Socioeconomic school segregation in a market-oriented educational system. The case of Chile

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Published online: 27 Jun 2013.

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This paper presents an empirical analysis of the socioeconomic status (SES) school segregation in Chile, whose educational system is regarded as an extreme case of a market-oriented education. The study estimated the magnitude and evolution of the SES segregation of schools at both national and local levels, and it studied the relationship between some local educational market dynamics and the observed magnitude of SES school segregation at municipal level. The main findings were: first, the magnitude of the SES segregation of both low-SES and high-SES students in Chile was very high (Duncan Index ranged from 0.50 to 0.60 in 2008); second, during the last decade, SES school segregation tended to slightly increase in Chile, especially in high schools (both public and private schools); third, private schools – including voucher schools – were more segregated than public schools for both low-SES and high-SES students; and finally, some market dynamics operating in the Chilean education (like privatization, school choice, and fee-paying) accounted for a relevant proportion of the observed variation in SES school segregation at municipal level. These findings are analyzed from an educational policy perspective in which the link between SES school segregation and market-oriented mechanisms in education plays a fundamental role.

Keywords: equity/social justice; research

Introduction: the policy relevance of school segregation

The educational policy relevance of the socioeconomic status (SES) segregation of the school-going population – defined broadly as the uneven distribution among schools of children with different social and economic characteristics – is essentially grounded in three concerns. Firstly, school has traditionally been seen as a channel for socialization that enriches by complementing the family experience; this is especially so in terms of introducing students to the complexities of social life, one of whose key characteristics is interacting with people from different socioeconomic backgrounds: school segregation may hinder that civic function. Secondly, given that education is an interactive process between teachers and students, and among students, the people (their capacities, resources, attitudes, and preferences) that make up the school constitute an essential part of the nature of the educational

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experience; thus, reducing students' socioeconomic segregation emerges as a relevant component in the quest for higher quality and equity in education, especially for low-income students. Lastly, social policies, including educational policies, targeted at improving the conditions of the poor and disadvantaged, face additional obstacles when tackling poverty concentration in a broad sense; in other words, the segregation of disadvantaged groups would raise their degree of vulnerability and entrench their exclusion. From this point of view, it is not so much the case that desegregation is a solution to the educational problems of the poor, but rather that segregation would hinder the solutions to those problems. In this paper, we report an empirical research on the socioeconomic school segregation of the Chilean educational system, which is a valuable context to study the relationship between school segregation and market-oriented reforms in education.

In an international educational context in which many countries are attempting market-oriented policies to improve schools' performance, this research is relevant because Chile is one of the countries with the highest private participation in the schooling system. Moreover, the Chilean educational system is characterized by a broad concept of school choice; a generalized voucher like funding mechanism, multiple for profit and not for profit private providers (both, with and without public subsidies), and an extended system of family co-payment across private-subsidized schools; however, few studies have been published connecting these features with school segregation.

Historically, both racial and economic residential segregations' have been widely studied in the USA (see for example Park 1926; Abramson, Tobin, and Vander Goot 1995); nevertheless, although Park (1926) defined segregation very early as the relation between the physical and social distance of certain groups or individuals, there is no consensus about the conceptual definition of segregation (White 1983; James and Taeuber 1985; Massey and Denton 1988; Jargowsky 1996; Rodriguez 2001; Sabatini, Caceres, and Cerda 2001; Vargas and Royuela 2006). In this study, we analyzed segregation as *unevenness,* which refers to the difference in the distribution of population groups in geographical and/or organizational units. Certainly, *unevenness* is a relative and not an absolute concept: a group is deemed segregated if it is distributed differently (compared to another group) in particular units. Later, in the research design section, we expand on this conceptual discussion.

In general terms, the harmful effects of residential segregation are well established in the literature, including negative impacts on labor market opportunities (Cutler and Glaeser 1997; Larrañaga and Sanhueza 2007; Ananat 2011), health aspects (Harding 2003; Kling, Liebman, and Katz 2006), and political efficacy (Ananat and Washington 2009), and certainly on educational opportunities and outcomes (Garner and Raudenbush 1991, for Scotland; Kaufman and Rosenbaum 1992; Rosenbaum 1995; Cutler and Glaeser 1997; Vartanian and Gleason 1999; Orfield 2001; Harding 2003; Kling, Liebman, and Katz 2006; Larrañaga and Sanhueza 2007, for Chile; Ananat 2011 for the USA).

Although less developed, the research about both socioeconomic and ethnic segregation in education is also a dynamic field of study in many countries. Broadly, previous research has found that – controlling for other relevant factors – disadvantaged students attending more segregated schools tend to have higher dropout rates and lower levels of academic achievement; additionally, researchers have also identified negative consequences of school segregation on students' risk behaviors and psychosocial aspects linked to school success (e.g. motivation) among

disadvantaged students (Balfanz and Legters 2001; Opdenakker and Van Damme 2001; Borman et al. 2004; Duru-Bellat, Mons, and Suchaut 2004, for France; Lee 2004; Orfield and Lee 2005; Opdenakker, Van Damme, and Minnaert 2006, for Belgium; Hawley 2007; Lauder et al. 2007, for England; Lee 2007; Hanushek, Kain, and Rivkin 2009, for the USA; Bonal 2012, for Spain).

The study on the consequences of school segregation has been strongly influenced by the discussion on the compositional effects and – more specifically – on peer effects. The theory suggests that within classrooms, peers' SES and cognitive abilities are important predictors of students' achievement (see Wilkinson et al. 2002; Wilkinson 2002, for conceptual discussions on this issue). Even though the literature on the effects of the composition of schools and classes dates back to the publication of the Coleman report (Coleman et al. 1966), systematic efforts to measure those effects on students' learning are quite recent. Unfortunately, the research on compositional and peer effects has faced conceptual limitations and problems of data quality (Thrupp, Lauder, and Robinson 2002): many studies have been hindered by small sample sizes while other results have been affected by high student mobility (Manski 1993) or the lack of information on teacher quality. However, recent studies have improved econometric techniques suggesting that the effects of composition may be important (Evans, Wallace, and Schwab 1992; Hoxby 2000; Gaviria and Raphael 2001; Sacerdote 2001; Schindler 2003; Angrist and Lang 2004; Ding and Lehrer 2006; Hoxby and Weingarth 2006; Duflo, Dupas, and Kremer 2008; and for a broader updated international revision see Dupriez 2010).

There is presently a significant debate on whether peer effects are decreasing or constant, and whether they are homogenous or heterogeneous, two issues closely related to the discussion on school segregation (Hoxby 2000; Angrist 2004; Ammermueller and Pischke 2006; Hoxby and Weingarth 2006). Some researchers argue that if we assume that the peer effect has diminishing returns in learning (decreasing effects), an increase in school segregation should produce a reduction in aggregating educational outcomes and the achievement gap would increase among different population groups (Epple and Romano 1998; Hsieh and Urquiola 2006). On the other hand, heterogeneous peer effect (i.e. different effects for different groups of students) has been identified by studies in several countries, although there is no consensus on the nature of this heterogeneity: studies linking school segregation with student academic achievement tend to show that disadvantaged students (in terms of family SES, race or academic achievement) would benefit from low levels of school segregation; nevertheless, the findings are not conclusive about whether non-disadvantaged students would be negatively affected by low levels of school segregation (see for example Hoxby 2000; Schindler 2003, for Denmark; Angrist 2004; Ding and Lehrer 2006, for China; Hoxby and Weingarth 2006; Hanushek, Kain, and Rivkin 2009, for the United States). We interpret this literature as suggesting that compositional and peer effects (both positive and negative) may be stronger for vulnerable groups.

Overall, the current evidence support the notions that the level of socioeconomic school segregation is a relevant characteristic of the educational systems and that – consequently – educational policies should be discussed in terms of their potential contribution to either increase or decrease SES school segregation. Thus, the main purpose of this study was to provide a better understanding of students' socioeconomic segregation in the Chilean school system, by estimating its magnitude, analyzing its recent evolution, and exploring its relationship with some of the

market dynamics that characterize Chilean education in addition to residential segregation.

Socioeconomic school segregation and educational market dynamics: the Chilean context

Market-oriented educational policies are currently being discussed in many countries, especially as an alternative to more traditional school improvement initiatives within the public sector. Market-oriented policies in education include voucher programs, school choice, privatization, cost-recovering mechanisms, and the promotion of competition among schools. Promoters affirm that the introduction of some of those market mechanisms to education will increase the effectiveness and efficiency of schools; in contrast, detractors predict that market dynamics will damage public schools and increase inequity in education, without certain gains in education quality (Belfield and Levin 2009; Witte 2009). As stated, from a comparative perspective, Chilean educational system is one of the most extreme cases of the introduction of market-oriented reforms; in fact, all the mentioned market-oriented policies have been implemented in Chile at national level since 1980. This makes Chile an attractive case for all researchers and policy-makers interested in the potential effects of large-scale market-oriented reforms.

In fact, the consequences of market reforms in Chilean education have been intensively studied during the last three decades. Overall, researchers have found small or no impact of those policies on improving the quality of Chilean education (see Bellei 2009; Drago and Paredes 2011, for recent reviews of this literature) and some negative consequences on educational equity, such as increasing test score gap between low- and high-SES students, and disseminating 'cream skimming' practices based on student's performance and discipline, all of which negatively affected public schools (Gauri 1998; Auguste and Valenzuela 2004; Hsieh and Urquiola 2006; Contreras, Sepúlveda, and Bustos 2010; Carrasco and San Martín 2012).

Within this context, the concern for SES school segregation has recently started to emerge in Chile; nevertheless, this issue has scarcely been empirically studied (Valenzuela, Bellei, and De los Ríos 2010; Elacqua 2012). For example, an OECD report (OECD 2004) affirmed that some Chilean educational policies exacerbated school segregation, but provided no direct evidence to support that statement. This paper aims to contribute to solve that gap.

Certainly, SES school segregation has sources beyond the educational system. Residential segregation is probably the most relevant external factor explaining educational segregation, since parents – especially for young children – tend to choose schools that are relatively nearer to home (Gallego and Hernando 2009; Carrasco and San Martín 2012). Previous research on urban areas in Chile has found that the level of SES residential segregation was intermediate at national level, but it was high in the Metropolitan Region of Santiago; studies also estimated that residential segregation has tended to slightly decreased in the last decades (Sabatini 1999; Rodríguez, 2001; Sabatini, Cáceres, and Cerda 2001; Larrañaga and Sanhueza 2007). Thus, a key policy question is whether educational systems merely reproduce residential segregation within educational institutions, or whether they increase or reduce it.

We hypothesized that – in addition to the urban segregation the socioeconomic segregation of the Chilean education could be explained by some market-oriented mechanisms, such as the universal parent school choice, the significant presence of

private schools (especially voucher schools), and the co-payment system (a fee-paying regulation within state funded schools).[1]

School choice is a potential contributing factor to SES educational segregation in Chile. This mechanism – which is aimed at raising the degree of competition among schools – would be a powerful incentive to school stratification, since parents with higher SES tend to seek out high performance schools and more prestigious schools for their children, producing a polarization of schools by social class and students' achievement (which are in turn highly correlated). This phenomenon of social-class-related school choice has been theoretically predicted (Ball 1993; Bourdieu 1997; Epple and Romano 1998; MacLeod and Urquiola 2009) and empirically demonstrated (Ball, Bowe, and Gewirtz 1995; Reay, Ball, and Taylor 1997; Whitty, Power, and Halpin 1998; Fiske and Ladd 2000; Ball 2003; Berry, Jacob, and Levitt 2003; Auguste and Valenzuela 2004; Hsieh and Urquiola 2006).

Privatization in education can also lead to higher SES school segregation (Persell 2000). In fact, several authors report a high degree of SES stratification by type of school ownership in Chile: while low-SES students tend to attend public schools, middle-SES students tend to attend voucher private schools, and high-SES students tend to attend non-subsidized private schools (García-Huidobro and Bellei 2003; González, Mizala, and Romaguera 2004; Elacqua 2007). In Chile, there are two complementary reasons that potentially link the presence of private schools to SES school segregation. The first factor is the selection of students by the schools through highly unregulated admission policies (as recently as 2009, a legal norm that partially regulated schools' selection until sixth grade was established). Schools have powerful incentives for selecting children from higher socioeconomic backgrounds and with better academic performance, since the 'costs' of teaching those children (both monetary and non-monetary) are lower; in Chile, these incentives increase given the test-based accountability policies. There is some evidence that indicates that those class-related and achievement-related student selection practices are more relevant in private schools (both non-subsidized and voucher) than in public schools (Bellei 2009). The second factor is the Chilean voucher mechanism, since the amount of this demand-side subsidy has been the same for all students independently of their SES.[2] In this context, the theory predicts that there should be a higher degree of segregation in voucher private schools than in public schools (Epple and Romano 1998; Auguste and Valenzuela 2004; Hsieh and Urquiola 2006; MacLeod and Urquiola 2009).

Finally, a further potential explanatory factor of SES school segregation in Chile is the existence of a co-payment mechanism within the state-funded educational system (*Shared Financing*).[3] Since the co-payment system allows subsidized schools to charge students' families with a mandatory fee on top of the public voucher, it introduces a price discrimination mechanism among those schools, which is directly linked to the SES students' population. The impact of this co-payment system has been scarcely studied (see Bravo and Quintanilla 2001, for an exception), but the official data shows that it expanded rapidly after the 1993 new regulations. In fact, the number of private schools using the shared financing mechanism increased from 232 in 1993 to 1963 in 2006; moreover, students attending voucher private schools with co-payment as a proportion of all students attending voucher private schools expanded fivefold between 1993 and 1998 – rising from 16 to 80% – stabilizing at a level of around 80%. Accordingly, in urban areas, enrollment in voucher private schools with the co-payment system represented 38% of all

fourth-grade students in 2006. As mentioned, public secondary schools can also introduce the co-payment mechanism: in 2006, 24% of public secondary school students attended schools with this shared financing system. Lastly, there is a high level of variation in the amount charged by schools (ranging from US$1 to US$133 monthly, in 2008) and a noticeable difference between private and public schools (while the average monthly fee in private schools was US$32 in 2008, the corresponding value in public school was US$5). Summarizing: the co-payment mechanism introduced an additional source of SES stratification within the publicly funded educational system by which students with lower SES tend to attend free-of-charge schools.

It is important to note that the segregation dynamics of the school-going population are not an exclusive phenomenon of the poorest sectors. In fact, the variables that we have hypothesized linked to the segregation of the poor (residential segregation, school choice, widespread school selectivity practices, and price discrimination mechanisms) can also function as segregation factors of students belonging to the highest SES families. Hence, in this study, we estimated SES school segregation for both low-SES and high-SES students.

In the rest of the paper, we provide cross-section and longitudinal empirical evidence about the discussed issues.

Research design

General approach

The methodology of the study was designed to tackle the two main objectives: to estimate the degree and evolution of the socioeconomic segregation of students among Chilean schools, and to study the link between students' segregation and market mechanisms operating in the Chilean educational system, especially the co-payment system. The key challenge to accomplish the first objective was to construct an appropriate database to estimate a valid segregation measure at both national and local levels; the basic approach for the second objective was to implement multiple regression analyses at municipal level.

Broadly, segregation can be defined as the distributional difference of various social groups among various organizational units and/or linked to a given territory or geographical area (James and Taeuber 1985), and it refers to the degree of proximity of people or social groups that share a social attribute such as ethnicity, education, or income level (Sabatini, Caceres, and Cerda 2001; Arriagada and Rodríguez 2003). The literature shows that segregation has various dimensions including the degree of similitude (or evenness), exposure, concentration, centralization, and clustering (Massey and Denton 1988; Gorard and Taylor 2002). In this study, we focused on evenness, which refers to the degree of similitude in the distribution of an individual characteristic among various units of a specific territory, and is linked to the unbalanced spatial distribution of a population with a specific social attribute.[4] The literature shows that there is no perfect segregation index, but to be valid it should include a limited range for its magnitude to be comprehensible, and thereby facilitate comparability; be solely linked to the distribution of the segregation population analyzed; and satisfy some basic mathematical attributes (James and Taeuber 1985; Hutchens 2004; Allen and Vignoles 2007). To estimate school segregation, we used the Duncan Dissimilarity Index (D-Index) (Duncan and Duncan 1955).[5]

The D-Index estimates the percentage of disadvantaged students (low-SES) that need to be transferred between schools in order to have a homogenous distribution among all the schools of a given territory.[6] D-Index has a range [0:1] where 0 represents a completely even distribution and 1 represents an absolute uneven distribution; for dissimilarity values above 0.6, the literature identifies situations of hyper segregation (Glaeser and Vidgor 2001).

Even though D-Index presents some limitations – for example, it is sensitive to the relative size of the population group analyzed and the number of units in which population can be distributed, such as the number of schools (Cortese, Falk, and Cohen 1976) – the rationale for using D however is twofold. First, it has become the most widely recognized and used segregation index by the specialized literature: recently, it has been used in studies measuring school segregation in OECD countries (see for example Jenkins, Micklewright, and Schnepf 2006; Allen and Vignoles 2007; Bonal 2012) and residential segregation in Chile (Larrañaga and Sanhueza 2007). Second, D-Index is simple to understand both its general meaning and longitudinal trajectories.[7] Additionally, its limitation to conduct correlation analysis across different geographical units can be tackled by controlling for information on these zones, as we explain in the next section.

Measures and datasets

School SES segregation

The estimate of the D-Index requires a dichotomous structure of students' distribution among schools located in defined geographical units. Therefore, we implemented a principal components analysis to create a national-level SES-index of students, which includes three individual-level variables: mother's education, father's education,[8] and household per capita income. We defined disadvantaged students as those belonging to the 30% of the lowest value of the SES-index; we also estimated school segregation for students situated in the 30% highest SES-index values. This strategy allows us to compare the evolution of school segregation of a constant proportion of the students' population; it also permits a direct comparison with Larrañaga and Sanhueza's study (2007) on poverty segregation in Chilean cities.

We obtained the information about students' families from the SIMCE (Sistema de Medición de la Calidad de la Educación, from its name in Spanish, Education Quality Measurment System) data-sets from 1999 to 2008.[9] Unfortunately, the data needed for estimating the SES-index was not available for some grade-years. Eventually, we were able to estimate SES school segregation at the national, regional, and municipal level for fourth graders in 1999 and 2008; for eighth graders (last year of primary education) in 2000 and 2007; and for tenth graders (second year of secondary school) in 2001 and 2008, and several additional years in between.[10] We also estimated (for specific years) the level of school segregation by type of schools, distinguishing public schools, voucher private schools, and non-subsidized private schools. Finally, given the scarce school alternatives that rural children face, rural educational segregation is highly determined by geographical segregation; hence, we restricted our study to urban zones.

Market mechanisms

To explore the relationship between the school SES segregation and the market dynamics operating in the Chilean educational system, we used two sets of related measures. The first one was the proportion of student enrollment at municipal level (fourth grade, urban zones) for each type of school: (free) public schools, free-of-charge private voucher schools, private voucher schools with co-payment system, and non-subsidized private schools. This is a measure of the relevance of private and fee-paying schools at local level. The second measure was the number of schools at municipal level of each defined type of school, which is an indicator of the (theoretically) available school choice options for families. We obtained all this information from the National Directory of Schools which is produced annually by the Ministry of Education.

Residential SES segregation

In order to study the relationship between school segregation and residential segregation, we also estimated the D-Index for the urban zones of 51 municipalities with 100,000 or more inhabitants – which represent around 70% of the Chilean population. To measure residential segregation, the study units corresponded to the distribution of the population in each urban census districts, which are municipal subdivisions (there were 1767 census districts in 1992 and 2328 in 2002; so – on average – there were only one or two schools per census district). We used data from the 1992 and 2002 Population Census[11] to construct a SES-index, based on the average education of people aged 18 or over of each household, and (following Larrañaga and Sanhueza 2007) on the presence of 10 durable goods (refrigerator, washing machine, microwave oven, computer, video-recorder, water heater, color television, cable-TV, telephone, and private vehicle). Then, we estimated 1992 and 2002 D-Index of residential socioeconomic segregation for the households whose members belong to the lowest 30% of the SES-index distribution (vulnerable group); we replicated this D-Index considering a subsample of households that include children aged less than 13 (i.e. the households more directly linked to the school population).

Interestingly, the average D-Index estimated for these 51 municipalities for all households decreased from 0.32 to 0.31 between 1992 and 2002; meanwhile, the same index estimated only for households with children aged less than 13, increased from 0.34 to 0.35. In other words, in those municipalities, families with children of primary school-going age were comparatively more segregated than the rest of the families. Moreover, that difference tended to increase slightly during between 1992 and 2002, evidence that is consistent with a higher level of poverty among families with children.

Additional covariates

Since school SES segregation at municipal level may be related with several additional local factors that potentially confound regression analyses, we also incorporate data about relevant municipal characteristics, in order to avoid overestimating the effects of policy variables on school segregation. Therefore, in our regression models, we included the total urban enrollment in fourth-grade primary schools (which captures the municipality size)[12]; SES students' distribution (high, middle,

and low SES); poverty rate; average per capita income (2006); and per capita income variation coefficient. The data on urban enrollment was also obtained from the 2006 National Directory of Schools; and the source of the last three variables was the 2000 and 2006 National Socioeconomic Characterization Survey (CASEN) of the Ministry of Planning.

Data analysis

To achieve the first research objective, we determined the level and evolution of school SES segregation in Chile by estimating the D-Index for several grade-years between 1999 and 2008 at the national level; additionally, for specific years, we also estimated the D-Index for urban areas at local level, and finally, we obtained separate estimates by type of schools (public, private voucher, and private non-subsidized). Although the main focus of the study was the SES segregation of disadvantaged students, we also estimated the D-Index for the subgroup of students from the highest SES.

Subsequently, to attain the second research objective, we conducted multiple regression analyses by modeling the relation between 2006 SES school segregation and the intensity of educational market dynamics at local level. Specifically, we used different econometric cross-section analyses, where the dependent variable was the D-Index at municipal level (only for urban areas) of fourth-grade students who belong to the 30% most disadvantaged Chilean student population.[13] We used the defined variables linked to the educational market mechanisms as explanatory variables, and several relevant municipal-level characteristics as control variables. We also added dummy variables for each of the Chilean geographical regions which represent non-observable fixed territorial and institutional effects. As explained, the most important covariate for this analysis was residential SES segregation which was expected to have a positive effect on school segregation; unfortunately, the inclusion of this covariate significantly reduced the sample size and forced us to use a previous measure of school segregation as the outcome variable (since the last Population Census was in 2002). Thus, we present regression results for both the larger 2006 sample without controlling for residential segregation and the reduced 1999 sample including residential segregation as a covariate.[14] Tables A1 and A2 in the Appendix contain basic descriptive statistics for all variables included in the analyses, for both larger and reduced sample of municipalities, respectively.

Magnitude and evolution of SES school segregation of Chilean education

Table 1 presents our estimates of the level of SES segregation of the Chilean school-going population, for the period between 1999 and 2008. Estimates are presented for all the years and grades for which the required information was available. The first panel contains the values of the Duncan Dissimilarity Index estimated for the students whose families were classified in the lowest 30% of the socioeconomic index, and the second panel presents the D-Index for the students coming from the highest 30% of the SES-Index.

The results presented in Table 1 allow us to draw several conclusions. First, the level of SES segregation of the school-going population is very high in Chile. For example, the D-Index for fourth-grade low-SES students in 2008 was 0.54 (recall that the literature defines D-Index values of 0.6 as hyper-segregation), which

Table 1. Socioeconomic school segregation in Chile: 1999–2008.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Statistical difference between last and first year
D-Index: 30% lowest socioeconomic level											
Fourth-grade primary school	0.51						0.50	0.53	0.53	0.54	**
Eighth-grade primary school		0.50							0.52		**
Second-grade secondary school			0.43					0.50		0.50	**
D-Index: 30% highest socioeconomic level											
Fourth grade primary school	0.58						0.59	0.59	0.60	0.60	**
Fourth grade primary school		0.58							0.58		
Second grade secondary school			0.53					0.59		0.59	**

Source: Authors' elaboration. Blank spaces indicate that the needed data was not available. Standard errors for Duncan indexes were estimated using bootstrapping with 100 replications.
Significance level: **<1%; *<5%.

implies that in order to have a homogenous distribution of disadvantaged students among schools, it would be necessary to transfer 54% of those students from schools with high to low concentrations of disadvantaged students. In fact, the SES school segregation was comparatively higher than the corresponding SES residential segregation estimated by Larrañaga and Sanhueza (2007) for the Chilean population as a whole, which ranged between 0.20 and 0.36 for 2002.

Second, during the studied decade, the level of SES school segregation had a moderate upward trend in Chile. Although with different strength, this tendency was identifiable in all series of Table 1. The most extensive series of comparable data were available for fourth graders: according to the results, between 1999 and 2008, the D-Index increased from 0.51 to 0.54 and from 0.58 to 0.60 for the students from the lowest and highest 30% SES, respectively. The increase in school segregation was not clearly linked to a similar trend in residential segregation in the Chilean cities, since Larrañaga and Sanhueza (2007) estimated a slight decrease in the D-Index for the SES residential segregation between 1992 and 2002 for two of their three poverty indexes (with the third remaining stable).

Third, low-SES Chilean students were more segregated in primary schools than in secondary schools, although this difference tended to decrease during the studied period. For high-SES students, the level of school segregation was similar in both primary and secondary schools.

Finally, the level of SES school segregation for high-SES students was higher; in fact, Table 1 shows that this pattern was true for all D-Index estimates for the corresponding grade-level groups. According to our findings, high-SES Chilean students were hyper-segregated in 2008 in both primary and secondary schools, with an estimated D-Index of 0.61 for students from primary level and 0.59 for those from secondary schools.

Public vs. private: SES school segregation according to the type of school

As explained, one of the key features of the Chilean education is the distinctions between schools according to their ownership status (private/public) and their main source of funding (state subsidy/family payments), which creates a system of three categories: public, voucher private, and non-subsidized private. We estimated national-level SES school segregation separately for each type of school. In other

Table 2. Socioeconomic school segregation in Chile by type of school. D-Index for students from the 30% lowest and 30% highest SES-index (fourth and tenth graders, in specified years).

	Low-SES students			High-SES students		
	Public	Voucher private	Non-subsidized private	Public	Voucher private	Non-subsidized private
Fourth-grade primary school						
1999	0.38	0.51	0.92	0.46	0.47	0.66
2006	0.38	0.53	0.98	0.46	0.51	0.78
Second-grade secondary school						
2001	0.31	0.41	0.65	0.41	0.50	0.50
2006	0.38	0.49	0.91	0.47	0.54	0.66

Source: Authors' elaboration.

words, we defined each type of school as an educational 'subsystem,' in order to comparatively estimate its level of internal segregation.[15] Table 2 contains the main results for both low- and high-SES students.

The findings consistently indicate (for all available estimates) that low-SES students are less segregated in public than in private schools, and the same applies comparing state-funded private schools with non-subsidized private schools. As shown in Table 2, the differences in the level of segregation for low-SES students among the three types of schools are noticeably. This pattern is also present in the estimated school segregation for high-SES students, but the differences among the three types of schools are less pronounced in this case.

Note that, although public schools tend to be less segregated, the D-Index for low-SES and specially for high-SES students attending public schools is relatively high, which suggests that certain structural aspects of the Chilean society (e.g. residential segregation) and its educational system (e.g. school choice and students' selection processes) could account for the observed SES school segregation.

Lastly, the estimates included in Table 2 show an apparent trend towards an increase in SES school segregation during the period under analysis within the two types of private schools, both in primary and secondary schools, for low-SES and high-SES students. This tendency of increasing SES segregation is also observed among public secondary schools.

SES school segregation in urban areas

Although SES school segregation tends to be larger in rural areas (due to the relative dispersion that characterizes the rural population, which makes it difficult for the school to effectively integrate various population groups), from an educational policy perspective, the issue of socioeconomic segregation is more pertinently studied in urban settings given the fact that this segregation is potentially linked to educational policy decisions, school organization, and family decisions. Thus, in order to study in depth the relationship between SES school segregation and the local-market dynamics of Chilean education, in the remaining sections of the paper, we focus on the school segregation of low-SES students in urban areas.

Firstly, we recalculated the Dissimilarity Index at national level only for schools situated in urban areas, and – as expected – the estimates were slightly lower than the previously discussed for the entire country, but the general patterns were the same.[16] For example, for fourth-grade students in 2006, the D-Index was 0.51 for urban schools; while for the whole country was 0.53. Similarly, the trend of increasing SES school segregation, especially in secondary schools, also applied to urban areas, both at a country level and for the three different types of schools.

Then, we estimated SES school segregation at the local level. Our findings suggest that the mentioned rise in urban school SES segregation has been a generalized phenomenon among Chilean municipalities: between 1999 and 2006, 86% of the 159 municipalities included in the analysis showed an increase in their estimated level of SES school segregation. Figure 1 depicts this trend graphically for fourth-grade students: each municipality is represented by a circle; the horizontal axis shows the municipal value of the D-Index for 1999; and the vertical axis shows the same for 2006. If the municipalities had maintained their level of segregation in both measurements, the circles would lie on the diagonal line; circles under the
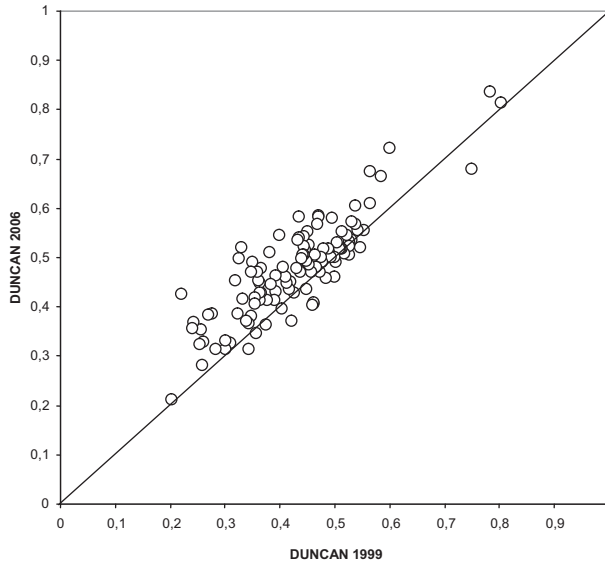
Figure 1. Evolution of urban segregation in Chile. Duncan Index 1999 vs. 2006 at a municipal level in urban schools, 30% students with lowest socioeconomic level, fourth-grade primary school. Source: Authors' elaboration.

diagonal indicate municipalities with a decrease in segregation between both measurements, while municipalities with increased segregation lie above the diagonal (thus, the vertical distance to the diagonal shows the magnitude of the change in school segregation). As shown, although Chilean municipalities varied greatly in terms of their magnitude and change of SES school segregation level, most of them were increasing their school segregation. In fact, 20% of all municipalities had increases in school segregation of over 10% points between 1999 and 2006; the corresponding weighted national average was about 4% points.

Finally, Figure 1 also shows a sizable level of heterogeneity in the estimated SES school segregation among Chilean municipalities, ranging from 0.21 to 0.84 in 2006. We found that the observed D-Index tended to be greater in Municipalities with larger population, lower poverty rates, higher number of schools, and higher presence of private schools. In the next section, we capitalize on these variations to conduct multiple regression analyses oriented to better understand the relationship between the SES school segregation and local-level factors.

The market dynamics: factors related to SES school segregation in Chilean urban areas

The level of SES segregation of the school-going population is the result of a complex weave of educational, social, demographic, and economic factors, among others. Therefore, in order to know whether or not there is a link between students' segregation and the market mechanisms functioning in the Chilean educational system, we studied the relationship between the observed municipal-level variation in the SES school segregation and several relevant characteristics of the Chilean

municipalities. Specifically, we conducted cross-section multiple regression analyses at municipal level. We used the D-Index for the 30% low-SES fourth-grade students in urban areas as the outcome variable and the defined educational local-market variables as the main predictors; we also controlled for several covariates, including residential segregation in some regression models.

Table 3 contains the key results of those analyses. Models 1 and 2 were fitted using the larger sample of 159 municipalities with at least five urban schools, which jointly represented 92% of the total urban fourth-grade enrollment for the year 2006; the outcome variable was the 2006 D-Index; in turn, models 3 and 4 were fitted using the reduced sample of 51 municipalities for which we had 2002 residential segregation data, and this time we used the 1999 D-Index as the outcome variable.

As showed in Table 3, model 1 contains the proportions of enrollment at municipal level that attended the three different types of private schools as the main predictor variables (the participation of municipal schools was omitted), distinguishing between voucher private schools with and without the co-payment system. The estimated coefficients indicate that the proportion of enrollment in both voucher private schools with co-payment system and non-subsidized private schools is statistically significant predictors of SES school segregation at municipal level ($p < 0.01$); model 1 also shows that the level of enrollment in free voucher schools was not related to the SES school segregation. In other words, at municipal level, the larger the proportion of fee-paying private schools, the larger the SES school segregation.

To deepen this analysis, model 2 incorporates the number of each of the four types of schools as predictor variables. Inspection of the estimates from model 2 shows that the introduction of the additional covariates had little impact on the previously estimated coefficients, suggesting that the relationship between fee-paying private enrollment and SES school segregation is fairly robust (recall that all those models controlled for a set of relevant additional covariates). Interestingly, model 2 indicates that the number of voucher private schools without shared financing is also positively related to the SES school segregation ($p < 0.05$), pointing out that the mere presence of private schools, even if they are free for the families, is a factor of segregation among schools.

Finally, the standardized coefficients related to each factor (reported in Table 3 too) allow the magnitude of their estimated effects on SES school segregation to be directly compared. Therefore, the proportion of private fee-paying enrollment at a municipality level emerges as the most closely linked factor to SES school segregation, followed by the proportion of voucher private enrollment with shared financing. Both results lead to the same conclusion: municipalities with higher fee-paying private school enrollment tended to have more segregated schools.

The key limitation of models 1 and 2 is that they do not control for SES residential segregation; hence, we attempted to overcome this problem by adding the D-Index for residential segregation as a covariate in models 3 and 4 (these specifications have a reduced sample size, because residential segregation could be estimated only for larger municipalities). Thus, our main purpose was to test whether the observed differences in the level of SES school segregation among municipalities were explained by the differences in residential segregation, and not by the educational market variables that we have discussed.

As expected, according to model 3 in Table 3, SES residential segregation was positively and strongly linked to SES school segregation ($p < 0.01$); nevertheless,

Table 3. Explaining SES school segregation at municipal level. Fitted multiple regression models, demonstrating the relationship between SES school segregation and educational local-market variables, controlling for selected covariates.

Variable	Total sample (outcome variable: 2006 D-Index)		Reduced sample (outcome variable: 1999 D-Index)	
	Model 1	Model 2	Model 3	Model 4
Participation of the enrollment private-subsidized without SF fourth-grade primary school	−.061 (.0529)	−.061 (.0568) [−.074]	.142* (.0813) [.157]	.098 (.1447) [.108]
Participation of the enrollment private-subsidized with SF fourth-grade primary school	.195*** (.0540)	.184*** (.0548) [.226]	.226*** (.0729) [.374]	.118 (.0821) [.196]
Participation of the enrollment private fee-paying fourth-grade primary school	.279*** (.0977)	.325*** (.0981) [.443]	.314** (.1403) [.430]	.399** (.1652) [.546]
Number of municipal schools		−.000 (.0009) [−.017]		−.001 (.0013) [−.086]
Number of subsidized schools without SF		.002** (.0009) [.130]		.001 (.0017) [.039]
Number of subsidized schools with SF		.001 (.0005) [.108]		.002** (.0008) [.228]
Number of private fee-paying schools		−.000 (.0011) [−.022]		−.000 (.0016) [−.023]
Degree of residential segregation 2002			.362*** (.0995) [.324]	.327*** (.0959) [.293]
Constant	.628*** (.0718)	.596*** (.0751)	.397*** (.1033)	.366*** (.1056)
Additional covariates	Yes	Yes	Yes	Yes
Number of municipalities	159	159	51	51
R^2	.795	.809	.937	.945

Key: $*p < .10$; $**p < .05$; $***p < .01$.
Notes: Weighted OLS by size of the municipal enrollment with corrected standard errors; squared brackets indicate standardized coefficients.
Total sample included all Chilean municipalities with five or more urban schools.
Reduced sample included all Chilean municipalities with five or more urban schools and with available data on SES residential segregation (2002 Census).
Additional covariates included: Total urban enrollment (for the largest sample), municipal poverty rate (for the largest sample), and percentage of low-SES and middle-SES students in the municipality – urban zones, regional dummies.

model 3 also shows that the level of private school enrollment (in all three types of private schools) was positively related to SES school segregation too, after controlling for residential segregation. The relevance of the educational market-related variables for explaining SES school segregation is clear upon comparing the estimated standardized coefficients: the estimated effects of the proportion of both non-subsidized private school enrollment (0.43) and fee-paying voucher school enrollment (0.37) were greater than the estimated effect of residential segregation (0.32).

Additionally, model 4 included the four complementary measures of the kind of school supply existing in the municipality (number of schools of each type). This reduced the estimated coefficients of the enrollment of both type of voucher private schools (in fact, both coefficients became statistically not significant[17]); however, the estimated coefficient of the variable that measures the number of private schools with shared financing became significant ($p < 0.05$). This finding suggests that at least part of the estimated effect of voucher private schools (especially those with the co-payment system) on SES school segregation is linked to the quantity of schools operating in a given area, an indirect measure of the intensity of school choice available for parents.

Lastly, it should be highlighted that all fitted models reported in Table 3 accounted for a remarkable large proportion of the observed variability in SES school segregation among municipalities (R^2 ranged from 0.80 to 0.95).

Overall, our estimates indicate that the educational policy variables are strong predictors of SES segregation at local level. For example, the estimated coefficients of model 3 imply that an increase of one standard deviation in the participation rate of the enrollment in voucher private schools with co-payment at municipal level was related to an increase in the SES school segregation of 0.37 standard deviations on the D-Index; this is 2.5 times the estimated effect of an equivalent increase in free private-subsidized schools, and 1.2 times the estimated effect on school segregation of an equal increase in residential segregation. These estimated effects are larger when we include the numbers of school types as additional control variables (model 4), which means that segregation in big cities is larger because individual schools are much more differentiated in price, serving targeted groups of families defined by their payment capacity.

Summarizing, based on the regression models of Table 3, we concluded that the variables linked to the market dynamics present in the Chilean education at local level accounted for a relevant portion of the observed differences in SES school segregation among municipalities, and that this relationship was not entirely explained by the degree of SES residential segregation.

Discussion and perspectives: the complexities of school segregation

The socioeconomic segregation of schools is a relevant characteristic of an educational system, since it potentially affects both the quality of the educational process and the equity of the distribution of educational opportunities and outcomes. Undoubtedly, SES school segregation is a complex result of causes that combine structural and cultural features of a society, with characteristics of the organization and operation of the educational system itself. In this paper, we presented an empirical analysis of the SES school segregation in Chile, whose educational system is regarded as an extreme case of a market-oriented education. Specifically, we estimated the magnitude and evolution of the SES segregation of Chilean schools at

both national and local levels, and we studied the relationship between some local educational market dynamics and the observed magnitude of SES school segregation at municipal level.

Summarizing, we found that the magnitude of the socioeconomic school segregation in Chile was very high and tended to slightly increase during the last decade; we also found that private schools – including voucher schools – were more segregated than public schools; and we estimated that some educational market dynamics (i.e. privatization, school choice, and fee paying) accounted for a relevant proportion of the Chilean SES school segregation. We interpret these findings as broadly consistent with our hypothesis that links SES school segregation and market-oriented mechanisms in education, which is additionally supported by recent international reports based on PISA 2009 (OECD 2010a) and handbook chapters specialized on these issues (Gill and Booker 2008), which demonstrated that larger private school participation on educational market is not coupled with improvement on the average national standardized test scores but it is strongly related to more segregated and unequal educational systems.

Our study faced some data limitations that prevent us from making more strong causal claims. For example, we did not have reliable data for estimating the segregation index prior to the implementation of the market-oriented reform in 1980 or even prior to the introduction of the co-payment system in 1989 and its reform in 1993; thus, it was not possible to conduct pre–post analyses. Additionally, although we controlled for several relevant covariates including urban segregation, cross-section multiple regression analyses did not allow us to make causal inferences. Therefore, additional research is needed to fully understand the relationship between SES school segregation and some of the market-oriented educational policies that are currently being discussed in many countries. Nevertheless, we do think that our findings provide enough evidence to be cautious about the potential effect of those policies on increasing SES segregation.

Certainly, a comprehensive evaluation of market reforms in education should consider not only equity but also quality issues. For example, Hanushek and Woessmann (2010) provided international evidence that market competition could improve educational outcomes when schooling systems contain strong accountability mechanisms and high levels of autonomy for their schools; nevertheless, as we discussed previously, the current international evidence is not conclusive on this dimension (Belfield and Levin 2009; Witte 2009).

An unexpected finding of our study was that the level of estimated SES segregation was somewhat higher in primary schools than in secondary schools. A plausible explanation is that higher possibilities of commuting for secondary school students contribute to greater social integration; another hypothesis is that – in areas with limited high-school supply – the larger relative size of secondary schools allows students who were more segregated in primary schools to be gathered; a third potential explanation is that in a context where secondary schools are more selective than primary schools (which have almost universal coverage), the social distance between the 30% lowest SES group and the rest of the students is smaller, and as such, they have higher chances of being more socially integrated. This latter hypothesis is also consistent with the fact that secondary school SES segregation has increased in the same period in which the dropout rate of the most disadvantaged students has decreased rapidly.

We did not study the effects of SES school segregation, but the fact that Chilean students are so highly segregated may be related to the finding that consistently indicates that – in comparative terms – students' academic achievement is strongly related to students' SES in Chile (Mizala, Romaguera, and Urquiola 2007; UNESCO-OREALC 2010; OECD 2010a), an issue that future studies should tackle.

An enduring debate within the sociological literature has evolved around the level of autonomy that educational systems have from other fields of their societies; from this perspective, the Chilean case shows that educational institutions are not just a mirror of contextual factors, since educational dynamics would have made SES school segregation considerably greater than residential segregation. Consequently, desegregation educational policies are needed if Chilean society wants more socially integrated schools. However, policy-makers tend to avoid desegregation policies as they are highly contentious (Bonal 2012).

In this respect, some policy implications that can be drawn from the current study clearly show the potentially controversial aspects of desegregation policies. For example, in order to reduce price discrimination in education, the co-payment mechanism should be eliminated, making voucher schools free, a policy that would be consistent with comparative evidence showing that countries with larger percentage of private financing for schools obtain lower average standardized test scores and more unequal educational outcomes across schools (Woessmann et al. 2009); additionally, to reduce self-selection, parent school choice should be controlled to some level, a policy that has been in place in many school districts for several years (Willie, Edwards, and Alves 2002; West 2006); besides, to ameliorate schools' exclusion practices, admission policies at school level should be regulated and supervised, as a recent Chilean law does for the early primary grades (Willms 2010; OECD 2010b); finally, to make possible that Chilean public education compete with private-subsidized schools in more egalitarian conditions, it is imperative that public schools receive a priority treatment in several dimensions, like funding, regulations, and school improvement programs, an standard practice in most countries (Bellei, Gonzalez, and Valenzuela 2010). All of these educational policy issues relate to very fundamental aspects of the organization of an educational system, its relationship with influential stakeholders, and its link to social-class dispute in the educational field.

Acknowledgments

Notes

1. Note that we are focusing on educational policy variables; additional factors – like cultural aspects linked to family preferences- are not discussed here. Anyway, there is no rigorous evidence about whether or not Chilean parents prefer segregated schools.
2. This changed in 2008, when the *Preferential Voucher Law* was passed: this differentiated the cost of the public voucher according to the socioeconomic level of students. Our empirical analyses covered until 2008, so they are not affected by this policy change.

3. *Shared Financing* schools apply a monthly charge per student. Depending on the amount charged, a partial discount of the public subsidy is applied. Even though parental contributions to state-funded schools were approved in 1988, the present framework of the co-payment system was set up in 1993. Although the co-payment system was initially restricted to voucher private schools (both primary and secondary schools), later it was extended to public secondary schools.

4. We also studied the exposure dimension of Chilean schools' segregation by estimating an Isolation Index (not reported here). The findings were highly consistent with those discussed in this paper. Results are available from the authors.

5. D-Index is calculated by: $D = \frac{1}{2}\sum_{i=1}^{I}\left|\frac{EV_i}{EVT} - \frac{ENV_i}{ENVT}\right|$ where i represents a school within the territory of analysis (country, region or municipality); EV represents the disadvantaged students and ENV the non-disadvantaged ones; while EVT is total disadvantaged students and ENVT is total non-disadvantaged ones.

6. Since D-Index is symmetrical, its value is identical for the group of disadvantaged and non-disadvantaged students, so what is relevant is the definition of the dichotomous separation of the school going population. For a technical discussion about the D-Index see Allen and Vignoles (2007), Hutchens (2004), and Cortese, Falk, and Cohen (1976).

7. For example, the Hutchens index (2004) is sensitive to population size but it is much more difficult to interpret and relate with the available research on this issue, and it tends to display low values when the level of segregation is moderate (Allen and Vignoles 2007).

8. Missing data on father's education was imputed from the mother's educational level.

9. SIMCE is the Chilean national testing system, which evaluates all students in 4th, 8th, and 10th grade in alternate years. Since 1998, SIMCE also applies a complementary survey to the families of students being assessed (the response rates of these surveys range from about 80 to 90%).

10. In order to have an estimate of the level of SES school segregation at a national level based on a completely different data source, we calculated the Dissimilarity Index using the information provided by JUNAEB (the public institution that coordinates the food program within the educational system), which is the percentage of students considered disadvantaged at the level of each school. Elacqua (2012) estimated school segregation in Chile by using this dataset. Broadly, our results were consistent with those reported there, but they were highly unstable because the quality of these data is lower. In particular, JUNAEB index is less appropriate for our purposes, mainly because – due to its link with the School Food Program, the proportion of schools that send information varied significantly over time and the value '0' is assigned to schools that do not send information (mainly all non-subsidized private schools and a significant but variable share of voucher private schools).

11. These databases include nearly 780,000 individuals for 2002 and 693,000 for 1992.

12. Also, controlling by size of enrollment and number of schools at municipal level corrects insensibility of Duncan-Index to population size (Cortese, Falk, and Cohen 1976).

13. Only municipalities with at least five urban primary schools were included, since a minimum number is required for families and schools to be able to choose.

14. Since the last Chilean Population Census was conducted in 2002, we decided to use the closer available data on school segregation for conducting regression analyses that controlled for residential segregation. Nevertheless, as a sensitivity analysis, we carried out similar regressions using 2006 data, and confirmed that the conclusions obtained for 1999 were robust.

15. Note that – *ceteris paribus* – the D-Index tends to be higher as the proportion of students considered in the reference category out of the total population is lower; in our study, the extreme case of this situation are the private fee-paying schools, in which nearly all students are non-disadvantaged. Nevertheless, as we will discuss, the multiple regression analysis showed that the level of school segregation was not a mechanical reflection of the existing proportion of disadvantaged students.

16. Detailed results are available from the authors.

17. Note that – obviously – both measures (level of enrollment and number of schools) are highly correlated.

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Appendix

Table A1. Descriptive statistics (large sample, models 1 and 2 in Table 3): urban schools, 159 municipalities with five or more schools, fourth-grade primary schools, 2006.

Variable	Mean	Standard deviation
Duncan index 2006	0.439	0.115
Duncan index 1999	0.389	0.124
Number of municipal schools	9.18	7.80
Number of subsidized schools without SF	3.56	4.16
Number of subsidized schools with SF	9.17	12.99
Number of private fee-paying schools	2.47	5.51
Enrollment participation fourth-grade municipal primary school	48.74%	19.17%
Enrollment participation fourth-grade private-subsidized primary school without SF	17.06%	16.83%
Enrollment participation fourth-grade private-subsidized primary school with SF	28.94%	21.30%
Enrollment participation private fee-paying fourth-grade primary school	5.25%	12.06%
Percentage of disadvantaged students in the municipality	30.44%	12.00%
Percentage of intermediate socioeconomic level students in the municipality	42.13%	8.22%
Municipal poverty rate	15.72%	7.34%
Total urban enrollment fourth-grade primary school	1136.0	1185.8
Average per capita income 2006 ($)	156,779	102,254
Per capita income variation coefficient	1.21	0.616
Dummy region 13 (and dummies for each region)	27.04%	–
Number of municipalities	159	–

Table A2. Descriptive statistics (reduced sample, models 3 and 4 in Table 3): urban schools, 51 municipalities or cities of 100,000 inhabitants or more, fourth-grade primary school, 1999 (weighted by urban enrollment 1999).

Variable	Mean	Standard deviation
Duncan index 1999	0.457	0.096
Residential segregation 2002 census	0.349	0.087
Number of municipal schools	20.87	9.17
Number of subsidized schools without SF	6.70	5.73
Number of subsidized schools with SF	16.96	13.35
Number of private fee-paying schools	8.86	8.95
Enrollment participation fourth grade municipal primary school	48.35%	13.65%
Enrollment participation private-subsidized fourth-grade primary school without SF	11.51%	10.58%
Enrollment participation private-subsidized fourth-grade primary school with SF	30.30%	15.90%
Enrollment participation private fee-paying fourth-grade primary school	9.82%	13.10%
Percentage of disadvantaged students in the municipality	21.63%	8.83%
Percentage of intermediate socioeconomic level students in the municipality	42.12%	8.63%
2000 poverty	16.84%	7.30%
Total urban enrollment fourth-grade primary school	3497.5	1703.7
Dummy region 13	50.51%	–
Number of municipalities	51	–