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# Destructive Creation: School Turnover and Educational Attainment

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# Destructive Creation: School Turnover and Educational Attainment

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**Abstract**

This paper studies the effect of school entry and exit in the Chilean market-oriented educational system. During the period 1994-2012, 2,151 schools closed, roughly one-fifth of the current stock of schools. At the same time 3,770 new schools entered the school system, mostly private-voucher schools. Given this significant school turnover we use a large panel of administrative data, which contains individual students' academic achievement and socio-demographic characteristics, to estimate the potential educational costs of this dynamics. We identify a causal effect of school closures on grade retention and school dropouts. School exit is associated with a 44 percent increase in the probability of grade repetition in 5th grade (2.2 percentage points) and a 79 percent increase in the probability of school dropout in tenth grade (1.1 percentage points). We also estimate the potential "productivity gains" associated to market's creative destruction dynamics by studying its impact on the schools contribution to students' educational achievement. We find that, at the municipality level, school turnover predicts improvements in school performance -after controlling for students' socioeconomic status- only for low population municipalities, while it has no effect for high population municipalities located in urban areas with intense market dynamics. Moreover, we find a negative impact on school performance if turnover is associated with a significant school replacement.

**Keywords**. school choice, exit, entry, market turnout, education, grade retention, dropout.
**JEL Classification: H4; I2**.

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# 1 Introduction

It is common to postulate that free-entry is central -even indispensable- for a market to work well. It is argued that "creative destruction" (Schumpeter, 1942) could lead both to vertical innovations (e.g. quality and productivity improvements) and horizontal innovations (e.g. product variety). In theory, free entry and exit may allow an industry to cleanse, leading low-quality providers to exit the market and offering more alternatives for consumers. In education, the potential benefits of creative destruction should translate into better school quality and a greater variety of educational projects available to parents. A more skeptical view emphasizes the costs and disruption that could be associated to creative destruction. This might be especially sensible in markets with significant failures such as information asymmetries and incomplete contracts, or if the costs of entry and exit are important (e.g. large infrastructure costs). In education, "school destruction" is associated with a disruption of children's learning and socialization process. It may also affect the live of families and involved communities.[1]

This paper explores different aspects of school entry and exit in Chile, where a nationwide school voucher program was introduced in 1981, creating a dynamic educational market with high turnover rates. For the period 2002-2012, we first estimate the potential educational costs of this dynamics in terms of disruption and harm to students. Specifically, we attempt to identify the causal effect of school closure on grade repetition and high-school dropout rates. Then, we estimate the potential "productivity benefits" associated to market's creative destruction dynamics by studying the impact of school turnover on schools' academic performance.

The Chilean case is interesting for several reasons; first, the country has a very liberalized school market that has been in place for more than 30 years without relevant changes. Second, we have new data on school entry and exit, and use individual administrative panel data that allows us to control for individual students' characteristics, both in the analysis of potential costs and productivity gains. Third, recent evidence has shown that anticipated school closure has potentially important pedagogic and social costs (Engberg et al 2012; de la Torre and

[1] Recent studies focus on the impact a school closure can have in neighborhood social cohesion (Witten et al, 2001) and the development of local society (Egelund and Laustsen, 2006).

Gwynne 2009; Kirshner et al 2009). In our case, since closures are unanticipated, the costs of adaptation are potentially larger as parents may not be prepared for the change, and the choice of a new school could be more constrained since schools tend to have fewer slots in grades different from the entry points into most schools (pre-K, first grade and ninth grade). Fourth, in the last decade many districts in the United States have decided to close schools due to declining enrollment, competition from charter schools, or chronically low levels of academic performance. Other education systems, including Western Ontario or Norway have implemented similar policies in recent years. However, there is scant research on the effect school closures have on student outcomes.[2]

We begin by characterizing the turnover dynamics of the Chilean school market. Between 1994 and 2012, the total number of schools in the system increased from 9,800 to 12,000. The net increase in schools seems to be significantly driven by demographics and increase in coverage. However, it hides an impressive turnover. The creation and destruction rates found in this paper for the Chilean school market are comparable to that shown by industries with small-to-medium-sized firms. Indeed, between 1994 and 2012 we found that 2,151 primary and secondary schools exit the market and about 3,770 entered the market.[3] Nearly half of the exiting schools were public and the remainder private. The annual "destruction rate" for public schools and private-voucher schools was around 1.1 percent per year. Larger turnover rates seem to be associated to neighborhoods that experienced population changes during this period. School creation during the period was mainly an urban phenomenon driven by private-voucher schools in areas of urban expansion.

The main finding of this paper is the identification of large causal effects of school closure on grade repetition and dropout rates. Our identification strategy for grade repetition, is based on comparing fifth-grade students displaced from a school that closed the previous year with classmates in the receiving school (i.e., we include fifth-grade schools' fixed effects). We take advantage of the richness of the dataset to control for the characteristics of the school attended in fourth grade (parents' schooling, grade repetition, standardized-test scores); at

[2]Nonetheless, there is a related literature on the effects of student mobility that consistently finds adverse effects of mobility on student outcomes (Hanushek et al 2004, Booket et al 2007, Xu et al 2009, Ozek 2009). Moreover, Hanushek et al 2004 also find that school mobility involves a negative externality, reducing achievement of all students in the receiving schools.

[3]The numbers are 2,822 and 4,647, respectively, if pre-K-and-kindergarten-only schools are included.

the individual level, in addition to sociodemographic characteristics, we control for two measures of cognitive skills (GPA and standardized-test scores in fourth grade), school-attendance record and grade repetition in previous years. We find that school closure increases the probability of grade repetition by 44 percent (2.2 percentage points). Moreover, we attempt to decompose this effect by comparing grade repetition for students displaced by an unanticipated closure and those who switch to a different school for other reasons and, thereby, must also face an adjustment cost. This is done by restricting the previous estimation only to students who switch schools at the end of fourth grade. Of the total effect, 1.5 percentage points (30 percent of the total) seem to be explained by the disruption of a closure and only 0.7 percent (14 percent of the total) by the adjustment faced by the regular effect of a switch to a different school.

Since dropouts occur mainly in high school, we estimate the effect of closure for tenth-grade students using controls similar to those used for grade repetition.[4] In this case, in addition to the school and individual controls described previously, we are able to address the potential endogeneity problem associated to the fact that students in closing schools could differ systematically in observables and non-observables to those in other schools. We do so by comparing the dropout rates of students whose schools close at time $t$ with that of students whose schools close in $t+2$. We find that the effect of school closure on high-school dropout rates is significant, increasing the probability of dropping out by 79 percent (1.1 percentage points).

Finally, we study the impact of school turnover between 2000 and 2012 on the school system's productivity; to accomplish this we compare the change in schools contribution to students' educational achievement between local markets with different school entries, exits and turnover. The school contribution is calculated as the average residuals from a regression of normalize students' test scores in standardized achievement test on parents' education. We find that, at the municipality level, school turnover predicts changes in school performance -after controlling for students' socioeconomic status- only for low population municipalities, which represents just 16 percent of the national population, while there is no association for

[4] We consider fifth-grade students for grade repetition and tenth-grade for dropout to take advantage of individual data on standardized test scores and family background that is consistently available for students in these grades.

high population municipalities. The results are confirmed if we use population increase and the number of schools normalized by population as instruments for turnover, in line with Hsieh and Urquiola (2006). Moreover, we find a negative impact on school contribution to students' learning if turnover is associated with a significant school replacement. Hence, we do not find an economically relevant productivity improvement in urban areas with intense market dynamics.

This paper contributes to two literatures. On the one hand, our disruption results contribute to a recent literature on the impact of student displacement on academic achievement. These studies have focused on the United States, and find that transition to a new school can have adverse effects on attendance and achievement gains for students from closed schools; effects that can be offset only when students move to higher-performing schools. Torre and Gwynne (2009) compare the learning trajectories (as measured by math and reading test scores) of students ages eight and older who were displaced by school closing in Chicago, to those of a group of students in similar schools that did not close. The authors find a negative effect on student achievement in the year the closings were announced, but find no effects after students enrolled in their new schools. The learning outcomes of displaced students depend on the characteristics of receiving schools.[5] The latter is consistent with our results as we find that grade repetition of displaced students increases with school difficulty.

Engberg et al (2012), adds to this literature addressing the non-random sorting of student out of closed schools into new schools, and examining a school closure plan in a mid-sized urban district, that explicitly sough to move students from low value-added schools, which would be closed, to high value-added schools. They analyze the rate of absences and students' academic performance after the reassignment. They find that the transition to new schools can have an adverse effect on attendance and achievement for students from closed schools, but these effects can be minimized when students move to higher-performing schools.

These papers do not study the impact of closures on grade repetition and dropout, and focus on anticipated closures in the U.S. However, their results are broadly consistent with our

[5] A second Chicago study by SRI International, examined the Renaissance 2010 initiative which had the goal of closing 60-70 schools and opening 100 new smaller schools by 2010. This study uses a matching strategy to examine two cohorts of students from closed schools attending 23 newly created schools and finds that students generally performed at the same levels as matched comparison students (Young et al 2009). Yet, a case study of a high school that closed in a western city shows that transferring students to new schools disrupted their relationship with teachers (Kirshner et al, 2009).

findings as we also find negative effects of closures on academic achievement. Although direct comparisons are not possible, the magnitude of the effects we find are considerably larger in percentual terms, in part due to the unanticipated nature of school closures in Chile. The richness and size of our individual panel allows us to control for student's cognitive skills, previous academic performance and fixed school effects.

On the other hand, our productivity results relate to the vast literature on the impact of market competition and regulation on educational outcomes.[6] Since the Chilean school system became a generalized voucher system after the 1981 market-oriented reforms, it has attracted much research. However, it has mainly focused on the relative performance of public and private-voucher schools[7], and on the impact of school competition on school performance (Hsieh and Urquiola 2006, Gallego 2006). Surprisingly little is known about a salient aspect of the Chilean school market, i.e., the effect of school turnover on educational outcomes.

More closely related to our paper, using data from 90 Chilean municipalities, Hsieh and Urquiola (2006) exploit the massive entry of private-voucher schools between 1982 and 1996 to identify the impact of the expansion of school choice on standardized test scores and schools' socioeconomic segregation at the municipal level. They find no significant effects of the increase in school choice on test scores for this period. In this paper we focus on a different dimension of market competition. Other important differences relate to the data used. While the Hsieh and Urquiola consider the period right after the voucher system was introduced in 1981, our results use data from the last two decades, so our results cannot be attributed to transient effects. Importantly, our measures of school contribution take advantage of administrative-individual-level data, allowing us to separate the contribution of family background from that of the school; additional controls are also included. We also have data for all 345 municipalities, which enables us to identify heterogeneous effects for low and high population communes. The former have low urbanization, relatively low school entry and replacement rates, and low participation of the private-voucher sector; the latter include the main urban centers, characterized by intense market entry and relatively

[6]There is a large literature that finds mixed results on the impact of school choice on school performance. Influential work includes Hoxby (2000), Rothstein (2007), and Cullen, Jacob and Levitt (2005) for the United States; Angrist, Bettinger and Cremer (2006) for Colombia and Hsieh and Urquiola (2006) for Chile.

[7]See, for example, McEwan (2001), Sapelli and Vial (2005), Anand et al (2009), Lara et al (2011), among others.

high replacement rates driven primarily by private-voucher schools. Our results for high-population urban areas are consistent with the findings of Hsieh and Urquiola, as turnover is associated with a negligible effect on school productivity, and even negative if local school replacement is high. In contrast, in low-population/low-urbanization communes the effect of turnover is positive.

The rest of the paper proceeds as follows. Section 2 briefly describes the Chilean school system. Section 3 presents our measures of entry and exit, the data, and the some stylized facts describing the connection of market turnover with school characteristics and socio-demographic variables. Section 4 presents our findings on the impact of school closure on grade repetition and high school dropouts. Section 5 explores the association between school turnover and school improvement. Section 6 concludes.

## 2 Chile's School System

In 1981, Chile introduced school finance reforms creating a liberalized school market. Three types of schools emerged: (i) Public or municipal schools are run by 345 municipalities which receive a per-student subsidy from the central government. These schools cannot turn away students unless oversubscribed; they are the suppliers of last resort. (ii) Private-voucher schools; these are independent religious or secular institutions that receive the same per student subsidy as public schools. Unlike the public schools, they can select their student establishing their own admission and expulsion policies. (iii) Private unsubsidized schools are also independent, but receive no public funding.[8]

In 1994, private institutions accounted for 36.4 percent of all schools and 40.7 percent of total enrollment. Private voucher schools alone accounted for 26.9 percent of all schools and 31.8 percent of enrollment. In 2012 private institutions accounted for 55.2 percent of all schools and 60.5 percent of enrollment, while the participation of private voucher schools reached 49.7 percent of all schools and 53.2 percent of enrollment.

All private schools can be explicitly for-profit. Some are run by privately or publicly-held corporations that control chains of schools, but the modal one is owned and managed by a principal/entrepreneur. There are few barriers to entry. While initially private-voucher

[8]More details about Chilean educational system can be found in Gauri (1998) and in Lara et. al. (2011).

schools were not allowed to charge tuition to supplement the voucher subsidy ("add-on" fees), this restriction was eased in 1993. Public schools are allowed to charge fees only at the secondary level, although in practice few of them do.[9]

# 3 Data and Basic Statistics

We start with a description of our measures of entry and exit and the data used. Next, we present some of basic stylized facts of school entry and exit dynamics in the Chilean market-oriented school system.

## 3.1 Measuring Entry and Exit

To identify individual school entries and exits, our starting point is the official listing of schools (*Base Directorios*) published annually by the Ministry of Education (MoE). It contains all schools -Pre-K, Kindergarten (K), primary, and secondary- since 1992.[10] In principle, each school is uniquely identified by an ID (labeled *RBD*). For each school, the listing contains the school name, address, municipality where it is located and whether it is located in a rural area. In contrast to other systems, private schools are not required to inform their closure to the MoE, hence, the official registry of closures is incomplete. Additionally, some non-voucher schools have become voucher schools over time. Each of these changes could be associated with ID changes that might mistakenly be considered as an exit or entry. To properly identify exits and entries, we conducted a procedure in three stages. In the first stage, the changes in the listings yield a set of potential entries and exits. In the second stage, first-stage exit candidate is validated using an Official Exit Record of the MoE that contains all the schools that were registered as closed by local officers. In the third stage, we use the individual panel with official administrative data available for each student since the year 2002 to filter candidates of the previous stages by tracking groups of students in closing and new schools. Finally, prior to 2002, we checked one-by-one all the names and addresses of the non-voucher private schools that closed between 1997 and 2001. The details of the

[9]Structural reforms have been approved during 2014 by the Chilean parliament. After a transition period, these reforms will imply that private-voucher schools will not be allowed to charge tuition, to be for profit, and to select students.

[10]These databases, as well as the majority of the other sources of information used in this paper, can be accessed by any researcher at www.centroestudios.mineduc.cl.

procedure can be found in the Appendix.

In addition to the sources of information described above we use other data sources. In particular, we consider: (1) The SIMCEs: standardized test taken every year by all students in the 4th and every other year by all 10th grade students. This database is critical to identify the effect of school closures on grade retention and high school dropouts. Moreover, from parent surveys that are carried out during the SIMCE process we obtain more information about individual students, for instance their mother's and father's education, and their opinion about schools' characteristics. (2) The administrative panel data from 2002 to 2013 for all students in the country from the Ministry of Education. This panel includes the school attended every year, the grade (and whether they repeat the grade), the attendance rate, and some basic demographic information. (3) Schools' IVE: a school-level measure of the students' socioeconomic vulnerability, calculated by the MoE in order to allocate school meals. (4) Other variables to characterize the social, demographic and economic characteristics of each municipality such as municipal population, income and unemployment rates.

### 3.2 Basic Facts: School Entry, Exit and Turnover 1994-2012

In line with the industrial organization and economics of innovation literature we use school turnover in a particular year to designate the sum of market entry and exit during that year. The creation or entry rate at time $t$ is simply the number schools that enter, normalized by the total number of schools in the system that year. Similarly, the destruction or exit rate is the number of exits, normalized by the total number of schools at the time of exit.

Figure 1 summarizes the basic facts of school entry and exit in Chile. Between 1994 and 2012, the number of schools that closed was 2,151, yielding an average annual exit of 113 schools per year and annual destruction rate of 1.10 per cent. Recent studies, with a smaller sample of schools than ours, have found very similar destruction rates for this period.[11] Importantly, over time, the number of school closures does not seem to be slowing down.[12] Nearly 15 per cent of the entire universe of schools that operated during the last two decades closed. The number of new schools that entered the system during this period was 3,770,

[11] For the sample of voucher schools offering primary school grades, Elacqua et al (2015, in preparation) report exits that amount to an average destruction rate between 1990 and 2008 of around 1 per cent.

[12] Indeed, if we consider primary and secondary schools only, during the span 2002-2012 the average number of closures was 129 schools per year.

with an annual average of 198 schools, and a creation rate of 2.0 per cent.

How large are these magnitudes? As mentioned earlier, the Chilean school system is, by design, one the most market-based in the world. Private-voucher schools are funded on a per-student formula and can be explicitly for profit[13]; they can charge add-on fees to parents; price-discrimination with parents in the same school is a common practice and selection based on family characteristics and academic performance was widespread during this period; the creation of new schools is weakly regulated and any entrepreneur willing to create a new school can do so, making it a free-entry-and-exit market. Thus, a natural "positive benchmark" are simply small and middle-sized firm industries. Indeed, the turnover rate of the Chilean school system -around 3 percent (3.5 percent if pre-K and K only schools are considered) is in fact quite similar to the average turnover rates found historically for middle and small-sized-firms industries, that range between 1 and 4 percent (See Grilliches and Regev 1979; Bartelsman, Haltiwanger, Scarpetta 2004 present cross-country comparisons; Benavente and Kulzer 2008, provide estimates for Chilean firms).[14]

In Chile, public, private-voucher and private non-voucher schools have different motives and constraints to create and close schools. For example, in contrast to private schools, a new public elementary school is required to offer all elementary grades and could not start by offering a few grades to expand gradually. At the same time, since public schools are under the administration of municipalities and many of them face significant financial deficits, the public supply of new schools has faced severe financial constraints.

During the period of study, if we focus on primary and secondary schools, 52 percent of the exits correspond to public schools, 33 percent to private-voucher schools and the rest private non-voucher schools. In contrast, entry was largely dominated by private-voucher schools, accounting for 81 percent during this period. Only 10 percent of entries were public schools.

[13]In 2012, nearly one third of total enrollment attended schools that -at least from a legal point of view-were for profit.

[14]Perhaps a more sensible benchmark would be to compare with other educational systems but there are no systematic statistics and the causes of school closures could be quite different across countries. Still, a handful of examples are consistent with the view that the Chilean school closure rates are relatively high, in all these cases similar rates of school closure to those in Chile generated major public debates. In Ontario, between 1999 and 2004, 275 schools were closed prompting the community to mobilize. This number corresponds to a rate of destruction of 1.14 percent, roughly the same as in Chile between 1994 and 2012. In the United States, the large number of closures during the last decade has led to public outcry in cities like New York, Chicago, and others. The destruction rate in the United States during this high turnover period (1995-2011) is also similar to Chile. In Denmark, with one-third of the Chilean population, the closure of 10 to 15 schools per year between 1990 and 1999, most of them rural, was also controversial (Egelund and Laustsen 2006).

Private non-voucher schools represented a smaller fraction of the creation and destruction of schools -9 and 14 percent, respectively- but exhibited a high exit rate -2.5 percent on average-, especially during years of economic downturn.

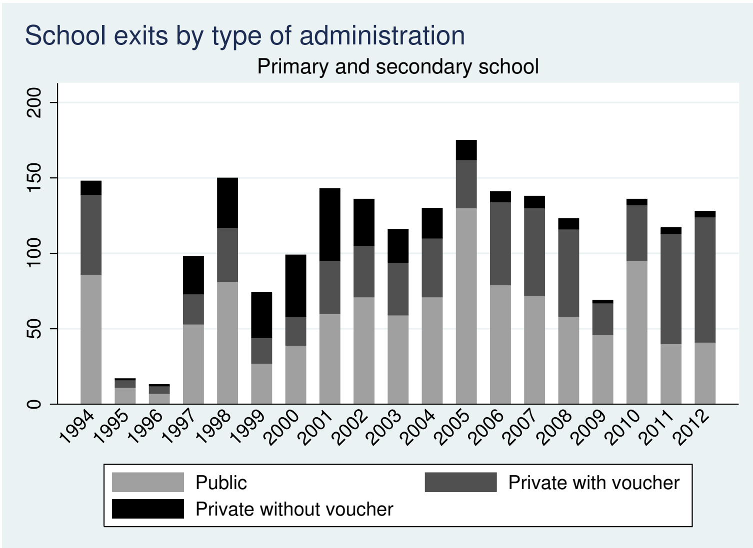


Figure 1: Annual Exit by Type of Administration (Primary and Secondary)

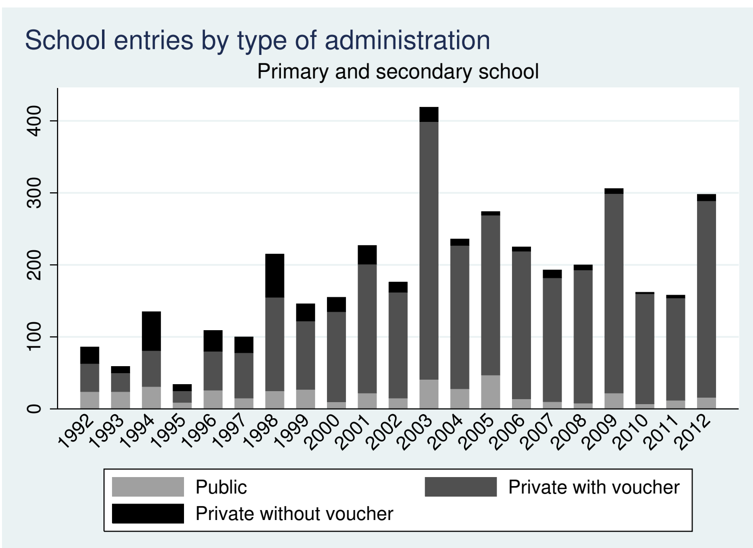


Figure 2: Annual Entry by Type of Administration (Primary and Secondary)

We highlight some descriptive facts regarding the school entry, exit and turnover dynamics in Chile between 1994 and 2012. First, schools that closed during this period had an average enrollment (the year prior to exit) of 330 students. This number is markedly smaller than the average enrollment of 90 students for schools that did not close during this period. Moreover, as shown in Table 1, almost half of the schools that closed were in the first quintile of the enrollment distribution.

Table 1: Distribution of Exits by Enrollment Quintile

| | Enrollment Quintiles | | | | |
|---|---|---|---|---|---|
| | I | II | III | IV | V |
| Exit | 49.17 | 18.05 | 21.26 | 8.14 | 3.38 |

This fact is not particularly surprising as most schools need a critical mass to be economically viable given the considerable fixed costs of school provision. In systems with regulated entry and exit, enrollment is a common factor education administrators take into account when closing or merging schools. Since school financing in Chile is largely based on a voucher system, so that the resources for each school increase almost linearly with enrollment, schools unable to enroll a critical mass of students are not viable.

Second, school exits have more impact on low-socioeconomic status (SES) students. Our SES measure is the IVE index, a measure of student vulnerability produced by the MoE for each school. Higher values are associated with more vulnerability, i.e., lower SES.

Table 2: School Exits by Students' Socioeconomic Status

| | | IVE Quintiles | | | | |
|---|---|---|---|---|---|---|
| | | I | II | III | IV | V |
| Exit | 2002-2012 | 12.91 | 11.73 | 20.76 | 29.33 | 25.27 |
| | 1994-2012 | 14.58 | 11.36 | 20.57 | 27.24 | 26.25 |

Table 2 shows that the distribution of IVE for schools that closed is concentrated on the highest levels of the vulnerability index. Three quarters of the schools that closed are in three highest vulnerability quintiles, that is, in the lowest SES quintiles. The average IVE for closing schools is 0.21 standard deviations higher than the average for schools that do not close. This fact is important because it points out that the effects -good or bad- associated to a free-entry and exit may have been larger for lower socioeconomic status children and communities. It also raises a caution on plain comparisons of educational outcomes between schools that close and those that survive as the population of students differ substantially in a dimension that covaries strongly with those outcomes.

Third, Table 3 shows that relative to the Rural/Urban distribution of schools during this period, the share of rural exits is somewhat higher (48.3% versus 43.8%). However, the pattern of entries was much more imbalanced in favor of urban schools (89.8% versus 56.2%).

Table 3: Rural/Urban Distribution of Schools Entry and Exit

| | Total | Entry | Exit |
|---|---|---|---|
| Rural | 43.77 | 10.21 | 48.32 |
| Urban | 56.23 | 89.79 | 51.68 |
| N obs | 10.468 | 3.917 | 2.117 |

Finally, the last facts to highlight are presented in Figure 3, which shows to what extent school closures are anticipated by families and how that anticipation influences the evolution of cognitive skills of the students who remain in the school until they are forced to leave by the closure. Since we do not have standardized tests for all grades, we use GPA information as a measure of cognitive skills. In particular, if the school $j$ closed in year $t$, we calculate the standardized GPA of the students in that school in year $t-4$. Then, the average cognitive skills of the students in that school in year $t-t'$ ($t' \in \{0,1,2,3,4\}$) is the standardized GPA, calculated in year $t-4$ of the students who are still attending that school in year $t-t'$.

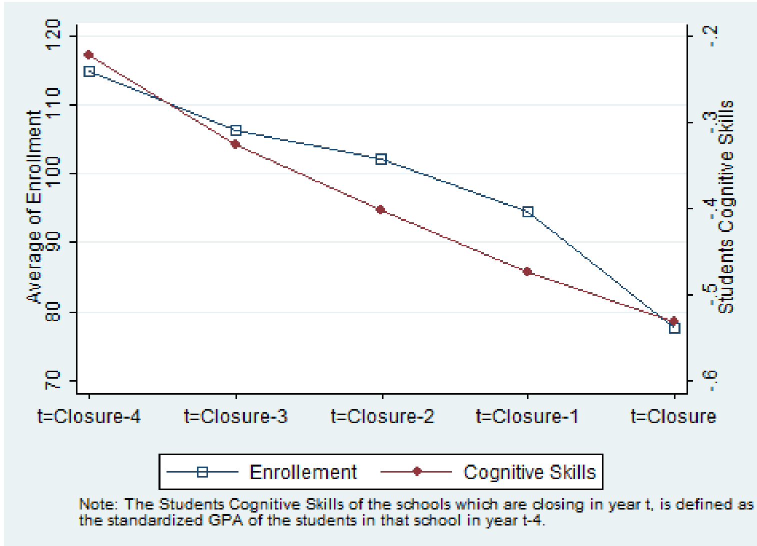


Figure 3: Anticipation of School Closures

Figure 3 illustrates two facts. First, while there seems to be some level of anticipation of school closure –enrollment decline accelerates the year of the closure–, many students stay at the closing school and are forced to switch to another school after the closure. Clearly, this is only a correlation analysis since we cannot determine whether parents anticipate closure or if the decline in enrollment is causing the school closure. Second, the average cognitive skills of students who remain at the school decline as the school approaches to its closure. This is something that must be considered in the empirical strategy to estimate the impact of school closure on students' outcomes.

## 4 School Closures, Academic Success and Dropouts

As we have documented, high turnover and widespread school closures -even in expanding areas- is a stylized fact of the Chilean market-based school system. This section studies two potentially adverse effects of school closure on educational attainment. Namely, we quantify the causal effect of school closure on grade retention and high-school dropout.[15] In the case of grade retention, we also study the characteristics of receiving schools that increase or attenuate the impact of schools' closing on grade retention.

[15]Both are related. In fact, there is solid evidence that grade repetition causes student dropout, see for instance Jacob and Lefgren (2009); and Manacorda, M. (2012).

## 4.1 Grade Retention

Using individual student data we estimate the effect of primary school closure on the probability of grade retention in fifth grade, controlling for a large set of school and individual characteristics, including previous grade retentions. In particular, we compare the probability of grade repetition in the fifth grade for students whose school closed in fourth grade with that of students whose school did not close. The advantage of using fifth-grade data is that all students take a standardized achievement test in the fourth grade, which we use to control for differences in cognitive skills. Thus, we use all the years in the panel for which we have fourth grade standardized achievement test information and student individual data, namely, 2005 and 2007-2011.

Table 11 in the Appendix presents descriptive statistics of our dependent and independent variables. Students whose schools closed the year they enrolled in the fourth grade are referred as *displaced students* and those whose schools did not close as *non-displaced students*. As expected, these two groups are quite different. In fact, displaced students not only have higher grade retention rates, but also lower performance, higher rates of previous grade retention,[16] and parents with lower educational attainment. All these variables are included as controls in our estimations. Since the same student may have different grade retention probabilities in different schools, we also include fifth-grade school fixed effect.[17]

In light of the previous literature, it is reasonable to decompose the total effect of school closure on grade retention into two effects. First, school closure forces a student to switch to a new school and this displacement is associated with adaptation costs. It is well known that, conditional on having the same ability, displaced students have a higher probability of grade repetition relative to those who do not switch to a different school.[18] Second, beyond the cost associated with any school switch, unanticipated displacement forced by school closure could be more disruptive than one caused by any other reason (e.g., parents' preferences, planned geographic relocation).

[16] This is approximated using age. It is a binary variable that takes the value 1 if the student is at least one year older that expected and zero otherwise.

[17] In Chile all schools are required to have the same repetition rules. For example, a student repeats a grade if she has two or more subjects below a mark threshold (4.0 in a mark scale from 1 to 7). But schools may have different standards to grade students and different policies to support low achievement students.

[18] See Hanushek et al. (2004).

To decompose these two effects, we consider two specifications. In particular, we estimate the following two linear probability models:[19]

$$Rep_{ijt} = \beta_0 + \beta_1 Closed_{it-1} + \beta_2 X_{it-1} + \beta_3 Z_i + \beta_4 W_{jt-1} + \theta_j + \eta_t + \varepsilon_{ijt}, \tag{1}$$

and

$$Rep_{ijt} = \beta_0 + \beta_1 Closed_{it-1} + \beta_2 X_{it-1} + \beta_3 Z_i + \beta_4 W_{jt-1} + \theta_j + \eta_t + \varepsilon_{ijt}, \quad \forall i \ s.t. \ j(i,t) \neq j(i,t-1). \tag{2}$$

The variable $Rep_{ijt}$ takes the value one if the individual $i$ repeats fifth grade at school $j$ at time $t$ and zero otherwise; $Closed$ stands for a school closure dummy; $X$ includes language and math standardized test scores, GPA, and attendance rate; $Z$ includes gender, dummies for parents' education, and previous grade retention; $W$ includes forth grade schools' average for language and math standardized test scores, parents' education, and previous grade retention; $\theta$ is fifth grade's school fixed effect; and $\eta$ is time fixed effect. Finally, $j(i,t)$ represents the school attended by student $i$ at time $t$.

Before turning to the results, we briefly discuss the merits of these specifications. Our intention is to find the causal effect rather than a simple correlation. Since they include fifth-grade school fixed effects, both specifications control for any feature of those schools that could drive the increase in the probability of grade retention, e.g., the school's difficulty. Moreover, in addition to socioeconomic and forth-grade school characteristics, we also control for three relevant measures of students' ability and knowledge: GPA, which is school specific; standardized test scores -a measure comparable across schools-; and whether they have repeated a grade before. The GPA and the standardized test scores control for cognitive skills, and previous grade retention allows us to control for any time invariant unobservable that is a determinant of grade retention. Finally, we control for the attendance rate, which can be interpreted as a measure of the student and parents' commitment and motivation. Given our controls it is hard to think of relevant –time variant– omitted variables that could bias the results.

[19]We estimate linear probability models to allow for fifth-grade school fixed effects.

The results are shown in Table 4, where columns (1) and (2) present the estimation of equation 1, with and without controlling for socioeconomic and previous grade retention variables, and columns (3) and (4) present the estimation of equation 2. We find that school closure increases the probability of grade retention by 2.2 percentage points, a statistically significant effect. Since grade repetition rates are around 5 percent, this means that the effect of school closure represents an increase of 44 percent in the probability of grade repetition. When we restrict our attention to the students who switch schools at the end of fourth grade (columns (3) and (4)), the size of the effect is 1.5 percentage points statistically significant, which is equivalent to a 30 percent increase of the probability of retention.

Table 4: Effect of school's exits on student grade retention

| | All Students | | Students Switching Schools | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| School exit | 0.0349*** | 0.0224*** | 0.0252*** | 0.0154** |
| | ( 0.00738) | ( 0.00699) | ( 0.00716) | ( 0.00698) |
| Math test score | -0.0001*** | -0.0001*** | -0.0003*** | -0.0003*** |
| | ( 0.00001) | ( 0.00001) | ( 0.00002) | ( 0.00002) |
| Language test score | -0.0001*** | -0.0001*** | -0.0002*** | -0.0002*** |
| | ( 0.00000) | ( 0.00000) | ( 0.00002) | ( 0.00002) |
| GPA at 4th grade | -0.0502*** | -0.0472*** | -0.0422*** | -0.0423*** |
| | ( 0.00072) | ( 0.00071) | ( 0.00161) | ( 0.00174) |
| Attendance at 4th grade | -0.0005*** | -0.0004*** | 0.0000 | 0.0001 |
| | ( 0.00005) | ( 0.00005) | ( 0.00012) | ( 0.00012) |
| Female | -0.0090*** | -0.0079*** | -0.0158*** | -0.0139*** |
| | ( 0.00033) | ( 0.00033) | ( 0.00125) | ( 0.00127) |
| Mother with primary education | | -0.0048*** | | -0.0109*** |
| | | ( 0.00075) | | ( 0.00349) |
| Mother with incomplete secondary education | | -0.0058*** | | -0.0104*** |
| | | ( 0.00074) | | ( 0.00332) |
| Mother with complete secondary education | | -0.0083*** | | -0.0183*** |
| | | ( 0.00067) | | ( 0.00309) |
| Mother with tertiary education | | -0.0086*** | | -0.0201*** |
| | | ( 0.00072) | | ( 0.00326) |
| Father with primary education | | -0.0018** | | -0.0056 |
| | | ( 0.00073) | | ( 0.00345) |
| Father with incomplete secondary education | | -0.0024*** | | -0.0040 |
| | | ( 0.00071) | | ( 0.00326) |
| Father with complete secondary education | | -0.0041*** | | -0.0055* |
| | | ( 0.00065) | | ( 0.00302) |
| Father with tertiary education | | -0.0034*** | | -0.0034 |
| | | ( 0.00070) | | ( 0.00320) |
| Constant | 0.4376*** | 0.5595*** | 0.4494*** | 0.5075*** |
| | ( 0.00664) | ( 0.01528) | ( 0.01347) | ( 0.02413) |
| Previous grade retention | NO | YES | NO | YES |
| 4th grade school characteristis | NO | YES | NO | YES |
| Year effects | YES | YES | YES | YES |
| N | 1187203 | 1090790 | 108377 | 99033 |
| adjusted R-squared | 0.076 | 0.077 | 0.098 | 0.102 |

Standard errors in parentheses; * Significant at the 10 percent level, ** Significant at the 5 percent level. *** Significant at the 1 percent level. We cluster standard errors by school.

Given our data we can also study whether the impact of a previous school closure on grade retention is attenuated or increased in receiving schools with certain characteristics such as school difficulty, defined as $\frac{Test\ score\ rank}{Average\ GPA}$,[20] and a set of indexes describing the

[20]A similar concern was considered by Engberg et al (2012). They show that the negative effects of school closure on students can be minimized when students move to schools that are higher-performing (in value-

extent to which schools consider parents' opinions, quality of teacher-student relationship, and the pedagogical support the school gives to low achievement students.[21] To do so, we run a probit regression of grade retention, considering only displaced students. In addition to individual characteristics, we include characteristics of the previous school as regressors. Table 5 shows the results of this exercise. As expected, school academic difficulty increases the probability of grade retention of displaced students. For other school characteristics, the effects are not statistically significant.

added terms).

[21]We build these indexes from the survey administered to parents when their children took the SIMCE test in 2005. For the variable describing the *Support to low achievement students*, we only consider the responses of parents whose child is bellow the median of the student performance distribution of her class.

Table 5: Probability of grade retention for displaced students (Probit marginal effects)

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Number of students | -0.00057** | -0.00065*** | -0.00047* | -0.00048* | -0.00043* | -0.00052** |
| | ( 0.00025) | ( 0.00025) | ( 0.00024) | ( 0.00025) | ( 0.00024) | ( 0.00024) |
| Difficulty | | 0.000075*** | | | | 0.000059** |
| | | (0.0000260) | | | | (0.0000272) |
| Parents opinions are considered by the school | | | 0.0414 | | | 0.0629 |
| % who say *Satisfied* | | | ( 0.05699) | | | ( 0.06547) |
| Parents opinions are considered by the school | | | 0.0455 | | | -0.0501 |
| % who say *Very satisfied* | | | ( 0.06860) | | | ( 0.09756) |
| Teachers and students have good relationship | | | | -0.0516 | | -0.0459 |
| % who say *Satisfied* | | | | ( 0.10955) | | ( 0.12058) |
| Teachers and students have good relationship | | | | -0.0054 | | -0.0153 |
| % who say *Very satisfied* | | | | ( 0.08870) | | ( 0.10042) |
| Support to low achievement students | | | | | -0.0145 | -0.0433 |
| % who say *Satisfied* | | | | | ( 0.05805) | ( 0.07116) |
| Support to low achievement students | | | | | 0.0527 | 0.0545 |
| % who say *Very satisfied* | | | | | ( 0.05269) | ( 0.07830) |
| Socioeconomic Group 2 | 0.0035 | 0.0079 | 0.0046 | 0.0057 | 0.0039 | 0.0152 |
| | ( 0.02557) | ( 0.02673) | ( 0.02809) | ( 0.02859) | ( 0.02757) | ( 0.03057) |
| Socioeconomic Group 3 | 0.0281 | 0.0210 | 0.0175 | 0.0150 | 0.0177 | 0.0238 |
| | ( 0.03067) | ( 0.02995) | ( 0.03056) | ( 0.03005) | ( 0.03054) | ( 0.03224) |
| Socioeconomic Group 4 | 0.0739 | 0.0370 | 0.0801 | 0.0792 | 0.0857 | 0.0748 |
| | ( 0.06666) | ( 0.05248) | ( 0.07277) | ( 0.07234) | ( 0.07537) | ( 0.07435) |
| Socioeconomic Group 5 | 0.0119 | -0.0129 | Dropped | Dropped | Dropped | Dropped |
| | ( 0.05905) | ( 0.03807) | | | | |
| Private-Voucher School | -0.0041 | -0.0047 | 0.0106 | 0.0170 | 0.0172 | 0.0166 |
| | 0.01275) | ( 0.01232) | ( 0.01477) | ( 0.02772) | ( 0.02891) | ( 0.03029) |
| Private non-voucher School | 0.1806* | 0.1749* | Dropped | Dropped | Dropped | Dropped |
| | ( 0.14835) | ( 0.15521) | | | | |
| Rural | 0.0149 | 0.0179 | 0.0154 | 0.0170 | -0.0145 | 0.0001 |
| | ( 0.02671) | ( 0.02878) | ( 0.02729) | ( 0.02772) | ( 0.05805) | ( 0.00003) |
| N | 1214 | 1178 | 979 | 979 | 977 | 950 |
| Pseudo R2 | 0.192 | 0.205 | 0.200 | 0.200 | 0.203 | 0.216 |

Standard errors in parentheses; * Significant at the 10 percent level, ** Significant at the 5 percent level, *** Significant at the 1 percent level. All models control mother and father education, gender, previous GPA, attendance rate, previous math and language test scores, age (which is a proxy of previous grade retention), and years. We cluster standard errors by school.

## 4.2 Dropout rates

We now estimate the effect of secondary school closure on the probability of dropping out. We define a dropout as a student who is missing for at least two years from the official student registry of the MoE. Since we have tenth grade standardized test scores at the individual level, we compare the dropout rates in tenth grade and thereafter, for students whose school closed in tenth grade to the rates of those whose school did not close that year-grade. We use all the years for which we have standardized test information and student individual data, namely, 2003, 2006, and 2008.[22]

Table 12 in the Appendix presents descriptive statistics of our dependent and independent variables, for those students whose schools did not close at tenth grade and those whose schools closed. As in the case of grade retention, there are marked differences between both groups. Thus, a solid empirical strategy is needed to estimate causal effects. To accomplish this task we have a complete set of controls, as in the estimation of the impact of school closure on grade retention. In addition, we run a specification of our model to test to what extent our approach deals with the endogeneity of closures. In particular, we compare the dropout rates between the students whose school closed in year t (treatment group) with the students whose school closed in year t + 2 (restricted control group). If the students who attended schools that closed at tenth grade are different in some drivers of dropout, which are unobservable for the econometrician, it should be the case that the effect we find of school closure on dropout must be higher when the control group is non restricted than when the control group is restricted. On the contrary, if the effect we find in these two estimations are similar, it implies that our empirical strategy is robust.[23]

To highlight the relevance of this exercise Figure 4 presents the density of the math and language test scores for three groups: the students whose school did not close in year $t$ (the unrestricted control group), the students whose school closed in year $t$, and the students whose school closed in year $t+2$. These two set of densities confirm that the treatment group is much more similar to the restricted control group, than to the unrestricted control group.

[22]We do not include the year 2010 in the main specification because one of our specifications would require data on school exits in 2013, which is not available.

[23]It is pointless to perform this robustness check analysis in the case of grade retention, because in that case the probability of grade repetition for the students whose school will close in 2 more years, depends on

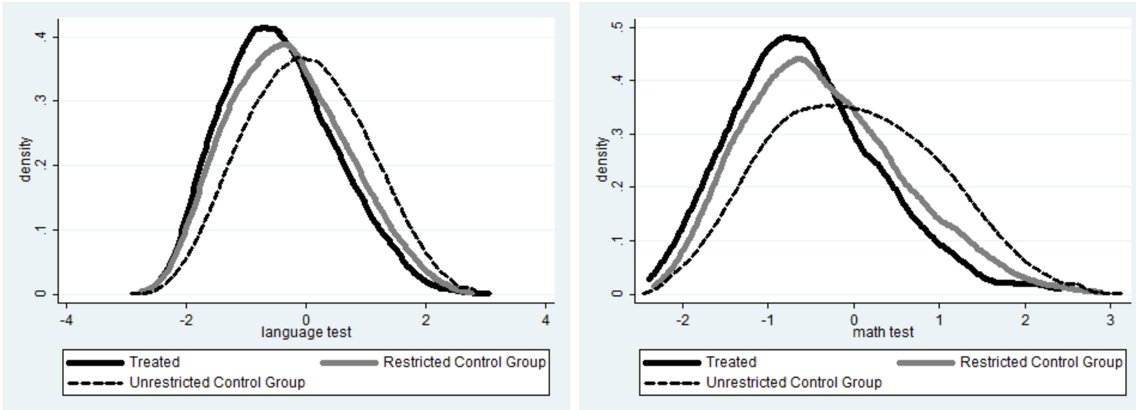


Figure 4: Math and Language Test Scores Density for Different Control Groups

We estimate the effect of school closure, running the following probit model, the marginal effects are reported in Table 6:

$$Pr(Drop_{it} = 1 | j(i, t-1) = k) \quad = \quad \Phi\left(\beta_0 + \beta_1 Closed_{it-1} + \beta_2 X_{it-1} + \beta_3 Z_i + \beta_4 S_k + \eta_t\right)$$

where $Drop_{it}$ takes a value one if individual $i$ leaves the educational system at time $t$ when he/she was attending tenth grade and zero, otherwise. As before, *Closed* stands for a school closure dummy; $X$ includes language test score and math test score, GPA, and attendance rate; $Z$ includes gender, dummies for parents' education; and $S_k$ includes a set of school $k$ characteristics such as the type of administration, the school mean in math and language test scores and the School Dropout rate at $t-1$;[24] $\eta$ is a time fixed effect.

Columns (1), (2), and (3) of Table 6 show the results of this probit regression including different sets of controls. When we include all the regressors, the effect of school closure on student dropout is a statistically significant increase of 0.44 percentage points. Since in this sample the dropout rate is around 1.4 percent per year, our estimate implies that school closure increases the probability of dropping out by 31 percent.

As discussed before, we run the same probit model, with the exact same covariates, changing the *control group* definition. In particular, in this case $Closed_{it}$ takes a value of one

the school level of academic difficulty, which most likely would be low.

[24]Given data restrictions (we only have student individual data since 2002), and to avoid using the same cohort twice, to calculate the school dropout rate in $t-1$, we define a dropout as a student who is missing for at least one year from the official students registry of the MoE.

if the school closes at time $t$, and it takes a value of zero if the school closing will occur three periods ahead (otherwise assigning a missing value). By doing so, we compare the dropout rates of students whose schools closed that year, with the dropout rates of students whose schools closed three years later. The results are shown in columns (4), (5), and (6) of Table 6.

In all cases the effects are similar in magnitude to the case with a less restricted control group and they are all statistically significant. In fact, the point-estimates are larger, however, the precision of our estimates is lower due to the large reduction in the sample size. When we include all the regressors, we obtain a 1.1 percentage point increase in the probability of dropping out, a 79 percentage increase. This exercise rules out the possibility that the estimated impact of school closure on students dropout is driven by the unobserved characteristics of students attending closing schools.

Table 6: Effect of school exit on student dropouts (Probit marginal effects)

| | All Students | | | Restricted control group | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| School exit | 0.0146*** | 0.0143*** | 0.0044* | 0.0162** | 0.0174** | 0.0111** |
| | ( 0.00492) | ( 0.00478) | ( 0.00305) | ( 0.00799) | ( 0.00914) | ( 0.00606) |
| Language test score | -0.0000*** | -0.0000*** | -0.0000*** | -0.0002** | -0.0002*** | -0.0002** |
| | ( 0.00000) | ( 0.00000) | ( 0.00000) | ( 0.00009) | ( 0.00010) | ( 0.00008) |
| Math test score | -0.0000*** | -0.0000*** | -0.0000*** | -0.0000 | -0.0001 | 0.0001 |
| | ( 0.00000) | ( 0.00000) | ( 0.00000) | ( 0.00009) | ( 0.00009) | ( 0.00009) |
| GPA at 12th grade | -0.0078*** | -0.0070*** | -0.0067*** | -0.0176*** | -0.0121** | -0.0167*** |
| | ( 0.00033) | ( 0.00032) | ( 0.00025) | ( 0.00581) | ( 0.00527) | ( 0.00474) |
| Attendance at 12th grade | -0.0002*** | -0.0002*** | -0.0001*** | -0.0005 | -0.0008** | -0.0002 |
| | 0.00002) | ( 0.00002) | ( 0.00001) | ( 0.00045) | ( 0.00042) | ( 0.00032) |
| Female | 0.0009*** | 0.0008*** | 0.0011*** | 0.0077 | 0.0063 | 0.0093 |
| | ( 0.00029) | ( 0.00028) | ( 0.00023) | ( 0.00735) | ( 0.00793) | ( 0.00687) |
| **Education of parents** | | | | | | |
| Mother with primary education | | -0.0018*** | -0.0016*** | | -0.0024 | -0.0027 |
| | | ( 0.00025) | ( 0.00025) | | ( 0.00773) | ( 0.00562) |
| Mother with incomplete secondary education | | -0.0026*** | -0.0021*** | | -0.0184** | -0.0164*** |
| | | ( 0.00025) | ( 0.00024) | | ( 0.00633) | ( 0.00367) |
| Mother with complete secondary education | | -0.0040*** | -0.0030*** | | -0.0154* | -0.0131** |
| | | ( 0.00026) | ( 0.00026) | | ( 0.00793) | ( 0.00556) |
| Mother with tertiary education | | -0.0016*** | -0.0008*** | | -0.0090 | -0.0034 |
| | | ( 0.00030) | ( 0.00031) | | ( 0.01148) | ( 0.00947) |
| Father with primary education | | -0.0014*** | -0.0012*** | | -0.0119 | -0.0074 |
| | | ( 0.00027) | ( 0.00025) | | ( 0.00713) | ( 0.00608) |
| Father with incomplete secondary education | | -0.0023*** | -0.0021*** | | 0.0010 | -0.0018 |
| | | ( 0.00026) | ( 0.00025) | | ( 0.01058) | ( 0.00893) |
| Father with complete secondary education | | -0.0036*** | -0.0030*** | | 0.0037 | 0.0067 |
| | | ( 0.00027) | ( 0.00026) | | ( 0.01003) | ( 0.00912) |
| Father with tertiary education | | -0.0011*** | -0.0009*** | | 0.0044 | 0.0003 |
| | | ( 0.00030) | ( 0.00029) | | ( 0.01028) | ( 0.00874) |
| **School Characteristics** | | | | | | |
| Voucher-private School | | | 0.0002 | | | -0.0167* |
| | | | ( 0.00029) | | | ( 0.01087) |
| Non Voucher-private School | | | 0.0059*** | | | 0.0078 |
| | | | ( 0.00125) | | | ( 0.01466) |
| School Mean Score in Math test | | | -0.00003*** | | | -0.0005** |
| | | | (0.000013) | | | ( 0.00025) |
| School Mean Score in Language test | | | -0.00001 | | | 0.0003 |
| | | | (0.000022) | | | ( 0.00033) |
| School Dropout rate at $t-1$ | | | 0.0365*** | | | 0.0325 |
| | | | ( 0.00533) | | | ( 0.03397) |
| N | 682217 | 617476 | 585932 | 2361 | 2117 | 1770 |
| Pseudo R2 | 0.129 | 0.138 | 0.153 | 0.095 | 0.119 | 0.165 |

Standard errors in parentheses; * Significant at the 10 percent level, ** Significant at the 5 percent level, *** Significant at the 1 percent level. All models include dummies for years 2003, 2006, and 2008. We cluster standard errors by school.

## 5 Market Turnover and School Academic Performance

In section 4 we provided evidence of some of the costs in academic achievement associated to school closures in a free-market school system. In this section we explore the association between market turnover and increases in school productivity, measured by its contribution to students' educational achievement. We start by documenting the stark differences between low-population/low-intensity markets with high-population/high-intensity markets. This heterogeneity turns out to be important to explain the association between market turnover and school productivity.

### 5.1 Heterogeneous School Markets

Table 7 illustrates market dynamics across municipalities with different levels of population and urbanization. The first column corresponds to all municipalities while the second one is for the Metropolitan Region (MR). The MR contains the capital city of Santiago and concentrates near to 40 percent of the country's total population. Relative to the national average, the share of private voucher schools in 2000 and the entry rate are almost doubled in the MR. In contrast, exit rates are very similar.

The next three columns splits municipalities into three groups according to their population (2002 Census): a first group of 211 low-population municipalities -almost two-thirds- with less than 25,000 inhabitants; a middle group of 40 municipalities with population between 25,000 and 45,000; and the third group, the high-population group, comprising the 85 municipalities in the highest quartile of the population distribution. In general, exit rates are quite similar across these groups, while the share of private-voucher schools, entry rate and urbanization all increase with communal population levels. The middle group has figures close to the national averages. However, most of the population is either in low-population or high-population municipalities, with statistics that differ significantly from national averages and are associated with stark differences in school markets. Overall, the low-population group concentrates 16 percent of the total population and has a low average urbanization. These municipalities have significant levels of rurality, low population density, and, in contrast to urban centers, a low participation of private voucher schools. In this group, school creation and destruction is mostly associated to the restructuring of public schools. Indeed, the low-population group displays entry, turnover and private voucher school participation considerably lower than the national average. The high-population group concentrates 75 percent of the total population; it includes all 52 municipalities of the MR and those corresponding to the main urban agglomerations in the country. School entry between 2000 and 2012 is markedly higher for the high-population group, largely driven by the dynamics of the private voucher sector. School creation during this period was predominantly an urban phenomenon driven by private-voucher schools in areas of urban expansion.

At the local level, part of school turnover can be interpreted as replacement: some of the schools that enter, replace schools that close. In principle, replacement could be a sign of both positive or negative market functioning. Replacement could be beneficial if it is systematically associated with an improvement in school quality, namely, better schools replace exiting schools. On the other hand, replacement could simply reflect market mis-coordination and be associated with disruption effects -as those we have documented in Section 4- and the duplication of investments. An imperfect measure of replacement -the part of turnover that "nets out"- is the overlap between entry and exit in a particular market. In a locality with more entry than exit, exits can be interpreted as a replacement of previously existing schools; similarly, with more exit than entry, entry can be interpreted as a replacement of some of the exiting schools (in general, $Replacement = \min\{Exit, Entry\}$). In Table 7 we can see that replacement for the 2000-2012 period is lower in low-population municipalities than in high-population markets (0.24 of a standard deviation).

### 5.2 Changes in Schools' Contribution to Test Results and Market Dynamics

Our measure of school productivity is its contribution to students' achievement in the SIMCE standardized test, controlling for students and school characteristics. In principle, the performance in test results is explained by students' socioeconomic background, school quality and environmental variables such as local crime. Market turnover should affect the contribution of the school to students' academic performance measured through test results. To isolate the contribution of schools, we normalize test scores and control for parents' education. Using a large panel of individual students data for the period 2000-2012 we run the following OLS

Table 7: Communal Heterogeneity of Market Dynamics

| | All | Met. Region | Communal Population < 25,000 | Communal Population 25,000-45,000 | Communal Population > 45,000 |
|---|---|---|---|---|---|
| Communal Average | | | | | |
| Urbanization | 45.0% | 82.7% | 29.0% | 41.6% | 86.2% |
| Public School Share (2000) | 73.7% | 44.6% | 84.9% | 72.4% | 46.6% |
| Private-Voucher School Share (2000) | 22.3% | 41.4% | 14.3% | 25.1% | 40.9% |
| Turnover Rate | 0.403 | 0.692 | 0.318 | 0.458 | 0.589 |
| Entry Rate | 0.259 | 0.51 | 0.181 | 0.313 | 0.432 |
| Exit Rate | 0.152 | 0.180 | 0.151 | 0.144 | 0.157 |
| Replacement Rate | 0.258 | 0.263 | 0.242 | 0.280 | 0.283 |
| Total Population (millions) | 15.24 | 6.06 | 2.39 | 1.31 | 11.44 |
| Number of Municipalities | 339 | 52 | 214 | 40 | 85 |

Share of public and private voucher schools are for the year 2000. Turnover, Entry, Exit and Replacement for the period 2000-2012.

regression:

$$SIMCE_{i,s,t} = \alpha * \text{Parents Education}_{i,t} + r_{i,t}$$

where $SIMCE_{i,s,t}$ is the simple average of SIMCE language and math scores of student $i$ in school $s$ in year $t$.[25] The variable Parents Education$_{i,t}$ is a vector of indicators with the level of education achieved by both parents, and $r_{i,t}$ is a residual that captures the school contribution to student i's test achievement.

Using the predicted scores we calculate the residual test score of student $i$ at time $t$ as $\hat{R}_{i,s,t} = SIMCE_{i,s,t} - \hat{\alpha} * \text{Parents Education}_{i,t}$. Next, for each school $s$, we construct a residual score $R_{s,2001}$ around 2001 averaging the individual residual scores for each school in years 2000-2002.[26] We interpret these numbers as indicators of each school's contribution to students' achievement around that time. A similar number is obtained for 2011, averaging the individual residual scores for each school in years 2010-2012. Note that while our definition of "school quality" excludes the impact of individual family background on test scores by construction, it does not exclude peer effects.

Our aim is to study the association between school turnover in a local market and the schools' productivity in the same local market. As a first approximation, we use each mu-

[25] Qualitative results are unchanged if we consider them separately.
[26] SIMCE scores are normalized each year and can be consistently compared across time.

nicipality as a local market and calculate the turnover rate in each municipality during the 2002-2012 period. Let $R_{m,t}$ be the average residual score in municipality $m$ for the year $t = 2001, 2011$. Therefore, the schools' contribution in each municipality between 2001 and 2011 is $\Delta ResSIMCE_m = R_{m,2012} - R_{m,2000}$. The average of this variable is 0.008 and its standard deviation is 0.976.

Figures 5 and 6 illustrate the bivariate relationship between the change of residual SIMCE and the turnover in two different sub-samples of municipalities, those with less than 25,000 inhabitants and those with 45,000 or more inhabitants. Figure 5 shows a positive association between SIMCE test score improvements and market turnover in low-population communes, while Figure 6 suggests a weak relationship, if any, for large-population communes.

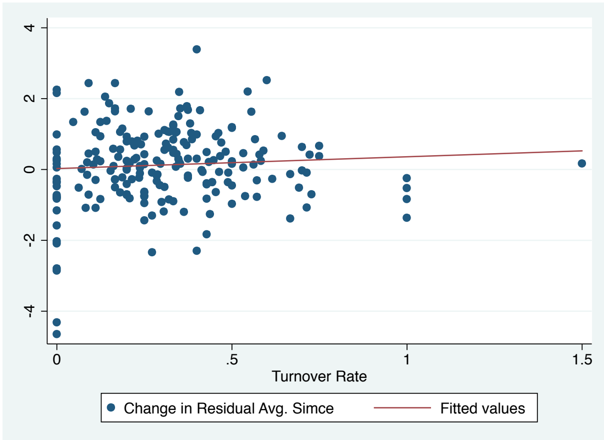


Figure 5: Change of Residual SIMCE Test Scores 2000-2012 and Turnover Rate, Municipality Population $\leq 25,000$

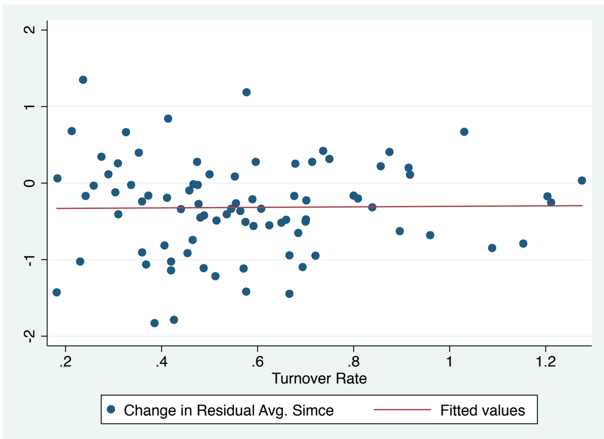


Figure 6: Change of Residual SIMCE Test Scores 2000-2012 and Turnover Rate, Municipality Population $> 45,000$

To further investigate this relationship, we estimate a linear model of the form

$$\Delta ResSIMCE_m = \beta_1 * Dynamics_m + \beta_2 * X_m + \varepsilon_m \tag{3}$$

where $Dynamics_m$ is either the rate of turnover, entry or exit in municipality $m$, and $X_m$ is a vector of socioeconomic and demographic controls at municipal level. We include communal poverty, inequality (measured as the interquartile income range), urbanization in the year 2000 and poverty decrease between 2000 and 2012, calculated using the National Socioeconomic Characterization Survey.[27] To control for local environmental factors that might affect school attendance and performance, we also consider the communal change in official crime reports to the police between 2001 and 2012. A complete list of descriptive statistics for the independent and dependent variables can be found in Table 8 in the Appendix.

Our specification resembles Hsieh and Urquiola (2006). Their focus is similar to ours, as they are interested in the impact of market competition -specifically choice availability- on standardized test scores. Their main specification is a regression of communal changes in SIMCE scores on a measure of the change in local competition and socioeconomic controls very similar to ours. They measure local competition as the enrollment participation of the private-voucher sector. In principle, this difference in test scores against difference in local competition approach controls for municipality fixed effects. They also instrument changes in local competition with changes in population and urbanization. Nonetheless, we have some differences with Hsieh and Urquiola. First, we look at a different period (2000-2012 versus 1986-1996). Second, we have a larger set of municipalities as the SIMCE test in our period of study is applied universally every year. With the exemption of insular low population communes such as Easter Island, Antartica, we consider all communes. This allows us to explore heterogeneous effects across municipalities. Third, we have a different dependent variable: taking advantage of administrative individual data available for the 2000-2012 period, we consider residual changes in SIMCE test scores instead of changes in test scores. That is, we try to isolate the contribution of the school from the students' family background. Fourth, in our case, we are interested in market dynamics. Although there is no immediate connection between the private market share and turnover variables, since most of

[27] The results are qualitatively unchanged if we use other controls such as per capita income, communal growth rate, educational attainment and education interquartile range, they are significantly correlated with the ones we present here.

the school entry in the Chilean case is explained by private-voucher schools, entry is correlated with the change in the share of private enrollment. Hence, our results related to entry might be partially interpreted as an extension of the results of Hsieh and Urquiola (2006) to our period. Since exit and turnover could be associated to a decrease in choice, our measures of market dynamics yield different information. Finally, we have added crime rate changes as a control variable, which, as already mentioned, may account for some environmental factors that potentially affect school demand, attendance and also the risks and costs faced by a school entrepreneur who decides whether to stay, enter or exit a local market.

Table 8 shows different estimates of Model 3 using the turnover rate as our measure of market dynamics. Columns (2), (4), (6), and (8) weighs observations by population, thus, giving more weight to large-population municipalities. Odd-numbered columns use no weights. Columns (1) and (2) show the OLS estimates. There are significant differences between the estimates with and without population weights. In the absence of weights (column 1), the relationship between changes in the school contribution to students' standardized tests results and turnover is positive and statistically significant. While we caution about a causal interpretation of the results, an increase of the turnover rate by one standard deviation is associated with an increase in test scores of 4 percent of a standard deviation. In contrast, with population weights market turnover has no effect whatsoever.[28] The differences introduced by population weights are not surprising once we ponder the stark differences across low and high population municipalities shown in Table 7. Indeed, since two thirds of municipalities are small and concentrate 16% of the population while the highest population quintile of municipalities concentrates 75% of the population, regressions without weights reflect mostly low population communes while those with weights reflect the reality of high population school markets.

Columns (3)-(8) show that the OLS conclusions survive different specifications. Columns (3) and (4) correspond to median regressions. The point estimates of the turnover coefficient are smaller than the OLS ones: it is roughly zero and statistically insignificant for the population-weighted specification, and the positive effect of the unweighted specification looses significance. This suggests that part of the positive OLS effect is driven by few munic-

[28]The same conclusion follows if we use the total number of schools in each municipality as weights rather than population.

ipalities with zero turnover that experienced drops in productivity. Columns (5) and (6) uses two instruments, previously used by Hsieh and Urquiola, for communal school turnover, the number of schools per 1000 inhabitants and the increase in population in each municipality. The point estimates for the IV are larger than the OLS ones, especially in the weighted specification, although both are statistically insignificant. The first stage estimates are shown in the Appendix (see column 1 in table 15) and the F-statistics are well beyond the thresholds suggested by Stock and Yogo (2002) to discard weak instruments. Rather than defending the merit of IVs inspired in previous work, we report the results to show the broad consistency of our correlational conclusions.

Finally, columns (7) and (8) explore one of the mechanisms that could partially explain the heterogeneity. We hypothesize that in markets with more intense dynamics, there could also be more mis-coordination. Schools entries and closures may be justified for demographic, efficiency and achievement purposes; nonetheless, in all OECD countries the accommodation of the school supply is usually planned in advance after analyzing school performance and demand trends and the ability of existing schools to incorporate new students. In contrast, in the Chilean school market system, these adjustments are entirely deregulated and decentralized. In municipalities that experience important population increases or social improvements many entrepreneurs may enter and simply replace other schools without offering better quality or superior resource management. As mentioned earlier, school replacement could be associated with market mis-coordination.

To explore this idea we include in the specification a *High Replacement* dummy that takes the value 1 for municipalities with a *Replacement/Turnover* ratio above the median and 0, otherwise, we also interact this variable with the turnover rate. We find that the interaction is consistently and negatively associated with changes in residual SIMCE scores, and statistically significant in the population-weighted specification.

Overall the results confirm the existence of relevant differences between low and high population markets, which we further investigate next.

Table 8: Change in Residual Test Scores and Market Dynamics, Math/Language Average

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | $\Delta Simce$ | $\Delta Simce$ | $\Delta Simce$ MReg | $\Delta Simce$ MReg | $\Delta Simce$ IV | $\Delta Simce$ IV | $\Delta Simce$ | $\Delta Simce$ |
| Urbanization | -1.067*** | -0.940*** | -0.983*** | -0.741*** | -1.507*** | -0.992*** | -1.086*** | -0.895*** |
| | (0.198) | (0.171) | (0.163) | (0.104) | (0.405) | (0.217) | (0.192) | (0.170) |
| Poverty | 0.375** | 0.229* | 0.410*** | 0.336*** | 0.520* | 0.263 | 0.351* | 0.221 |
| | (0.186) | (0.135) | (0.130) | (0.0782) | (0.271) | (0.161) | (0.186) | (0.137) |
| Interquartile Range | -0.204*** | -0.153*** | -0.185*** | -0.182*** | -0.138* | -0.145*** | -0.203*** | -0.145*** |
| | (0.0654) | (0.0346) | (0.0600) | (0.0201) | (0.0782) | (0.0409) | (0.0657) | (0.0346) |
| Poverty Decrease | 0.234 | 0.122 | 0.132 | 0.0557 | 0.305* | 0.135 | 0.224 | 0.129 |
| | (0.161) | (0.113) | (0.189) | (0.0610) | (0.185) | (0.116) | (0.164) | (0.114) |
| Change in Crime | -10.15** | -11.57*** | -7.047 | -11.96*** | -4.340 | -10.59** | -9.853** | -11.02** |
| | (4.686) | (4.329) | (6.162) | (2.844) | (7.630) | (4.898) | (4.805) | (4.530) |
| Metropolitan Region | 0.376*** | 0.318*** | 0.434*** | 0.351*** | 0.193 | 0.302*** | 0.362*** | 0.282*** |
| | (0.0984) | (0.103) | (0.102) | (0.0702) | (0.238) | (0.106) | (0.0968) | (0.101) |
| Turnover Rate | 0.410** | 0.114 | 0.252 | -0.0773 | 1.392 | 0.254 | 0.554*** | 0.192 |
| | (0.163) | (0.178) | (0.175) | (0.106) | (1.103) | (0.454) | (0.202) | (0.199) |
| High Replacement | | | | | | | 0.261 | 0.190 |
| | | | | | | | (0.183) | (0.174) |
| Turnover Rate*High Repl. | | | | | | | -0.428 | -0.541* |
| | | | | | | | (0.277) | (0.283) |
| Constant | 0.585*** | 0.681*** | 0.533*** | 0.623*** | 0.252 | 0.618*** | 0.496*** | 0.635*** |
| | (0.163) | (0.140) | (0.120) | (0.0712) | (0.448) | (0.231) | (0.188) | (0.158) |
| Population Weights | NO | YES | NO | YES | NO | YES | NO | YES |
| Observations | 280 | 280 | 280 | 280 | 280 | 280 | 280 | 280 |
| Adjusted $R^2$ | 0.209 | 0.367 | 0.168 | 0.235 | 0.147 | 0.365 | 0.209 | 0.377 |

Robust standard errors in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

### 5.3 Heterogeneous Effects

To explore the heterogeneous effect of market dynamics on school productivity we split the sample in two groups, the low population group consisting of municipalities with less than 25,000 inhabitants in the year 2002, and the high population group with those having 45,000 inhabitants or more. Table 16 in the Appendix summarizes statistics of each subsample for the dependent and independent variables of interest is in the Appendix. The first four columns in Table 9 show the results for the low-population group and the next four columns the results for the high-population one.[29]

For low-population municipalities, in line with the unweighted specifications of Table 8, we find a significant positive association between the turnover rate and changes in residual SIMCE scores. Once again, raising a caution about a causal interpretation, for the low-population group, an increase of the turnover rate by one standard deviation is associated with a sizeable increase in test scores between 9 and 12 percent of a standard deviation. Columns (3) and (4) show that for this group, both exit and entry rates display a positive association with changes in residual SIMCE scores. In contrast, in line with the weighted specifications of Table 8, for high-population municipalities we find no significant effects. If anything, column (8) shows a negative relationship between changes in residual scores and the school exit rate. Columns, (2) and (5) confirm the negative association between school productivity and turnover associated with high school replacement rates.

We conclude that market turnover matters only for low-population municipalities, which represent 16 percent of the national population. In high-population municipalities turnover has no association with school contribution to students' learning. Moreover, we find that there is a negative impact if turnover is associated with a high replacement, something we interpret as a market mis-coordination. This latter effect is more relevant in high-density population zones such as the Metropolitan Region. Our interpretation is that in urban areas with higher entry, turnover, and replacement, mostly driven by private-voucher schools, there are no productivity gains measured by school contribution to students' test scores- associated with market dynamics.

[29] In the Appendix we show that these results are not driven by the fact that the number of municipalities is smaller in the high population sample, nor the fact that we have omitted the 40 municipalities with populations between 25,000 and 45,000. If the sample is split in two equal-sized groups and all municipalities are considered, the results are qualitatively identical.

Table 9: Change in Residual Test Scores, High versus Low Population Municipalities

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | $\Delta Simce$ | $\Delta Simce$ | $\Delta Simce$ | $\Delta Simce$ | $\Delta Simce$ | $\Delta Simce$ | $\Delta Simce$ | $\Delta Simce$ |
| Urbanization | -1.228*** | -1.298*** | -1.056** | -0.911** | -0.692* | -0.524 | -0.712** | -0.678** |
| | (0.413) | (0.388) | (0.414) | (0.437) | (0.353) | (0.353) | (0.353) | (0.331) |
| Poverty | 0.298 | 0.317 | 0.248 | 0.252 | 0.706*** | 0.700*** | 0.737*** | 0.709*** |
| | (0.294) | (0.306) | (0.294) | (0.293) | (0.213) | (0.210) | (0.218) | (0.211) |
| Interquartile Range | -0.833*** | -0.776*** | -0.909*** | -0.784** | -0.131*** | -0.118** | -0.125*** | -0.118** |
| | (0.314) | (0.296) | (0.325) | (0.318) | (0.0444) | (0.0490) | (0.0449) | (0.0453) |
| Poverty Decrease | 0.323 | 0.331 | 0.293 | 0.275 | 0.167 | 0.202 | 0.178 | 0.134 |
| | (0.273) | (0.282) | (0.271) | (0.273) | (0.144) | (0.127) | (0.145) | (0.134) |
| Change in Crime | -5.616 | -5.215 | -7.636 | -6.518 | -12.34** | -11.77** | -11.55** | -11.81** |
| | (10.61) | (11.01) | (10.81) | (10.72) | (5.366) | (5.474) | (5.491) | (4.768) |
| Metropolitan Region | 0.185 | 0.221 | 0.323 | 0.299 | 0.372*** | 0.298** | 0.365*** | 0.373*** |
| | (0.252) | (0.246) | (0.232) | (0.267) | (0.115) | (0.114) | (0.115) | (0.113) |
| Turnover Rate | 0.868** | 1.236** | | | -0.0238 | 0.118 | | |
| | (0.350) | (0.625) | | | (0.240) | (0.258) | | |
| High Replacement | | 0.251 | | | | 0.366 | | |
| | | (0.279) | | | | (0.262) | | |
| Turnover Rate*High Repl. | | -0.614 | | | | -1.016** | | |
| | | (0.679) | | | | (0.416) | | |
| Entry Rate | | | 0.697* | | | | 0.0815 | |
| | | | (0.376) | | | | (0.243) | |
| Exit Rate | | | | 1.113* | | | | -1.129 |
| | | | | (0.647) | | | | (0.764) |
| Constant | 1.084*** | 0.917*** | 1.290*** | 1.060*** | 0.460 | 0.317 | 0.408 | 0.580** |
| | (0.274) | (0.313) | (0.276) | (0.278) | (0.301) | (0.309) | (0.304) | (0.276) |
| Municipal Population | $< 25,000$ | $< 25,000$ | $< 25,000$ | $< 25,000$ | $\geq 45,000$ | $\geq 45,000$ | $\geq 45,000$ | $\geq 45,000$ |
| Observations | 159 | 159 | 159 | 159 | 82 | 82 | 82 | 82 |
| Adjusted $R^2$ | 0.160 | 0.154 | 0.144 | 0.150 | 0.368 | 0.414 | 0.369 | 0.388 |

Robust standard errors in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

# 6 Conclusions

In 1981, Chile introduced school finance reforms creating a liberalized school market that has been in place for more than 30 years without significant changes. The creation of new schools has been weakly regulated, making it a free-entry-and-exit market. During the last two decades a massive destruction and replacement of schools was a distinctive characteristic of the market-oriented Chilean education system. Almost 15 percent of the schools that existed between 1992 and 2012 closed; a pattern that does not seem to be declining over time. In fact, the turnover rate of the Chilean school system is quite similar to the average turnover rates found historically for middle and small-sized firms' industries.

Given this significant school turnover we estimate the potential educational costs of this dynamics intending to identify the causal effect of school closure on grade repetition and high-school dropout rates. Using a large panel of individual student administrative data for the period 2002-2012, we find that school closure is associated with a 44 percent increase in the probability of grade repetition in fifth grade (2.2 percentage points). We attempt to decompose this effect by comparing grade repetition for students displaced by an unanticipated closure and those who switch to a different school for other reasons and, thereby, must also face an adjustment cost. Of the total effect, 1.5 percentage points (30 percent of the total) seem to be explained by the disruption of a school closure and only 0.7 percent (14 percent of the total) by the adjustment faced by the regular effect of a switch to a different school. We also find, as expected, that receiving school academic difficulty increases the probability of grade retention. Moreover, students displaced by school closures can experience a 31 percent increase in the probability of school dropout in tenth grade (0.44 percentage points), this result is robust, if we restrict the control group to (more similar) students whose school will close three periods ahead, the probability of dropping out experiences a 79 percent increase (1.1 percentage points).

We also estimate the potential "productivity gains" associated to creative destruction by studying its impact on the schools contribution to students' educational achievement. We find that, at the municipality level, school turnover predicts improvements in school performance -after controlling for students' socioeconomic status- only for low population municipalities. In the high population group of municipalities turnover and exit have no effect on school contribution to students' learning. Moreover, we find that there is a negative impact if turnover is associated with a high replacement, something we interpret as a market mis-coordination. This latter effect is more relevant in high-density population areas, including the country's main urban centers. Our interpretation is that in urban areas with higher entry, turnover and replacement, mostly driven by private-voucher schools, there are no productivity gains associated with market dynamics.

In sum, the impressive market turnover exhibited by the Chilean school system caused adverse effects on students' educational attainment, while it did not bring significant productivity benefits for most of the student population, at least as measured by quality indicators based on standardized achievement tests.

The results of this paper, together with recent evidence for the US on the impact of school closures on student outcomes, suggest that school closing is not necessarily effective as a policy measure to improve student achievement. Producing higher levels of achievement would require moving students to schools that perform significantly better than the closing school, in order to compensate for the adverse effects on student attendance and achievement gains of a transition to a new school. This finding holds if school closure is a planned decision as it has been the case in US school districts, or if it is determined by market competition, as it has been the case in Chile.

A more detailed study to better understand the limited impact of school turnover on educational quality is a subject of future research. Estimating other costs of school closure such as such as "mobility externalities", i.e., disruption affecting students in the receiving schools, and the impacts on teaching staff and neighborhoods would complement this paper's findings. It also seems interesting to assess other potential benefits of low entry barriers, such as the availability of a large variety of educational projects.

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# Appendix A Measures of Entry and Exit

To identify entries and exits we conduct a procedure in three stages. Each stage refines the set of schools identified as potential entries and exits in previous stages. Hereafter, each period $t$ is a year in the set {1994, 1995,..., 2012}.

The *first-stage* definition of entry and exit is obtained using an unbalanced panel built from the official listing data base. A school $i$ is a first-stage exit candidate at time $t$ if that school was present, at least, for the previous two periods ($t-1$ and $t-2$) and is not in the listing for the next two periods ($t+1$ and $t+2$).[30] Similarly, a school $i$ is a first-stage entry candidate at time $t$ if the school was not in the listing in previous years and remains in the list for at least two years ($t+1$ and $t+2$). Although the listing is an official data base, it is well known that it has some missing values which implies that our *first stage* definition of entry and exit could overestimate these values. Further, during the period considered there have been administrative changes affecting the RBD of a subset of schools.[31] Due to these considerations our next stages depurate the initial definition.

In the second stage, each first-stage candidate exit is validated using an Official Exit Record of the MoE that contains all the schools that were registered as closed by local officers of the MoE between 1990 and 2014.[32] Thus, while the first source of information (the panel data from the official listings) is required to specify the year of the exit, the second source of information (the Official Exit Record) is useful to validate whether it was a real closing. Regarding entries, we validate our first stage by merging such a data base to an administrative record of the MoE that specifies the year in which the school was granted official recognition by the State.

The third and final step of the procedure takes advantage of an administrative panel data set with student individual information. The panel provides information for all the students in the system for the years 2002-2013. It includes each student's school, GPA, attendance rate

[30] Since we only have information until 2013, we make an exception for 2012, checking just one year ahead.

[31] During the late nineties, some schools had different RBDs for different education levels and normalized this situation by assigning the oldest RBD to all of them. Similarly, between 1997 and 2003 roughly one-thousand schools expanded and for some of them -120 according to the Ministry's information- these expansions ("anexos") were initially associated to a different RBD. Since then, 80 have reverted to a single RBD.

[32] From our conversations with the staff of the MoE we concluded that, if anything, this source of information underestimates the number of closings. The registry of exits relies on declarations sent by exiting schools and schools were not mandated to declare their closing.

and gender (and other variables not used herein). Using this information we can eliminate errors associated to a school that may appear with two different IDs (RBD) at different points in time. For example, some schools changing from one type of administration to another -for instance from non-voucher private to voucher private- may have changed their RBD as part of the process. Our filter avoids errors associated to these changes, that would otherwise be counted as *fake* closures and entries. The method used is as follows: for each school $j$ that is considered as closed at time $t$ (given our second-stage definition), we find the school $j'$ that, at time $t+1$, has the highest number of students from school $j$. Then we compare by eye's inspection, school by school, whether the names and addresses of schools $j$ and $j'$ coincide suggesting that both are the same school. Hence, the student panel data is used to pair each second-stage candidate exit school in $t$ with a single school in $t+1$ that might be the same school and, if so, it is confirmed as a *fake* closure. This makes the procedure feasible and accurate.[33]

Table 10: Stages to validate the number of exits and entries

| | Pre K + K-12 | | Primary and Secondary (1-12) | |
|---|---|---|---|---|
| | Exits | Entries | Exits | Entries |
| Stage 1 | 4,264 | 5,056 | 3,216 | 4,042 |
| Stage 2 | 2,971 | 4,694 | 2,281 | 3,817 |
| Stage 3 | 2,835 | 4,647 | 2,151 | 3,770 |

Table 10 shows how each stage of validation reduces the number of entries and exits. Comparing Stage 1 with Stage 3, the depuration process affects much more the identification of exits. The last step, a school-by-school check –that covers all candidates for 2002-2012 and private schools for 1997-2001-, implied a small reduction of the number of exits and entries, especially when compared to the number reduction between the first and the second stage

[33]There is anecdotal evidence that following the Asian crisis of 1997-98 many non-voucher private schools changed their type of administration to voucher private and some also changed their RBD. This is prior to 2002, the first year of the panel. To filter these potential errors, we checked one-by-one all the names and addresses of the non-voucher private schools that closed between 1997 and 2001 and searched for voucher private schools with similar addresses and names one year after the possible closing. This exercise led us to identify 16 *fake* closures. Since we don't have the student panel data prior to 2002, our search for *fake* closures was more time-consuming and presumably more error-prone for the 1994-2001 period than it was for 2002-2012 period.

(Stage 1 - Stage 2 = 935 vs Stage 2 - Stage 3 = 130). Since our last filter leaves little room for an error, we are confident of the accuracy of our measures for the last decade of our sample. At the same time, since this rigorous check decreased the number of exits by a small amount (around 5%), it reassures us that the level of accuracy of the first two stages is quite high.

# Appendix B Descriptive statistics: effect of school closure on grade retention and drop out rates

Table 11: Descriptive statistics for grade retention regressions

| Variable | Mean Non Displaced Students | Mean Displaced Students | Difference | Test Statistic | P-Value |
|---|---|---|---|---|---|
| Grade retention | 0.024 | 0.068 | -0.044 | -12.40 | 0.00 |
| Math test score | 253.5 | 231.1 | 22.4 | 18.31 | 0.00 |
| Language test score | 263.7 | 244.8 | 18.9 | 15.76 | 0.00 |
| GPA at 4th grade | 5.9 | 5.8 | 0.1 | 7.83 | 0.00 |
| Attendance at 4th grade | 94.1 | 94.5 | -0.4 | -2.66 | 0.01 |
| Female | 0.50 | 0.44 | 0.06 | 5.52 | 0.00 |
| Mother with primary education | 0.11 | 0.15 | -0.03 | -4.41 | 0.00 |
| Mother with incomplete secondary education | 0.16 | 0.16 | -0.01 | -1.06 | 0.29 |
| Mother with complete secondary education | 0.33 | 0.28 | 0.05 | 4.59 | 0.00 |
| Mother with tertiary education | 0.27 | 0.22 | 0.05 | 4.45 | 0.00 |
| Father with primary education | 0.12 | 0.14 | -0.02 | -2.05 | 0.04 |
| Father with incomplete secondary education | 0.16 | 0.18 | -0.02 | -2.67 | 0.01 |
| Father with complete secondary education | 0.32 | 0.29 | 0.03 | 2.74 | 0.01 |
| Father with tertiary education | 0.28 | 0.22 | 0.06 | 5.39 | 0.00 |
| Older (proxy of previous repetition) | 0.06 | 0.13 | -0.06 | -11.26 | 0.00 |

The Test statistic is z-statistic for proportions and t-statistic for continuous means (tested by unequal variance).

Table 12: Descriptive statistics for drop out regressions

| Variable | Mean Non Displaced Students | Mean Displaced Students | Difference | Test Statistic | P-Value |
|---|---|---|---|---|---|
| Drop out | 0.012 | 0.041 | -0.028 | -8.85 | 0.00 |
| Math test score | 251.1 | 216.0 | 35.1 | 23.00 | 0.00 |
| Language test score | 255.3 | 232.4 | 22.9 | 16.94 | 0.00 |
| GPA at 10th grade | 5.4 | 5.2 | 0.2 | 10.00 | 0.00 |
| Attendance at 10th grade | 92.2 | 90.4 | 1.8 | 6.35 | 0.00 |
| School mean in Math test score | 251.3 | 218.4 | 33.0 | 35.7 | 0.0 |
| School mean in Language test score | 255.6 | 234.2 | 21.4 | 30.4 | 0.0 |
| School Drop out rate at $t-1$ | 0.043 | 0.109 | -0.066 | -23.11 | 0.00 |
| Female | 0.50 | 0.44 | 0.06 | 4.07 | 0.00 |
| Mother with primary education | 0.12 | 0.12 | 0.00 | 0.29 | 0.77 |
| Mother with incomplete secondary | 0.16 | 0.16 | -0.01 | -0.80 | 0.43 |
| Mother with complete secondary education | 0.29 | 0.25 | 0.04 | 2.60 | 0.01 |
| Mother with tertiary education education | 0.28 | 0.29 | -0.01 | -0.80 | 0.42 |
| Father with primary education | 0.12 | 0.10 | 0.02 | 2.02 | 0.04 |
| Father with incomplete secondary education | 0.15 | 0.13 | 0.02 | 1.46 | 0.14 |
| Father with complete secondary education | 0.28 | 0.25 | 0.02 | 1.72 | 0.09 |
| Father with tertiary education | 0.32 | 0.36 | -0.04 | -3.02 | 0.00 |
| Voucher-private School | 0.51 | 0.84 | -0.33 | -22.96 | 0.00 |
| Non Voucher-private School | 0.07 | 0.10 | -0.02 | -3.07 | 0.00 |

The Test statistic is z-statistic for proportions and t-statistic for continuous means (tested by unequal variance).

# Appendix C Additional tables for communal level regressions

Table 13: Descriptive statistics of communal level variables

| | mean | sd |
|---|---|---|
| $\Delta Simce$ | .0958125 | .8714951 |
| $\Delta Math$ | .093164 | .8631145 |
| $\Delta Lang.$ | .0940416 | .8931871 |
| Turnover Rate | .441238 | .2894589 |
| Entry Rate | .278062 | .2669126 |
| Exit Rate | .1631761 | .1080014 |
| Replacement/Turnover | .2600531 | .1538665 |
| Number of Schools | 34.04797 | 28.44503 |
| Schools/1000 inhab. | 1.238289 | .9716471 |
| Share Private Voucher | .2533629 | .2014695 |
| Urbanization | .4806966 | .3291187 |
| Population | .5288537 | .7389284 |
| Population Increase | 6.058749 | 42.64558 |
| Poverty | .3357934 | .4731408 |
| Interquartile Range | 1.101925 | .7173104 |
| Poverty Decrease | -.2435424 | .4865837 |
| Change in Crime | .0084768 | .008244 |
| Observations | 271 | |

Table 14: Heterogeneous effects: Descriptive statistics for High and Low Population municipalities

| Low Population ($\leq$ 25,000) | | |
|---|---|---|
| | Mean | S.D. |
| Change in Res. SIMCE | 0.249 | 1.057 |
| Turnover Rate | 0.332 | 0.234 |
| Entry Rate | 0.170 | 0.187 |
| Exit Rate | 0.162 | 0.128 |
| Replacement Rate | 0.242 | 0.178 |
| Number of Communes | 159 | |

| High Population (>45,000) | | |
|---|---|---|
| | Mean | S.D. |
| Change in Res. SIMCE | -0.261 | 0.585 |
| Turnover Rate | 0.597 | 0.275 |
| Entry Rate | 0.440 | 0.260 |
| Exit Rate | 0.157 | 0.071 |
| Replacement Rate | 0.282 | 0.123 |
| Number of Communes | 82 | |

Table 15: Determinants of Communal Turnover in Low and High Population Municipalities

| | (1)<br>Turnover Rate | (2)<br>Turnover Rate | (3)<br>Turnover Rate | (4)<br>Turnover Rate |
|---|---|---|---|---|
| Schools/1000 inhab. | -0.0489*** | -0.105*** | -0.0387*** | -0.319** |
| | (0.0138) | (0.0369) | (0.0130) | (0.158) |
| Share Private Voucher | 0.233*** | 0.184 | 0.358*** | 0.185 |
| | (0.0727) | (0.119) | (0.110) | (0.185) |
| Population | -0.0732** | -0.0414 | -0.307 | -0.0481 |
| | (0.0352) | (0.0312) | (0.300) | (0.0401) |
| Population Increase | 0.00213*** | 0.00133*** | 0.0138* | 0.00180*** |
| | (0.000592) | (0.000265) | (0.00724) | (0.000541) |
| Urbanization | 0.270*** | 0.159 | 0.327*** | -0.0636 |
| | (0.0760) | (0.136) | (0.0832) | (0.241) |
| Poverty | -0.143*** | -0.192*** | -0.114** | -0.219** |
| | (0.0357) | (0.0508) | (0.0530) | (0.109) |
| Interquartile Range | -0.0521*** | -0.0470*** | -0.0786 | -0.0362** |
| | (0.0152) | (0.0119) | (0.0556) | (0.0181) |
| Poverty Decrease | -0.0776** | -0.0751** | -0.0953* | -0.120 |
| | (0.0312) | (0.0374) | (0.0495) | (0.0846) |
| Metropolitan Region | 0.164** | 0.0466 | 0.220 | 0.0133 |
| | (0.0714) | (0.0557) | (0.165) | (0.0737) |
| Constant | 0.388*** | 0.554*** | 0.352*** | 0.838*** |
| | (0.0491) | (0.101) | (0.0707) | (0.247) |
| Population Weights | NO | YES | NO | NO |
| Municipalities | All | All | Pop$<25,000$ | Pop$\geq 45,000$ |
| Observations | 280 | 280 | 159 | 82 |
| F Statistic | 21.14 | 26.26 | 10.17 | 4.51 |
| Adjusted $R^2$ | 0.437 | 0.442 | 0.356 | 0.275 |

Robust standard errors in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

**Robustness of Heterogeneous Effects**

The first two columns of table 16 split the sample into two groups. The first group is the one corresponding to municipalities with a population of 25,000 or less, that is, the same low-population group used in the main text. The second group is simply the rest of the sample, that is, we include municipalities with population between 25,000 and 45,000 in the high-population group. The second two columns split the sample in two equally-sized groups. As before, the point-estimate for the large population group (columns 2 and 4) are small and not statistically significant.

Table 16: Changes in Residual Scores in High an Low Population Municipalities: Robustness

| | (1)<br>Low Pop. | (2)<br>High Pop. | (3)<br>Low Pop. | (4)<br>High Pop. |
|---|---|---|---|---|
| Urbanization | -1.228*** | -0.825*** | -1.176** | -0.908*** |
| | (0.413) | (0.266) | (0.513) | (0.247) |
| Poverty | 0.298 | 0.332* | 0.244 | 0.337* |
| | (0.294) | (0.192) | (0.317) | (0.178) |
| Interquartile Range | -0.833*** | -0.145*** | -0.969*** | -0.130*** |
| | (0.314) | (0.0444) | (0.339) | (0.0441) |
| Poverty Decrease | 0.323 | 0.121 | 0.269 | 0.182 |
| | (0.273) | (0.150) | (0.300) | (0.146) |
| Change in Crime | -5.616 | -10.70** | -0.737 | -12.26** |
| | (10.61) | (5.112) | (12.26) | (4.737) |
| Metropolitan Region | 0.185 | 0.389*** | 0.104 | 0.406*** |
| | (0.252) | (0.107) | (0.278) | (0.104) |
| Turnover Rate | 0.868** | 0.169 | 0.845** | 0.199 |
| | (0.350) | (0.194) | (0.352) | (0.185) |
| Constant | 1.084*** | 0.462* | 1.182*** | 0.500** |
| | (0.274) | (0.242) | (0.284) | (0.215) |
| Observations | 159 | 121 | 140 | 140 |
| Adjusted $R^2$ | 0.160 | 0.298 | 0.148 | 0.303 |

Robust standard errors in parentheses

* p<.10, ** p<.05, *** p<.01