test scores among 4th and 8th graders using a hierarchical linear methodology, and accounting for non-random selectivity of students into school sector.

The basic premise of this study is that schools are important units of educational stratification among voucher schools. Three findings emerge from the analysis in support of this premise. First, a much larger proportion of the variance in socioeconomic status is *between schools* in the private-voucher sector than in the public one. This pattern suggests that while the private-voucher *sector* serves an economically diverse population, each voucher *school* focuses on a socioeconomically homogeneous community. Given the institutional design of the Chilean voucher system – in particular, a flat voucher, independent of students' need, and the ability of private-voucher schools to select students according to the criteria of their choice – we interpret this finding as suggesting that voucher schools use of the flexibility provided by the educational regulations to shape their student body and manage their teaching staff, thereby specializing in distinct market niches to accomplish their diverse financial and educational objectives.

The substantial variation in socioeconomic makeup of the student body across private-voucher schools raises the next question: does school-level SES matter for test scores, net of student-level resources? The answer is a clear yes. The association between aggregate school-level SES and test scores is much

stronger – twice as much – in the private-voucher than in the public sector, leading to a pronounced socioeconomic stratification of achievement. In other words, for students attending private-voucher schools, their educational achievement is more closely related to the aggregate SES of their school than to their own family's socioeconomic resources. These findings are strikingly consistent across grades (4th and 8th) and test score subject (math and language) suggesting that they identify a general attribute of voucher schools rather than idiosyncratic patterns.

One likely mechanism for the strong contextual effect of SES on test scores in the private-voucher sector is the add-on fees that these schools have been allowed to charge since the 1990s. By imposing fees, schools can select better-off families and translate the additional tuition funds into higher educational achievement. Our findings are not consistent with this hypothesis. We find that the contextual influence of SES on test scores does not decline after accounting for add-on fees, and that net of school-level SES, the amount of tuition fees levied on parents is not associated with higher achievement. In sum, the financial resources contributed by parents do not appear to translate into higher test scores once socioeconomic resources at the school level are accounted for.

Why is that private-voucher schools that charge add-on fees are able to extract resources from parents if their students do not outperform free private-voucher schools, net of individual resources? One possible answer is that parents care about peer socioeconomic makeup in itself, regardless of achievement (see Elacqua et al., 2006; Hsieh and Urquiola, 2006). Alternatively, parents may be able to assess average school performance, but not the value added by the school. Given the strong correlation between socioeconomic status and students' performance (e.g. Mizala et al., 2007), choosing a high-SES schools is a rational strategy to maximize their children's achievement. Even though our research design does not allow us to formally test whether add-on tuition fees induce sorting across schools, our findings suggest that the "shared financing" system may provide a vehicle for socioeconomic stratification across schools, which contributes to the inequality in test scores without improving the overall level of educational achievement.

Further exploring why the contextual effects of SES matter so much in the private-voucher sector – substantially more than in the public sector – is also an important task for future research. A rich literature on school effects suggests diverse pathways of influence: aggregate family SES at the school level may be a proxy for beneficial peer interactions, teachers' expectations, school normative climates, curriculum, basic infrastructure resources, or unobserved individual attributes (Rumberger and Willms, 1992; Pallas et al., 1994; Willms, 1985; Heyneman and Loxley, 1983; Fuller and Clarke, 1994; Willms and Somers, 2001; Baker et al., 2002; Gamoran and Long, 2006; Hauser, 1970; Raudenbush and Bryk, 1986). Most likely, several of these dimensions are at play and feedback dynamics among them exist. For example, higher-SES student bodies likely attract more motivated families and provide an incentive for schools to select them. High concentration of more advantaged families may induce a normative environment more conducive to learning. This, in turn, may increase the ability of better-off schools to attract more capable and motivated students and teachers, in a dynamic that widens the socioeconomic gap in achievement across schools, creating unequal learning communities.

Disentangling the mechanisms driving the strong contextual effect of SES in private-voucher schools has important policy implications. If school-level SES affects voucher school students' achievement largely because of its relationship to potentially alterable school organizational features, resources, or practices such as curriculum, teachers' expectations or infrastructure, then

socioeconomic stratification itself may not be an important issue. Policies targeted to increase school resources and to reform school structures may go a long way towards addressing the substantial socioeconomic achievement gap in the private-voucher sector. If, in contrast, the contextual effect of SES cannot be traced to school characteristics potentially modifiable by policy, then peer effects emerging from socioeconomic segregation itself may be a concern (Rumberger and Palardy, 2005). Furthermore, even if the proximate factors explaining contextual effects of SES are school organizational features, these factors may depend on the social makeup of the students attending each school. For example, educators and school officials may respond to poor students by lowering expectations and offering less demanding curricula. In this case, socioeconomic stratification may be the fundamental cause of the observed socioeconomic achievement gap. As highlighted by Rumberger and Palardy (2005), to the extent that schools respond to the demands and political influence of their constituents, higher-resource communities may be able to successfully lobby for more resources and reform in their schools. In such circumstance, reducing the socioeconomic stratification across schools may be necessary for equalization of educational opportunity.

This task transcends the educational system and involves addressing residential segregation, which is pronounced in the Chilean context (Sabatini et al., 2001). In the U.S., children usually have to attend schools in the educational system where they live, so that "school segregation and residential segregation are inextricably entwined" (Denton, 1996: 795). In the Chilean choice system, families are formally allowed to enroll their children in any public or private-voucher school they choose, and the influence of socioeconomic segregation is less explicit but likely as powerful to the extent that no compensation for transportation costs – substantial for poor families – is provided.

Our analysis shows that school-level characteristics such as school size, teachers' experience, rurality, religious schools, or parental add-on fees have a small influence on achievement after accounting for the socioeconomic composition of the student body, and they play almost no role in accounting for the influence of aggregate school-level SES on test scores. However, none of the school-level variables currently available in the data adequately captures organizational and normative features at the school level. Obtaining such data is, however, possible in Chile given the good educational data collection infrastructure that exists in the country. The SIMCE test is a census of students and schools administered annually to pupils of a specified grade level with a schedule that, since 2005, gives the SIMCE test every year to 4th graders and rotates between 8th, and 10th grades. It already includes parental, teacher, and principal questionnaires, to which inquiries about normative and organizational characteristics of schools can be added at minimal cost. Furthermore, the grade schedule of the SIMCE test can be arranged so that individual students can be followed over time providing longitudinal information on students' test score gains, allowing researchers to capture the value added by the school. These feasible changes would go a long way to help decipher the different paths for the strong influence of the socioeconomic composition of schools on educational achievement in Chilean private-voucher schools.

Finally, the institutional design characteristics of the Chilean voucher system are undergoing a substantial transformation. As mentioned, a recent 2008 law establishes a means-tested voucher and forbids private-voucher schools from selecting elementary school's students based on entry exams and parental interviews. These measures should alter the incentive structure facing voucher schools, reducing the incentives and ability to recruit socioeconomically advantaged students. These changes could go a long way in reducing the socioeconomic segregation across private-voucher schools and could weaken the influence of school-level SES on students' test scores. Although it is still too early to evaluate this hypothesis, we hope to have provided a needed missing piece for understanding of socioeconomic stratification in the Chilean universal voucher system, and a baseline to evaluate the consequences of policy change.

Appendix A

See Tables A1–A4.

Table A1
Summary statistics all schools and by sector. Chilean 4th graders, 2002.

	Total		Public		Private voucher	
	Mean	SD	Mean	SD	Mean	SD
Individual-level variables						
SIMCE language score 2002	249.648	52.370	240.784	51.347	261.199	51.431
SIMCE math score 2002	245.217	52.557	237.048	51.923	255.868	51.461
Student SES	−0.150	0.808	−0.388	0.723	0.155	0.809
Gender (female)	0.492	0.500	0.486	0.500	0.499	0.500
N books at home	36.727	47.481	29.009	41.323	46.913	52.856
Expectations: post-secondary education	0.509	0.500	0.405	0.491	0.647	0.478
Repeated grade	0.094	0.292	0.119	0.324	0.061	0.239
Attended preschool	0.906	0.291	0.883	0.321	0.937	0.243
N observations (students)	196,212		109,910		86,302	
School-level variables						
SIMCE language score 2002	241.305	27.605	235.662	23.426	250.784	31.263
SIMCE math score 2002	236.310	27.880	230.950	24.180	245.310	31.180
School SES	−0.388	0.570	−0.599	0.395	−0.034	0.639
Dummy rural	0.370	0.480	0.490	0.500	0.160	0.370
Student/teacher ratio	23.990	19.290	21.560	17.160	28.080	21.820
Teachers' years of experience	18.090	6.500	20.630	5.600	13.820	5.630
Ln enrollment 2002	5.660	1.120	5.530	1.160	5.880	1.020
Dummy religious school	0.060	0.240	0.000	0.000	0.160	0.367
N observations (schools)	5204		3262		1942	

Table A2
Summary statistics all schools and by sector. Chilean 8th graders 2004.

	Total		Public		Private voucher	
	Mean	SD	Mean	SD	Mean	SD
Individual-level variables						
SIMCE language score 2004	247.368	50.434	240.232	49.008	259.290	50.531
SIMCE math score 2004	248.348	47.746	241.510	45.738	259.772	48.834
Student SES	−0.113	0.886	−0.335	0.792	0.263	0.909
Gender (female)	0.501	0.500	0.494	0.500	0.512	0.500
N books at home	40.439	57.032	31.829	49.187	54.825	65.682
Expectations: post-secondary education	0.708	0.455	0.633	0.482	0.834	0.372
Repeated grade	0.165	0.371	0.190	0.392	0.124	0.329
Attended preschool	0.915	0.279	0.893	0.309	0.952	0.214
N observations (students)	173,907		108,792		65,115	
School-level variables						
SIMCE language score 2004	243.572	25.067	237.557	20.494	253.237	28.495
SIMCE math score 2004	244.892	25.135	239.444	20.687	253.648	28.901
School SES	−0.269	0.652	−0.513	0.451	0.122	0.731
Dummy rural	0.307	0.461	0.414	0.493	0.136	0.343
Student/teacher ratio	23.174	17.949	20.684	16.913	27.170	18.825
Teachers' years of experience	19.129	6.253	21.845	5.231	14.769	5.205
Ln enrollment 2004	5.862	0.923	5.756	0.944	6.032	0.862
Dummy religious school	0.065	0.246	0.000	0.000	0.166	0.373
Observations (schools)	4888		3013		1875	

Table A3
Logit choice model: determinants of attending private-voucher school versus public school. 4th grade 2002.

	b	SE
Students SES	0.726[**]	(0.008)
Gender (female)	0.046[**]	(0.011)
Books at home	0.002[**]	(0.0001)
Expectations post-secondary education	0.421[**]	(0.012)
Repeated grade	−0.178[**]	(0.021)
Attended preschool	0.098[**]	(0.021)
N of public schools per km^2 in municipality where the student lives	−0.710[**]	(0.024)
N of private voucher schools per km^2 in municipality where the student lives	1.066[**]	(0.019)
Constant	−0.787[**]	(0.022)
LR chi^2 (9)	28,764.09[**]	
Pseudo R^2	0.120	
N	174,451	

[**] $p < .01$.

Table A4
Logit choice model: determinants of attending private-voucher school versus public school. 8th grade 2004.

	b	SE
Students SES	0.645[**]	(0.008)
Gender (female)	0.089[**]	(0.011)
Books at home	0.002[**]	(0.0001)
Expectations post-secondary education	0.411[**]	(0.014)
Repeated grade	−0.110[**]	(0.015)
Attended preschool	0.120[**]	(0.022)
N of public schools per km^2 in municipality where the student lives	−0.519[**]	(0.023)
N of private voucher schools per km^2 in municipality where the student lives	0.875[**]	(0.019)
Constant	−1.184[**]	(0.024)
LR chi^2 (9)	24,878.31[**]	
Pseudo R^2	0.107	
N	175,114	

[**] $p < .01$.

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