Spillover Effects of School Infrastructure Upgrade: Evidence from Peru

Fabiola Alba-Vivar

Sarita Oré-Quispe

August, 2024

Abstract

This paper examines a school infrastructure upgrading program and its direct and indirect impacts on enrollment, school dropout rates, and student achievement. We exploit the program's rollout over four years before an abrupt redesign left some schools without the upgrade. Our findings suggest that schools receiving the upgrades experienced a 0.58 percentage point reduction in dropout rates. However, we observe spillover effects on nearby schools: an increase in private school closures and a decline in enrollment, predominantly affecting the public sector. Notably, reading test scores in nearby private and public schools also dropped, suggesting that the students leaving these schools were likely those with higher human capital.

Keywords: School Infrastructure, Spillover Effects, Private Schools

JEL Codes: XXXXXX

This project has benefited from data provided by the Peruvian Ministry of Education and the generous funding of the Consorcio de Investigacion Economica y Social in Peru (CIES). Stanislao Maldonado, Diether Beuermann, and anonymous reviewers have provided excellent comments on earlier versions of the CIES working paper. We thank the comments and suggestions from Alex Eble, Carolina Concha-Arriagada, and Eric Verhoogen. We are deeply thankful to Roberto Mendoza and Dennys Casiano, who provided excellent research assistance. All remaining errors are our own.

Department of Economics, Wake Forest University. E-mail: albavif@wfu.edu

Teachers College at Columbia University. E-mail: spo2111@tc.columbia.edu

1 Introduction

Providing a supportive learning environment and facilitating effective teaching practices heavily rely on school infrastructure functionality. However, many schools in developing countries face major challenges due to lacking facilities and resources. For instance, nearly 40% of elementary school students in Latin America attend schools that do not have adequate water and sanitation services (Duarte et al., 2017). Whether students would benefit from attending schools with better equipment and educational spaces is an important question in education for which studies provide mixed results.[1] Much less is known about the market effects that large infrastructure investments can have on nearby schools, especially in contexts of radical education privatization[2] and deregulated markets, with higher levels of competition between low-cost private and public schools.

We study the direct and the spillover effects of school upgrading on enrollment, school exit and learning in Peru. We exploit the exogenous variation created by the Emblematic Schools Program.[3] This Program was created in 2009 and aimed at refurbishing, equipping, and upgrading the school infrastructure of all the 238 major historical educational institutions (or emblematic schools) nationwide.[4] Interestingly, this policy also sought to improve the reputation of public schools, which had drastically lost prestige over previous decades (Guadalupe et al., 2017). The unexpected closure of the Program in 2014 provided us with a list of emblematic schools that were target by the Program, but did not get it. This event,

[1] Andrabi et al. (2023); Cellini et al. (2010); Hong and Zimmer (2016); Martorell et al. (2016); Neilson and Zimmerman (2014) present mixed results on school upgrading programs on students' school achievement. Notice that upgrading existing schools and building new schools can lead to different outcomes. While creating new schools increases the number of available seats, upgrading allow students to enjoy more modern facilities, in the exact location and usually with the same teachers and staff (Lafortune and Schonholzer, 2022). Studies on school construction programs have found positive effects on student achievement (Burde and Linden, 2013; Kazianga et al., 2013, 2019; Lafortune and Schonholzer, 2022), enrollment (Burde and Linden, 2013; Dinerstein et al., 2020; Kazianga et al., 2013), attendance (Kazianga et al., 2013), and education attainment and future income (Duflo, 2001).

[2] Although education privatization is a global trend, the Peruvian case is considered one of the most radical cases (Balarin and Escudero, 2019).

[3] Its complete name is Program for the Recovery of Emblematic and Centennial Public Educational Institutions.

[4] These schools have historical trajectory -with their creation starting in the 1950s- and are almost 4 to 13 times bigger in terms of enrollment than other public and private schools, respectively (Table 1).

together with the staggered timing in which schools were intervened, form the basis of the staggered difference-in-difference strategy we use.

First, we explore the effects of providing better learning environment to the emblematic schools on students' dropout rate and learning, measured by students' performance on national standardized tests. We define that a emblematic school was treated if at least one infrastructure project was finalized. By 2014, there were 91 treated schools and 147 never treated. Our results indicate no effects on standardized tests in math and reading for second graders; however, we did find a significant reduction in the dropout rate by 0.58 percentage points.

We then moved to the analysis of the spillover effects on enrollment, school exit and school performance on competing schools located in the emblematic schools' relevant markets. This analysis is particularly relevant, given that private enrollment in Peru reaches up to 50% in large urban areas. Following recent literature (Allende, 2019; Ansari, 2021; Dinerstein et al., 2020; Slungaard, 2022), we define the educational relevant markets using a distance criterion. Specifically, we define that a school is a emblematic school's close competitor if it is located 2km around it.[5] In this setting, we define the treatment at the market level, and our universe of study are the competing private and public schools. A relevant market is treated if there is a emblematic school was treated by the Program. Our control group are the remaining relevant markets containing an emblematic school that was supposed to be treated by the Program but was not.

Our results suggest that public school infrastructure upgrading can lead to a reconfiguration of the educational market structure. In particular, we found that the start of operations of the upgraded emblematic school generated some competitive pressure that made the competing private schools 4.5 p.p. more likely to leave the market. This effect in private schools is similar to the effect (5 p.p.) found by Dinerstein et al. (2020) when a new public school opens in the Dominican Republic. Additionally, these schools that remained in the market

[5] As robustness check, we analyze other distances (1 to 5km). Our results are robust to the different definitions of the markets, with only some slight changes in magnitudes (Appendix Figures A.9 and A.10).

lost 20% of their enrollment, on average. From the heterogeneous effects results we found that the effect on school closure is lead by Lima and other regions with high levels of school competition. Moreover, although all analyzed groups of schools have a decrease in enrollment, this reduction is larger for the elementary schools with lower education quality.

We did not find effects on school exit in the competing public schools. However, they also lost 20% of their enrollment. When analyzing heterogeneous effects on enrollment, we found that schools facing higher competition lost on average more students. For instance, schools located in Lima lost 68 students; while schools located outside Lima, 19 students. We did not find differences in the effect magnitudes among elementary schools of different education quality.

We also analyzed the spillover effects on dropout rate, and the reading and math standardized tests for second graders. We did not find any aggregate effect on dropout. However, when analyzing particular groups, we found an increase in dropout rates in the public schools located at markets where students do have a smaller school choice set. Regarding the performance in standardized tests, we only found significant effects for the public schools. In particular, the reading z-score reduced by -0.103 standard deviations (σ) and the math z-score by -0.059σ. However, we found that some groups of competing private schools experienced an improvement in students' learning: elementary schools in low competition environments increased their performance in reading (0.121σ) and math (0.135σ).

Next we analyze the potential mechanisms that explain these results. We first look at the schools' responses in terms of their educational inputs: school staff and infrastructure. For the emblematic schools, we found that -besides the expected improvement of their infrastructure- there were no effects on school and teaching staff. This would suggest that the effects on the reduction of the dropout rate could be explained by and enhance in students' academic enthusiasm from having a better school environment. For the competing schools, we did not find effects on teaching staff either. We found some significant effects on infrastructure, however the magnitude of the effects are economically insignificant and unlikely to explain the results on school exit, enrollment and students' performance.

The paper speaks to four strands of the literature. First, we contribute to research investigating the relationship between educational spaces and student outcomes. Our study also contributes to the literature that examines the market effects and spillovers of school investments.[6] Dinerstein and Smith (2021) examined an education reform that provided additional funding to public schools and found that this led to the exit of private schools (mainly low-quality ones) and an increase in dropout rates. Neilson and Zimmerman (2014) found no effects on competing schools, and Andrabi et al. (2023) found a significant improvement in the standardized test scores of competing public and private schools, particularly those located closer to the treated schools. Dinerstein et al. (2020) studied a large construction program for public schools in the Dominican Republic, and found that it affected the private educational sector by generating a negative effect on enrollment, and an increase in school exit and dropout. We build on these studies and complement this literature by providing evidence on the spillover effects of school infrastructure upgrading on school exit, enrollment, dropout and student's achievement for the context of Peru.

A third strand of literature examines the competition mechanism in generating market spillovers. From the school choice approach, the literature focuses on the effects generated in the educational market after the opening of charter schools on enrollment (Slungaard, 2022), attendance (Slungaard, 2022), suspensions (Rossetto and Aniceto, 2020; Slungaard, 2022), school performance (Ansari, 2021; Gilraine et al., 2021; Rossetto and Aniceto, 2020; Slungaard, 2022) and teacher salaries (Jackson, 2012). We contribute to this literature by showing that public school upgrading can change the educational market structure, even when there is no introduction of new competing schools. Finally, this paper also speaks to the literature that explores parental preferences for schools (e.g. Abdulkadiroğlu et al., 2020; Beuermann et al., 2022). We complement this literature by showing that improvements in school infrastructure can lead to changes in the demand for schools.

[6] The vast majority of studies analyze the spillover effects on housing prices or school zone composition (Bayer et al., 2007; Black, 1999; Cellini et al., 2010; Neilson and Zimmerman, 2014).

The remainder of this paper is organized as follows: in section 2, we present the education setting in Peru and the upgrade infrastructure program. In section 3, we present the data. Sections 4 and 5 include the empirical strategy and descriptive statistics. Sections 6 and 7 present the main results of the paper and conclusion.

2 Background

2.1 The Peruvian Education Market

The Peruvian education system includes two mandatory levels of basic education: primary and secondary education. Primary education spans six years (grades 1 to 6), while secondary education lasts five years (grades 7 to 11). Each year, around 5.5 million students are enrolled in these levels (2015-2019). Over the past decade, the net enrollment ratio for primary education has consistently exceeded 97%, and for secondary education, it has remained above 80%.[7]

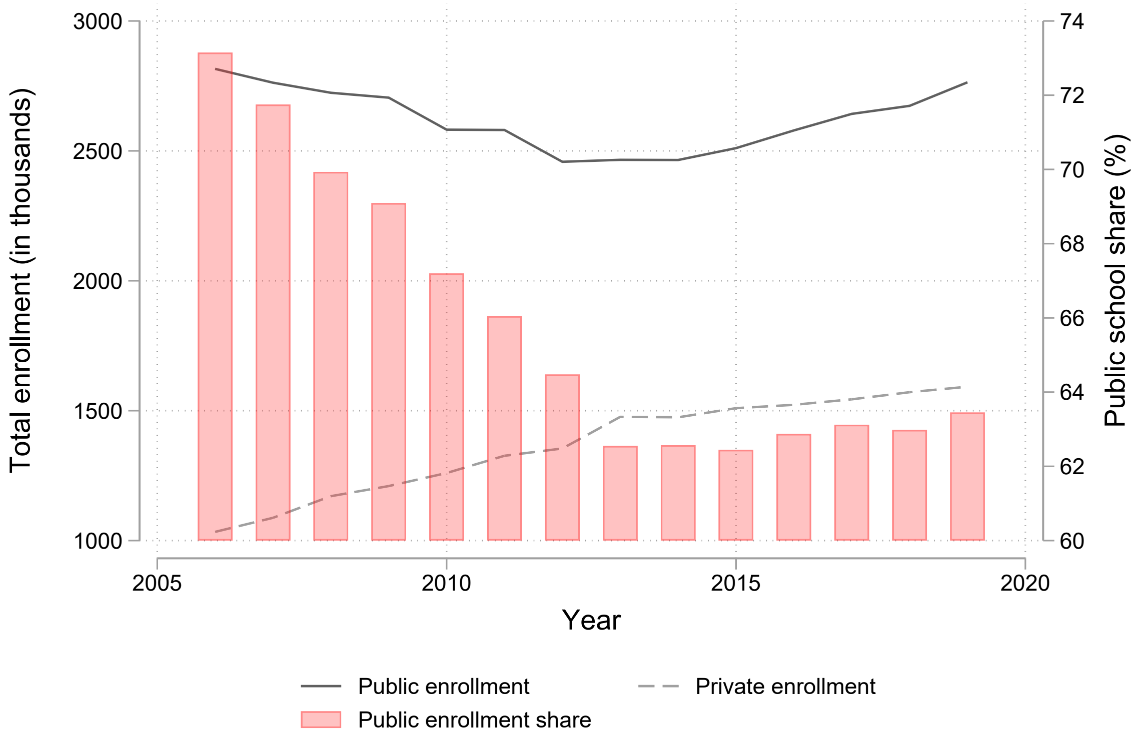
Our study focuses on both primary and secondary schools located in urban education markets in major Peruvian cities. Urban areas host 69.2% of the 30,907 private and public schools, accounting for 76.9% of total enrollment. Metropolitan Lima, the capital, alone represents approximately 33.3% of this enrollment. Similar to other countries in the developing world, private schools play a significant role in the education market, especially in urban areas. Private schools account for over 25% of total urban enrollment and current trends suggest this share is increasing over time (Figure 1).[8] Private schools are typically for-profit organizations and tend to be smaller than public schools. On average, their enrollment is approximately 40% of that of a traditional public school. Unlike other countries in the region, private schools do not receive subsidies through vouchers, meaning their tuition fees

[7] World Bank Open Data.

[8] Several qualitative studies have examined the factors driving the increase in private enrollment in the country, see the work of Balarin (2015); Cuenca (2013); Cuenca et al. (2019); Roman and Ramirez (2018) and Sanz (2014). These studies find that the main factor is the *perception* that private schools offer better quality education than public schools. Additionally, families believe that private education enhances social status and provides better opportunities for higher education.

translate directly to out-of-pocket expenses for parents.

Figure 1: School Enrollment and Public Enrollment Share



Source. ESCALE School Census (2006-2019).

The administration of public and private education systems in Peru differs significantly. The public education system is managed by the Ministry of Education (MINEDU), which is responsible for funding, setting school calendars, determining the national curriculum, and designing and distributing textbooks in public schools. In contrast, the private education sector is largely unregulated. Private schools operate independently and make their own decisions on how to organize and run their institutions. Teachers in private schools are not required to meet certification requirements and are only subject to general labor laws applicable to private employers.

The lack of regulation in the private sector stems from the 1996 reform that liberalized the education market (Legislative Decree No. 882). In 1989, 88.7% of schools were public, and there was a significant classroom deficit. The government aimed to modernize the educational system and expand enrollment by promoting private investment. To achieve this, market entry barriers were lowered by providing tax incentives and exemptions for private schools. Consequently, private schools in Peru vary widely in terms of quality and cost, ranging from low-cost, low-quality institutions to high-cost, high-performance ones. However, most of the supply of schools is low-cost (approximately 60 percent). What is more, the lack of regulation also led to the proliferation of informal and illegal schools.

2.2 The School Upgrading Program

Established in 2009, the Emblematic Schools Program aimed to refurbish, renovate, and equip priority existing schools at both the primary and secondary levels (Saavedra and Gutierrez, 2020). In contrast to initiatives designed to increase school capacity, this program only focused on replacing and refurbishing existing classrooms, as well as renovating or constructing new auxiliary areas, such as sports fields, laboratories, and teacher areas. Each emblematic school initially received a standardized package of auxiliary areas determined by the central government.[9] The program prioritized schools with a significant historical trajectory, located in middle-income areas and those serving a large number of students (MINEDU, 2013).

Initially, the program included 20 schools in Metropolitan Lima. By mid-2011, it had expanded to eventually include 238 schools nationwide[10] Of these schools, 74.8% are located in major cities, and 20.6% are in Metropolitan Lima (Figure 2). The distribution of participating schools is as follows: 71.5% offer both elementary and secondary education, 24.3% are exclusively secondary schools, and 4.2% are solely primary schools.

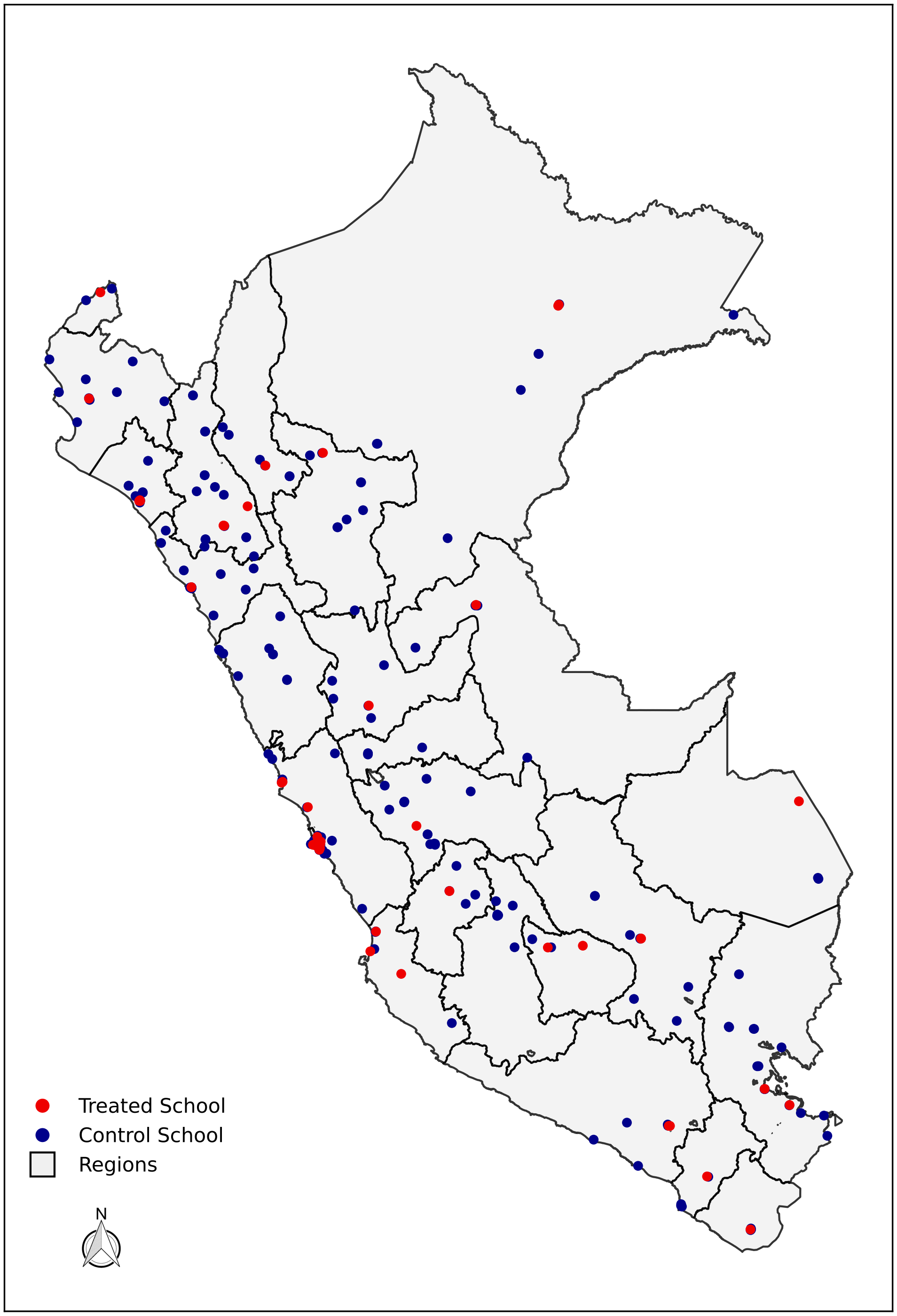
The administration of the Emblematic Schools Program underwent a significant change in January 2013, as ongoing and new upgrade projects for the Emblematic Schools switched to be managed by the School Infrastructure Office (OINFE) at MINEDU.[11] During OINFE's ad-

[9] Since 2015, officials from the Ministry of Education (MINEDU) have indicated that this package varies by school to address specific needs and population demands.

[10] More details about the program can be found in Appendix B.

[11] At the end of President Alan Garcia's administration (2006-2011), an Anti-Corruption Investigation Commission was established to investigate potential corruption activities involving individuals, firms, and government officials from central and local governments. The investigation covered all sectors, including

Figure 2: Emblematic Schools Program Across Peru



Source. ESCALE School Census (2006-2019). Notes. The map illustrates the spatial distribution of the 238 educational institutions included in the Emblematic Schools Program, categorized as either treated (executed) or control (planed but not executed) schools as of 2014.

the Education sector and its Emblematic Schools Program. In July 2012, the Commission found evidence of collusion between private companies and central government officials, recommending changes in program management and administrative processes to mitigate future corruption risks.

ministration, only three new emblematic schools were upgraded. In light of delayed progress in construction works and findings from the 1st School Infrastructure Census (2014), which revealed that approximately 70% of public schools nationwide required infrastructure improvements, and 67% lacked essential services (water, sewage, or electricity), the program was redesigned and renamed as the National Education Infrastructure Program (PRONIED).

Our study focuses on the early stages of the program (2009-2014), prior to PRONIED's activities. We chose not to include the period under PRONIED administration for two main reasons. First, PRONIED's scope extends beyond the 238 emblematic schools, prioritizing underprivileged schools with significant infrastructure deficits. Second, the coordination of treatment timing with local governments and schools under PRONIED could correlate with other factors affecting the outcomes of interest.

By 2014, only 91 schools (out of 238 original planned) had completed their first infrastructure investment projects. On average, 15 emblematic schools were upgraded annually (Figure 3).Each school undertook an average of 9 infrastructure upgrade projects, receiving a total investment of 1.5 million USD. The duration of each upgrading project was approximately 1.5 years. During construction, some students were temporarily relocated to nearby public school premises, but their affiliations and education remained under the oversight of their original schools.[12]

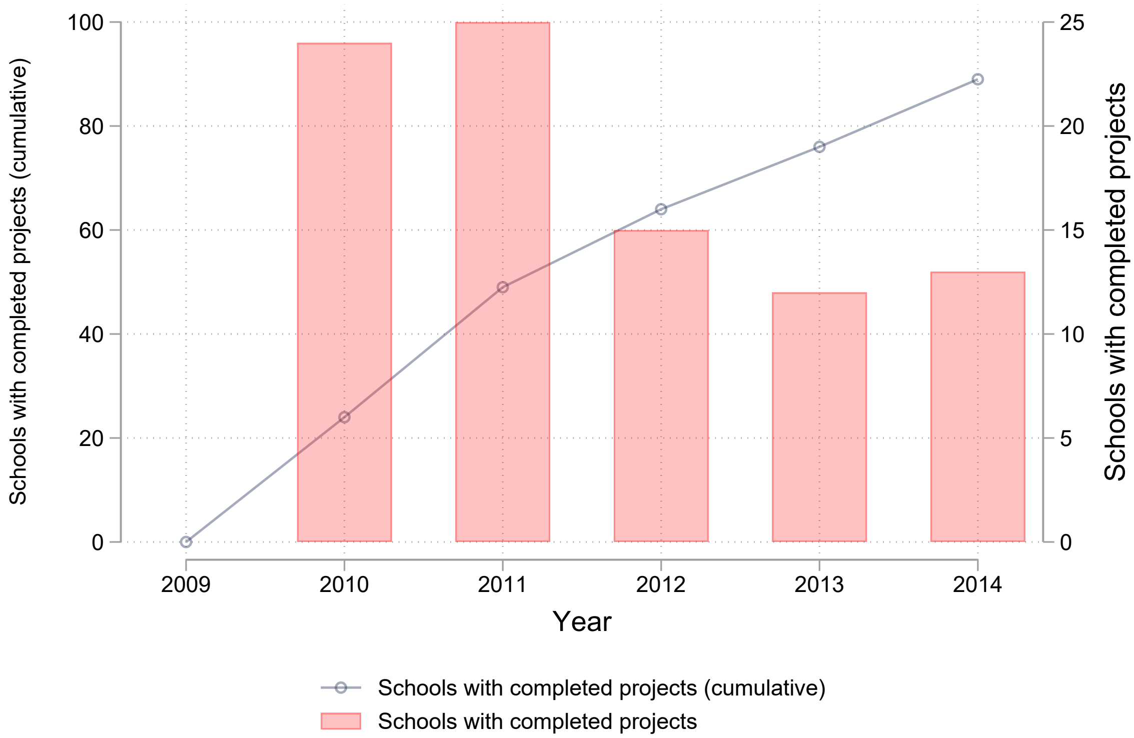
3 Data

3.1 Program Administrative Records

We use administrative data from the Emblematic Schools Program to obtain the final list of selected schools (238 schools). Additionally, we have information regarding the physical and financial progress of each infrastructure investment project, their starting and ending dates, and the number of students benefiting from this program. This allows us to determine

[12]In comparison to the subsequent program, schools treated by PRONIED received an average total investment of 4 million USD.

Figure 3: Number of emblematic schools with a completed project



Source. Administrative data of the National Educational Infrastructure Program - PRONIED

the precise moment when the schools are treated. We also have information on the exact characteristics of the renovations, refurbishing, and equipping from the projects' technical documentation.

3.2 Educational data

This study relies on 2 primary educational data sources from the Ministry of Education: the School Census (SC), and the Student Census Evaluation (SCE).

The School Census (2006 - 2014).— contains school-level data of all private and public operating schools on enrollment, teaching staff, and students' outcomes. Specifically, it provides information on enrollment by gender, age, and grade; the number of teachers by gender, grade, level of education attained, and type of contract; and school dropout by gender and grade. It also includes self-reported data on school facilities and its conditions. More importantly, the Census contains information on the schools' addresses, which we use to geocode each institution. This information is crucial for defining the relevant market for each Emblematic School. Our main outcomes are school exit, enrollment and students' achievement. The information on teacher composition and school infrastructure will allow us to analyze how schools adjust their educational inputs when they are directly or indirectly exposed to infrastructure upgrading.

The Student Census Evaluation (2007 − 2014).— provides individual-level results on standardized test scores in mathematics and reading for 2nd graders. All private and public schools with more than five 2nd-grade students should take this test. These results do not condition or relate to grades obtained at school.

4 Empirical Strategy

This paper focuses on the early stages of the Emblematic Schools Program between 2009 and 2014, before an abrupt change in its administration. By 2014, only 91 of the 238 targeted schools had received the program. Given the phased implementation of these investments, we use a difference-in-difference strategy with staggered treatment.

There are three possible ways to define the timing of the treatment due to the construction process's different stages: (i) when the schools began their construction process, (ii) when the first construction project was completed and available for students, and (ii) when all construction projects at the schools were finalized and available for students. Our preferred option for treatment is when the infrastructure upgrade is first available to students, as this is the most pertinent event for student enrollment and school achievement. Furthermore, we focus on when the first infrastructure work becomes available rather than when all projects are completed, since by 2014, only seven schools had fully completed all construction works. However, recognizing that schools may be forward-looking (Dinerstein et al., 2020), we also analyze the start of the construction process as a relevant event for assessing school exit outcomes (See Section 8).

An advantage of our empirical strategy is that it does not require random assignment to the treatment group. However, a potential threat is the possibility that the opening of the renovated schools might be correlated with other shocks affecting the dependent variables we are analyzing. Our discussions with Ministry of Education officials confirmed that no additional programs were implemented in these schools concurrently with the Emblematic Schools Program. To evaluate the direct effects of the Program on the treated schools, we employ a difference-in-difference model at the school level, as follows:

$$y_{st} = \delta_s + \gamma_t + \beta \mathbb{1}[PCE_s \times Post_t] + X_{st} + \varepsilon_{st} \tag{1}$$

Where y_{st} is the variable of interest at school level s in period t. Our variables of interest are students' performance measured by the national standardized tests (reading and math), and the dropout rate.[13] $\mathbb{1}[PCE_s \times Post_t]$ is the indicator function that takes the value of 1 when the Program is active in school s. β is the coefficient of interest (ATT). δ_s and γ_t are the school and year fixed effects, respectively. ε_{st} is the error term. We use an event study to visualize the dynamic results and show the treatment effects before treatment to validate the assumption of parallel trends. Instead of using the ''two-way fixed effects" estimator, we rely on the Borusyak et al. (2021) imputation estimator, which is robust to heterogeneous and dynamic treatment effects, ideal for the nature of our staggered treatment.

To evaluate the indirect effects of the program, we expand our sample to include nearby

[13]We do not include enrollment as an outcome because the emblematic schools were already operating at full capacity before the program was implemented, and increasing the number of seats offered was not the program's objective. Consistent with this, in Appendix Table A.1, we show no effects on enrollment. Appendix Figure A.1 presents the corresponding event study plot. We observe a negative trend during the pre-period, with significant effects in periods -2 and -1 when school upgrades were in progress. There is also a significant negative effect in year 0, when the upgraded school began full operation. According to Ministry of Education officials, these declines in enrollment during construction periods can be attributed to parents' dissatisfaction with the temporary relocation of their children to other school venues. The high volume of parental complaints led PRONIED, since 2015, to avoid relocating students by constructing temporary classrooms in open spaces within the emblematic schools during the upgrading process. Enrollment levels return to pre-upgrade levels after the first year of infrastructure upgrade completion.

schools located in the neighborhood of the participating emblematic schools. First, we define the relevant markets of the 238 eligible schools for the program. A relevant market is defined as a market that includes all schools among which there is close competition or which, from the consumer's perspective, there are other schools available for substitution. Following previous literature, we define the relevant market using a distance criterion (Allende, 2019; Ansari, 2021; Dinerstein et al., 2020; Slungaard, 2022). Specifically, the relevant market for program-eligible schools includes those located within a 2 km buffer zone.[14] but other distances are explored as a robustness check (see Section 8). This definition assumes that competing schools are geographically proximate and that students generally select schools near their home residences.

Some relevant markets include multiple eligible emblematic schools. When both control and treatment emblematic schools are present, we define the market as treated in the earliest year when any treatment school completes its first construction project. If there are multiple treated emblematic schools within a market, we consider the treatment to occur in the earliest year any school finishes its first construction project. In this scenario, the post-event periods may exhibit larger treatment effects due to the subsequent treatment of additional schools within the same market.

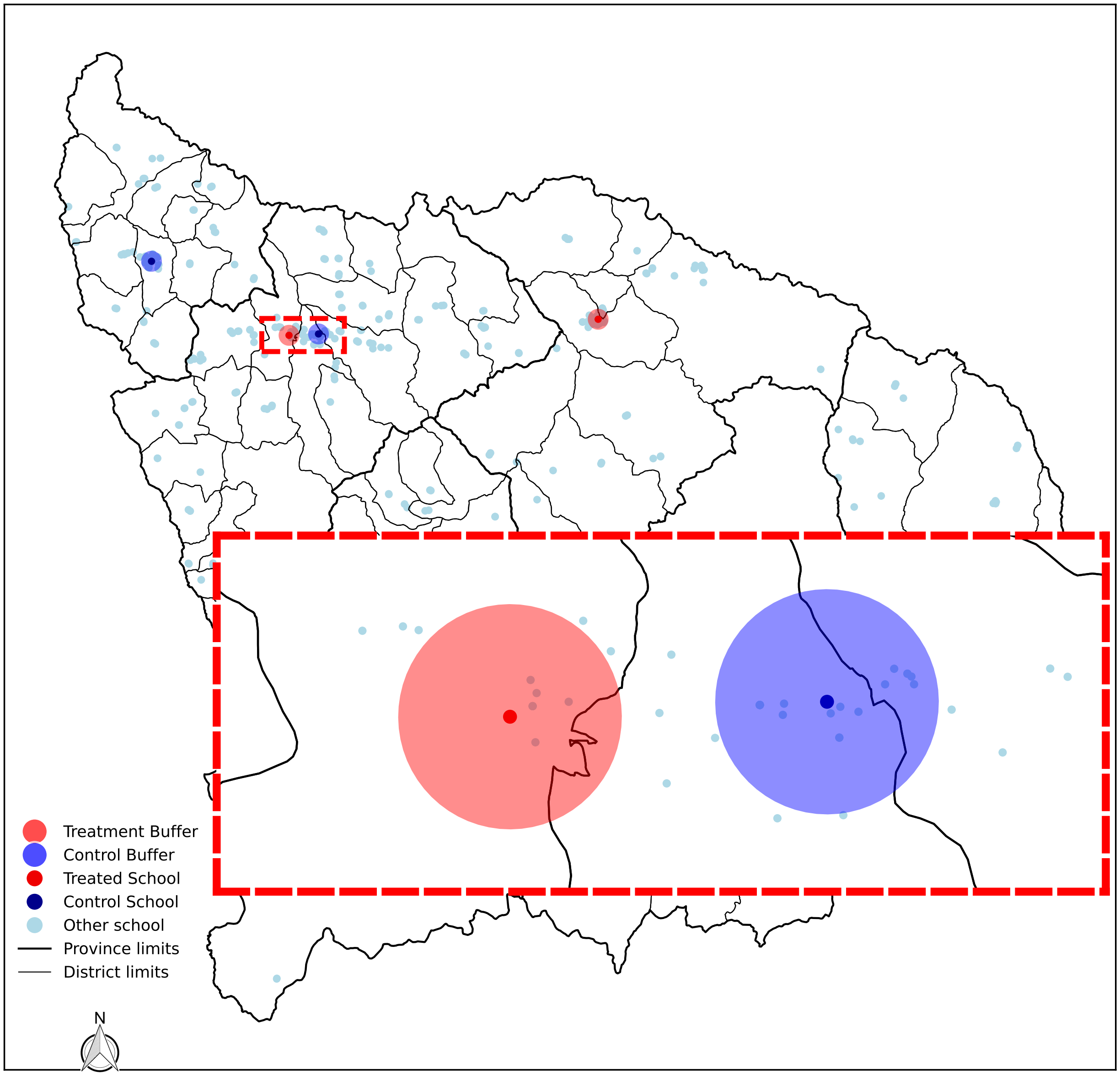
Figure 4 illustrates how relevant markets are constructed for Apurimac, using a 2 km distance criterion. Our final sample includes 161 relevant markets, each containing an average of 56 competing schools.[15] Treatment assignment occurs at the market level. Schools located around the upgraded emblematic schools are designated as treated competing schools within their respective relevant markets, while those situated near the control emblematic schools

[14] Using the National Survey of Budget Programs (ENAPRES), which provides information on the commuting time from home to school, and speed assumptions on kilometers per hour (Velasquez, 2023), we estimate that students commute an average of 1.64 km. Moreover, this commute is greater in major cities (2.25 km) than in non-major cities (1.57 km) (Table A.4). Accinelli (2018) finds that in low-income areas of Lima, the primary education market is highly competitive, with a market size of 1 km. Allende (2019) reports that in Peru, the average distance between a family's residence and their chosen school is 3 km.

[15] Since we explore the competition channel between schools, we restrict the sample to relevant markets composed of at least five competing schools. Only three relevant markets were excluded based on this criterion.

are classified as control competing schools.

Figure 4: Relevant markets in Apurímac (2km)



Source. ESCALE School Census (2006-2019).

For the analysis of the spillover effects, the econometric specification is as follows:

$$y_{jmt} = \eta_j + \tau_t + \theta \mathbb{1}[PCE_{jm} \times Post_t] + X_{jmt} + \mu_{jmt} \tag{2}$$

This specification is similar to Equation 1, with the difference that $\mathbb{1}[PCE_{jm} \times Post_t]$ is the indicator function that takes the value of 1 when the emblematic school in the relevant market m is treated. In other words, the indicator function takes the value of 1 when the competing school j in the relevant market m is indirectly exposed to the Emblematic School Program (i.e. an emblematic school is treated). θ is the coefficient of interest.

5 Descriptive Statistics

Table 1 shows the summary statistics for the three analyzed samples for the period before the school upgrading program started (2006 - 2009): i) the emblematic schools, ii) the competing private schools, and iii) the competing public schools. Panel A shows the percentage of schools that exit the market and the average yearly enrollment. As we can see, the competing private schools are more likely to leave the market and are smaller in enrollment. While the average enrollment in these private schools is 81 students, the enrollment in the emblematic and competing public schools is 1,065 and 270, respectively.

On Panel B, we observe the students' academic outcomes and the 2nd graders standardized tests for both math and reading. The average dropout rate is 6.6% in the traditional public schools, and lower in the emblematic and private schools (3.9 and 2.4%, respectively). The emblematic and private schools have similar average math scores (approximately 0.25 s.d.), while the traditional public schools have an average of -0.20 s.d. In terms of reading scores, the private schools show the highest scores (0.5 s.d.), followed by the emblematic schools (0.23 s.d.) and the traditional public schools (-0.4 s.d.).

Panel C shows the teachers' characteristics. The number of teachers in emblematic schools is double the number in comparison with the number of teachers in private and other public schools. The percentage of female teachers is close to 50% in all samples. Almost all teachers have higher education studies. The percentage of teachers with long-term contracts or tenure is higher in public schools. Finally, teachers in other public schools are more likely to assume additional managerial roles at schools. Panel D shows the infrastructure variables. The emblematic schools have the highest access to the basic services of water, electricity, and sewage (93%), followed by the private schools (89%) and the traditional public schools (54%). The emblematic schools have three times more classrooms than the private and public schools. However, private school classrooms have better conditions.

Table 1: Descriptive statistics

	Emblematic schools			Competing private schools			Competing public schools		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
A. ***School exit***									
School exit	1,504	0.01	0.09	58,390	0.23	0.42	54,466	0.03	0.18
Total enrollment	1,504	1064.80	675.78	58,390	80.84	123.87	54,466	269.91	292.38
B. ***Student's achievement***									
Dropout (%)	1,482	3.92	3.23	42,831	2.39	5.29	51,846	6.55	6.51
Math z-score	407	0.26	0.83	16,559	0.24	0.87	20,932	-0.20	1.06
Reading z-score	408	0.23	0.77	16,543	0.50	0.80	20,939	-0.40	0.97
C. ***Teacher variables***									
Administrative staff	1,467	0.88	1.37	43,886	0.42	0.75	50,965	0.42	0.82
Number of teachers	1,463	18.19	25.45	37,977	7.76	8.57	50,349	8.97	11.97
Female (%)	1,463	54.79	30.65	37,977	56.97	33.44	50,349	52.94	33.25
With management positions (%)	1,463	23.64	33.69	37,977	22.75	34.00	50,349	30.15	35.59
With higher education (%)	1,016	99.53	4.78	29,867	99.66	3.90	33,582	99.42	5.66
With tenure (%)	1,268	70.80	36.00	32,754	31.45	41.54	41,868	67.20	40.08
D. ***Infrastructure variables***									
Access to basic services (%)	1,476	93.29	25.02	42,366	88.93	31.38	51,912	54.28	49.82
Number of classrooms	1,473	33.60	15.26	42,237	11.57	7.90	51,820	11.85	8.45
Classrooms in good condition (%)	1,473	50.90	36.98	42,217	94.90	17.36	51,812	49.29	38.78
Has teacher rooms (%)	1,477	64.73	47.80	42,442	57.08	49.50	51,943	26.38	44.07
Has library (%)	1,477	88.76	31.60	42,401	54.86	49.76	51,900	52.06	49.96
Has laboratory (%)	1,480	68.65	46.41	42,570	23.72	42.53	51,964	22.21	41.57
Has administrative building (%)	1,475	89.42	30.76	42,333	86.66	34.00	51,902	59.93	49.00

Sources.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).
NOTE.— The table shows descriptive statistics for enrollment, school exit, academic results, teacher variables and educational infrastructure for public schools, private schools and the emblematic schools. The period of analysis is between 2006-2009. Test scores correspond to 2nd graders and are standardized into z-scores based on yearly averages and standard deviations. The Access to basic services variable is a dummy that takes the value of 1 when the school has access to piped water, electricity and sewage services.

The balance tables are in the Appendix (Tables A.2 and A.3). These tables show the balance test for the treated and control schools during the period before the Program (2006 - 2009). Table A.2 shows that the treated emblematic schools are bigger in terms of enrollment and size of infrastructure but equal in all other characteristics. Table A.3 shows small treated and control schools in terms of infrastructure and teaching staff in the public schools. It also shows that the private schools in the treated markets have larger enrollment, and higher students' test scores in both math and reading. There are also differences in the teaching staff and infrastructure; however, these differences are economically trivial. While these results are reassuring, it is worth noting that our identification strategy does not require balance between treatment and control schools at baseline. Instead, it relies on the assumption of parallel trends, which we investigate later using an event study.

6 Results

6.1 Direct effects on the Emblematic Schools

Table 2 shows the results from estimating Equation 1 for our outcomes of dropout and 2nd grade students' academic performance in standardized tests in math and reading. We find a decrease in the dropout rates by 0.58 percentage points. This result is in line with the effect (12.2 p.p.) found by Adukia (2017), although in a smaller magnitude. Figure A.2 shows the corresponding event study plots on the dropout rate. There are no pre-trends in the dropout rates which validates our post-treatment results. We find no effects on any standardized tests both in reading and math. However, these results may be a limited measure of academic outcomes for the emblematic schools, as improvements in school facilities may have greater effects in other subjects such as science, where laboratories, for instance, can make an important contribution as the work of Cellini et al. (2010) points out.

Table 2: Direct Effects on Students' Achievement

	Enrollment (%) (1)	Enrollment (log) (2)	Dropout (%) (3)	Reading z-score (4)	Math z-score (5)
SchInfr x Post	-24.198	0.004	-0.583*	0.034	-0.006
	(31.660)	(0.070)	(0.331)	(0.105)	(0.071)
Dep. Var. Mean	1,083.02	7.43	3.34	0.45	0.36
Observations	1,719	1,719	1,701	512	513
School FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Sources.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).
NOTE.— Standard errors in parentheses. Errors clustered at the school level.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

6.2 Spillover Effects

In this section, we estimate Equation 2 to explore the spillover effects that the school upgrading program had on the nearby competing schools located 2km around selected schools. Similarly to the previous section, we explore the results on student achievement, as well as enrollment and school exit.

6.2.1 Spillover Effect on School Exit and Enrollment

Table 3 shows the indirect effects on school exit and enrollment. Panel A and B show the effect for private and public schools, respectively. Column 1 shows the effects of having an upgraded emblematic school in the educational relevant market on surrounding schools. While there are no effects for the public schools, we find that private schools' exit rate increase by 4.5 p.p. This effect in private schools is similar to the effect (5 p.p.) found by Dinerstein et al. (2020) when a new public school opens in the Dominican Republic. Figure A.3 shows the event study plot. We found no evidence of a violation of parallel trends. Additionally, we see that the effect on private school exit starts immediately after the improved emblematic school opens.

Next, in Columns 1 to 5, we show the results on enrollment in levels and logs for the schools, in their non-conditional and conditional versions. The conditional estimations

Table 3: Spillover Effects on School Exit and Enrollment

	School exit (1)	Total non-conditional Enrollment (2)	Total conditional Enrollment (3)
A. ***Private schools nearby***			
SchInfr x Post	0.045***	-8.878***	-9.339***
	(0.010)	(1.835)	(2.127)
Dep. Var. Mean	0.16	102.05	126.71
Observations	64,686	64,686	49,550
B. ***Public schools nearby***			
SchInfr x Post	0.005	-40.817***	-41.145***
	(0.006)	(4.962)	(5.048)
Dep. Var. Mean	0.02	457.97	469.09
Observations	24,265	24,265	23,642
School FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Market Time Trends	Yes	Yes	Yes

Sources.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).
NOTE.— Standard errors in parentheses. Errors clustered at the school level.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

(Columns 3 and 5) restrict the sample of schools to those that do not close during the analysis period, while the unconditional version (Columns 2 and 4) includes all the school sample. Results reported in Column 3 show that there is a reduction on the number of enrolled students for both private and public schools. This reduction is bigger for the public sector (-41.1) than for the private sector (-9.3). However, in relative terms, they both experience a similar reduction of approximately 20% (Column 5). The unconditional results have similar effect sizes, suggesting that the effects are mainly explained by the surviving schools. Figure A.3 shows the event study plots for these outcomes. We found no evidence of a violation of parallel trends for any of the variables for either public or private sector.

Figure 5 shows the heterogeneous effects on school exit and enrollment for different groups: level of education (elementary and high schools), region's competitiveness level (high and low competitive regions), whether the school is located in the capital Lima or not, and whether the school was above or below the reading standardized test (z-score) median. Notice that this last category is only available for elementary schools. In Panel A and B we see the results for school exit for the private and public schools. Notably, we find heterogeneous effects for different groups of schools. For the private schools, we see that their increase in the likelihood of closure is lead by Lima and other regions with high levels of school competition. We also see that this closure happens in both elementary and high school, and in schools of different education quality. Regarding the public schools -for which we did not find aggregate effects in school exit-, we see that there is a increase in school exit for the elementary schools, and for both elementary schools of low and high education quality.

Panel C and D present the heterogeneous effects on enrollment. For the private schools, we see a reduction in enrollment in all analyzed groups. Notably, this decrease is higher in the elementary schools with lower education quality. Regarding the public schools, the effect on enrollment is negative for all groups, except in the regions with low school competition. There are important differences in magnitudes across the competitiveness level school faces. For instance, schools located in Lima lose an average of 68 students; while schools located outside Lima, an average of 19 students. Interestingly, we did not find differences in the effect magnitudes among elementary schools of different education quality.

———————— ————————

6.2.2 Spillover effects on students' achievement

Table 4 shows the spillover effects on dropout rates, and the reading and math standardized tests for second graders. As seen in Column 2, we do not find effects on dropout. Nevertheless, there is a significant reduction in the scores 2nd-grade students get in reading and math standardized tests in the public competing schools (Columns 4 and 6). This negative effect is bigger in reading (-0.103σ) than in math (-0.059σ). There are no spillover effects on private schools' test scores. In Figure A.4, we validate the assumption of parallel trends for the nearby schools. We find no evidence of a violation of parallel trends.

———————— ————————

Similar to Figure 5, Figure 6 presents the heterogeneous effects on dropout and 2nd-grade students' performance on standardized tests (reading and math). Panel A and B

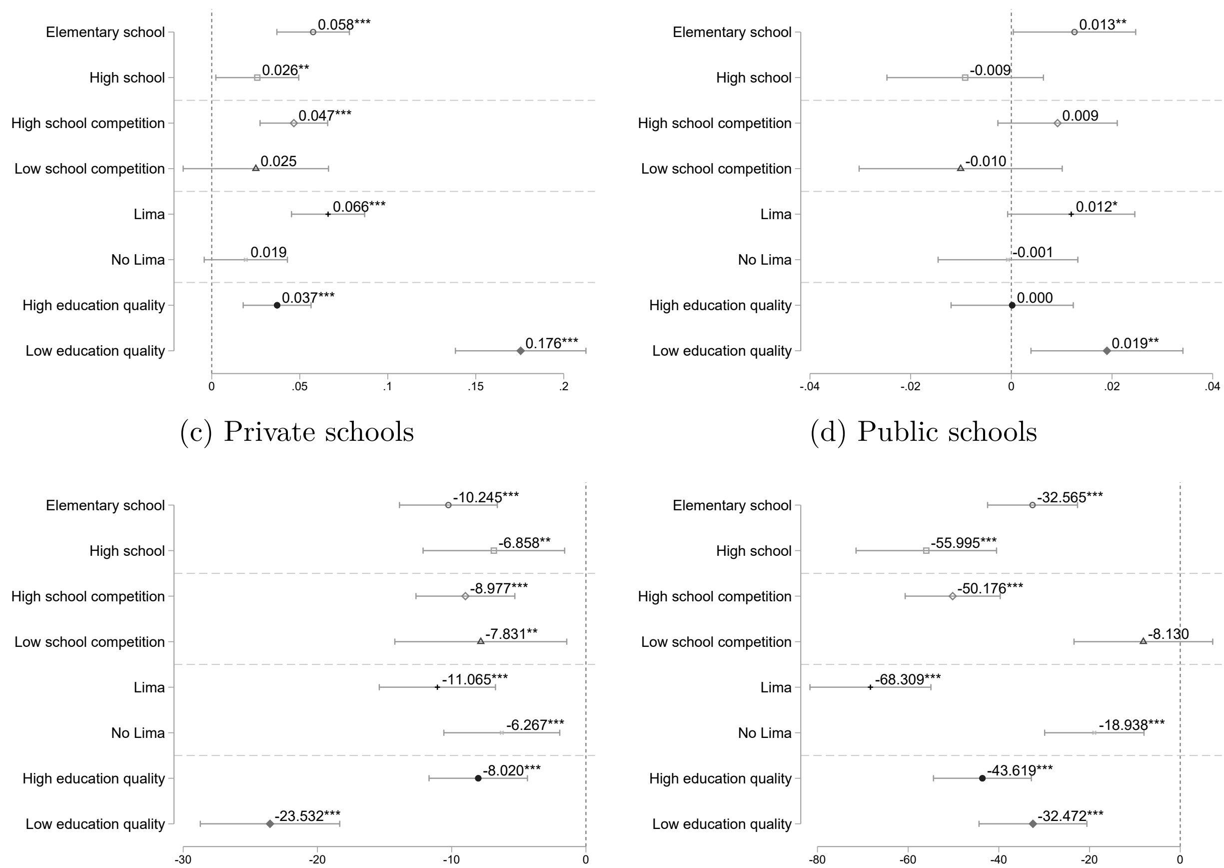
Figure 5: Heterogeneous Effects on School Exit and Enrollment, by Group

(a) School Exit - Private schools

(b) School Exit - Public schools

(c) Private schools

(d) Public schools



Source.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).
NOTE.— Dummies were generated for schools according to educational level (elementary and high school); level of competitiveness (measured as the group of relevant markets in regions where the density of private schools is higher than the median); quality of education (dummy that separates schools with positive results in standardized reading tests) and belonging to the Lima region.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

present the results on dropout for the competing private and public schools. In line with the aggregate results, we did not find effects on dropout for any group of the private schools with a confidence level of 95%. For the case of the public schools, we found significant increases in dropout for the high schools (0.722 p.p.), the competing schools in low competitive regions (0.699 p.p.), and schools outside the capital (0.359 p.p.). In other words, dropout in public schools increases in the markets where students do have a smaller school choice set.

Panels C and E present the heterogeneous effects on the reading and math standardized

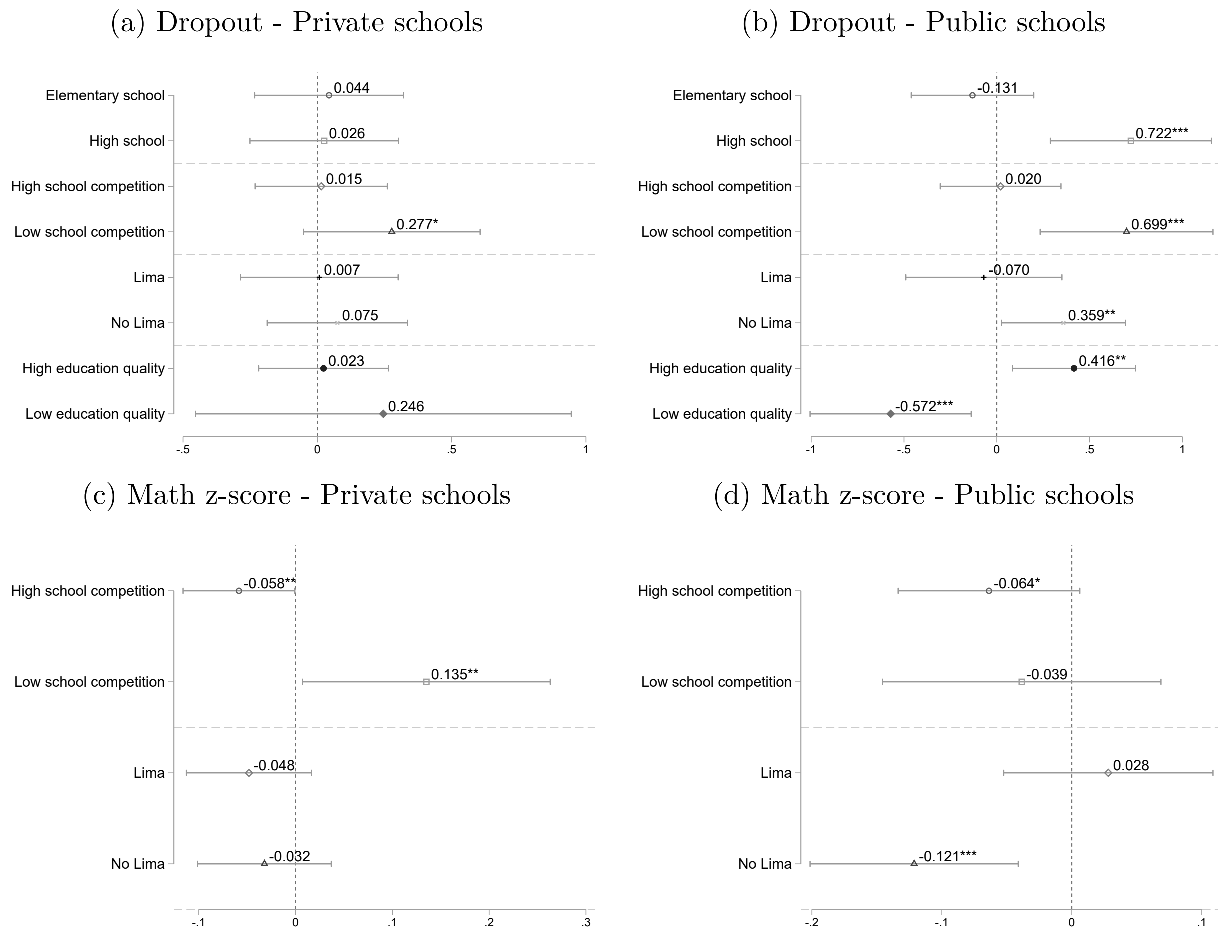
Table 4: Spillover effects on Student's Achievement

	Non-conditional Dropout (%) (1)	Conditional Dropout (%) (2)	Non-conditional Reading z-score (3)	Conditional Reading z-score (4)	Non-conditional Math z-score (5)	Conditional Math z-score (6)
A. ***Private schools nearby***						
SchInfr x Post	0.036	0.148	-0.021	-0.013	-0.041	-0.035
	(0.122)	(0.117)	(0.025)	(0.025)	(0.029)	(0.030)
Dep. Var. Mean	1.79	1.74	0.51	0.53	0.19	0.21
Observations	52,060	46,996	23,045	21,598	23,058	21,611
B. ***Public schools nearby***						
SchInfr x Post	0.169	0.195	-0.103***	-0.107***	-0.058*	-0.059*
	(0.157)	(0.156)	(0.029)	(0.029)	(0.035)	(0.035)
Dep. Var. Mean	4.30	4.28	0.00	0.00	0.12	0.12
Observations	23,610	23,392	13,135	13,037	13,130	13,032
School FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Market Time Trends	Yes	Yes	Yes	Yes	Yes	Yes

Sources.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).
NOTE.— Standard errors in parentheses. Errors clustered at the school level.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

tests for the private schools. We found that there is a significant increase in both the reading (0.121σ) and math (0.135σ) z-scores in regions of high school competition. Similarly, Panels D and F show the results for the public schools. For reading, we see that this decrease in performance happens both in elementary.

Figure 6: Heterogeneous Effects on Student Achievement, by Group



Source.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).
NOTE.— Dummies were generated for schools according to educational level (elementary and high school); level of competitiveness (measured as the group of relevant markets in regions where the density of private schools is higher than the median); quality of education (dummy that separates schools with positive results in standardized reading tests) and belonging to the Lima region. As for the heterogeneous effects in the standardized tests, only the results by competitiveness and Lima region are shown.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

7 Mechanisms

In this section, we explore the mechanisms that could explain the previous results. Our results on enrollment, school exit and students' achievement could be explained by school, teacher, parents and students behavioral responses. Since we only have one source of plausible exogenous variation and many variables that could account for these effects, this analysis does not attempt to isolate to what extend each response accounts for our results.

In first place, the school upgrading Program might generate school and parents' behavioral responses that could explain the results in enrollment and school exit. From the school side, they might adjust their tuition fees and/or their educational inputs (e.g. teaching hiring or school infrastructure). On the other side, the Program could parents' preferences and demand of schools. Parents may now value more the public school for their upgraded facilities and the recreational opportunities or enhanced safety they provide, or simply because they are aesthetically more appealing (Cellini et al., 2010). Moreover, they could also interpret the Program as an informational shock regarding school quality, which in turn could potentially increase public schools' attractiveness, affecting their school choice.

School upgrading and equipping could also improve academic performance through different channels (Cellini et al., 2010; Neilson and Zimmerman, 2014). On the student's side, it can decrease distractions, minimize missed school days, and enhance academic enthusiasm. On the teachers' side, it can affect teaching strategies and improve morale, reducing absenteeism and turnover. Finally, it could also affect parents' involvement in their children's academic pursuits at home.

In this first version of the study, we present the results on the schools' behavioral responses on school inputs, leaving for future work the exploration of the remaining potential mechanisms for which there is available data.

Teaching Staff and School infrastructure: Specifically, we explore if schools adjusted their teaching staff and infrastructure. Table 5 shows the effects on teaching staff. In particular, this table reports the estimates from Equation 1 for the emblematic schools (Panel A) and the estimates from Equation 2 for the competing schools (Panel B and C). We analyze the number of school staff (teachers and non-teaching staff), teachers' characteristics (sex, role, and education), and teachers' contract (tenure track) for the sample of schools that do not close (conditional estimates). For the emblematic schools, it is observed an increase in the number of teachers (Column 2); however, they 5 p.p. more likely to assume management positions. For the case of the competing private schools, we do see a significant reduction on the non-teaching staff (Column 1); however this magnitude is not economically significant. We did no find any effect on teaching staff in the competing public schools. Figure A.6 presents the dynamic effect plots for these outcomes for the private and public sector. These results confirm the validity of the parallel trends assumption.

Table 5: Effects on Teaching Staff

	Adm. Staff (1)	Number of teachers (2)	Female teachers (%) (3)	Management positions (%) (4)	Higher education (%) (5)	Tenure (%) (6)
A. ***Emblematic Schools***						
Treat*Open	-0.119	1.481**	-2.947	5.019**	-0.962	2.298
	(0.140)	(0.734)	(2.062)	(2.250)	(0.805)	(2.661)
Dep. Var. Mean	0.53	18.49	56.49	13.84	99.43	73.63
Observations	1,675	1,675	1,567	1,567	1,313	1,408
School FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
B. ***Private schools nearby***						
Treat*Open	-0.062***	-0.046	0.555	0.677	0.082	-0.275
	(0.020)	(0.099)	(0.740)	(0.703)	(0.103)	(0.880)
Dep. Var. Mean	0.23	7.77	58.15	13.02	99.67	35.93
Observations	43,429	42,716	40,320	40,320	35,483	34,525
C. ***Public schools nearby***						
Treat*Open	-0.062	-0.117	-1.400	1.575	-0.018	-1.406
	(0.041)	(0.161)	(0.989)	(1.051)	(0.200)	(1.043)
Dep. Var. Mean	0.32	10.76	57.04	15.23	99.50	69.77
Observations	22,717	22,698	21,385	21,385	17,847	19,147
School FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Market Time Trends	Yes	Yes	Yes	Yes	Yes	Yes

Sources.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).
NOTE.— Standard errors in parentheses. Errors clustered at the school level.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

Next, we evaluate the effects on school infrastructure. Table 6 is similar in structure to Table 5. We analyze the outcomes of access to basic services (electricity, water and sewage), the number of classrooms and their condition, as well as the availability of auxiliary infrastructure (teacher rooms, library, laboratory, and administrative building). In Panel A, we see that the emblematic schools improved their access to basic services in 2.7% and improved their classroom conditions by 34.7 percentage points. We can also see that there were no increase in the number of classrooms or school capacity. These results are in line with the objective of the Emblematic School Program under study.

Regarding the competing schools, we found some adjustments in their infrastructure. The competing private schools that remained in the market reduced their number of classrooms and their conditions. On the other hand, the competing public schools slightly reduced their number of classrooms. However, we find some evidence of existence of pre-trends for some outcomes (Figure A.8).

Table 6: Effects on School Infrastructure

	Acces to basic services (1)	Number of classrooms (2)	Classrooms in good condition (%) (3)	Auxiliary areas (%) (4)
A. ***Emblematic schools***				
Treat*Open	0.027*	-2.091	34.739***	0.008
	(0.015)	(1.550)	(5.454)	(0.028)
Dep. Var. Mean	0.94	36.97	46.08	0.674
Observations	1,665	1,543	1,660	1,688
School FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
B. ***Private schools nearby***				
Treat*Open	0.011	-0.501**	-2.411***	0.015*
	(0.008)	(0.197)	(0.724)	(0.009)
Dep. Var. Mean	0.94	12.59	95.63	0.45
Observations	35,089	29,674	39,710	45,631
C. ***Public schools nearby***				
Treat*Open	-0.002	-1.145***	-1.750	-0.011
	(0.009)	(0.219)	(1.762)	(0.011)
Dep. Var. Mean	0.89	17.60	45.91	0.47
Observations	23,280	21,879	23,210	23,455
School FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Market Time Trends	Yes	Yes	Yes	Yes

Sources.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).
NOTE.— Standard errors in parentheses. Errors clustered at the school level.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

8 Robustness Checks

In this section, we conduct robustness checks to validate the main findings.

Relevant market definition: According to Table A.4, students commute an average of 1.6km from home to school. We extend our main analysis of spillover effects to consider other distances for defining the relevant markets. Figures A.9 and A.10 show the event study plots for our main outcomes using buffers of 1 to 5km, for private and public schools separately. In general, we can observe that our results maintain for different definitions with some minor changes in magnitudes.

Timing of treatment: Later versions of this paper will include a robustness check for different treatment definitions. In particular, considering that schools might be forward looking, we will define the timing of the event as the moment when the emblematic schools start their construction process. This new definition may be of importance for the outcome of school exit.

9 Conclusions

In this paper, we examine the direct and spillover effects of a national school infrastructure upgrade program in Peru. Using a staggered difference-in-difference strategy, we find that this program reduced dropout rates by 0.58 percentage points, but there were no other effects on students' achievement. Interestingly, we explore the spillovers effects of this program in a context where private and public schools are constantly competing. We document how the upgrade of these schools produced market effects. The opening of upgraded emblematic schools pressured competing schools to leave the market. Competing private schools 4.5 p.p. more likely to leave the market. This effect in private schools is similar to the effect (5 p.p.) found by Dinerstein et al. (2020) when a new public school opens in the Dominican Republic. From the heterogeneous effects results, we found that the effect on school closure is lead by Lima and other regions with high levels of school competition.

Both private and traditional public schools are losing enrollment in the relevant markets we study, and this reduction is larger for the elementary schools with lower education quality. An unresolved question that we will address in future versions of this paper is where these students who leave these schools are going. Additionally, we found that the reading z-score reduced by -0.103σ and the math z-score by -0.059σ in the traditional public schools. We then analyzed if school inputs (teaching staff and infrastructure) could be mechanisms that explain these results. However, this is unlikely to be the case. Future work will incorporate additional robustness checks, and explore additional mechanisms that can explain the observed results.

References

Abdulkadiroğlu, A., Pathak, P. A., Schellenberg, J., and Walters, C. R. (2020). Do parents value school effectiveness? *American Economic Review*, 110(5):1502–39.

Accinelli, M. A. (2018). The more the merrier? the effects of competition on achievement in public schools and low-fee private schools in lima, peru.

Adukia, A. (2017). Sanitation and education. *American Economic Journal: Applied Economics*, 9(2):23–59.

Allende, C. (2019). Competition under social interactions and the design of education policies. *Job Market Paper*.

Andrabi, T., Bau, N., Das, J., Karachiwalla, N., and Khwaja, A. I. (2023). Crowding in private quality: The equilibrium effects of public spending in education. Technical report, National Bureau of Economic Research.

Ansari, A. H. (2021). Collaboration or competition? evaluating the impact of public private partnerships (ppps) on public school enrolment. *International Journal of Educational Research*, 107:101745.

Balarin, M. (2015). The default privatization of peruvian education and the rise of low-fee private schools: Better or worse opportunities for the poor? 2015 esp working paper series.

Balarin, M. and Escudero, A. (2019). El desgobierno del mercado educativo y la intensificación de la segregación escolar socioeconómica en el perú.

Bayer, P., Ferreira, F., and McMillan, R. (2007). A unified framework for measuring preferences for schools and neighborhoods. *Journal of political economy*, 115(4):588–638.

Beuermann, D. W., Jackson, C. K., Navarro-Sola, L., and Pardo, F. (2022). What is a Good School, and Can Parents Tell? Evidence on the Multidimensionality of School Output. *The Review of Economic Studies*, 90(1):65–101.

Black, S. E. (1999). Do better schools matter? parental valuation of elementary education. *The quarterly journal of economics*, 114(2):577–599.

Borusyak, K., Jaravel, X., and Spiess, J. (2021). Revisiting event study designs: Robust and efficient estimation.

Burde, D. and Linden, L. L. (2013). Bringing education to afghan girls: A randomized controlled trial of village-based schools. *American Economic Journal: Applied Economics*, 5(3):27–40.

Cellini, S. R., Ferreira, F., and Rothstein, J. (2010). The Value of School Facility Investments: Evidence from a Dynamic Regression Discontinuity Design. *The Quarterly Journal of Economics*, 125(1):215–261.

Cuenca, R. (2013). La escuela pública en lima metropolitana: ¿una institución en extinción? revista peruana de investigación educativa, 5, 73-98.

Cuenca, R., Reátegui, L., and Oré-Quispe, S. (2019). Itinerarios de la educación privada en perú. *Educação & Sociedade*, 40.

Dinerstein, M., Neilson, C., and Otero, S. (2020). *The Equilibrium Effects of Public Provision in Education Markets: Evidence from a Public School Expansion Policy*. Princeton University, Industrial Relations Section.

Dinerstein, M. and Smith, T. D. (2021). Quantifying the supply response of private schools to public policies. *American Economic Review*, 111(10):3376–3417.

Duarte, J., Jaureguiberry, F., and Racimo, M. (2017). Sufficiency, equity and effectiveness of school infrastructure in latin america according to terce.

Duflo, E. (2001). Schooling and labor market consequences of school construction in indonesia: Evidence from an unusual policy experiment. *American Economic Review*, 91(4):795–813.

Gilraine, M., Petronijevic, U., and Singleton, J. D. (2021). Horizontal differentiation and the policy effect of charter schools. *American Economic Journal: Economic Policy*, 13(3):239–76.

Guadalupe, C., León, J., Rodríguez, J. S., and Vargas, S. (2017). Estado de la educación en el perú: análisis y perspectivas de la educación básica.

Hong, K. and Zimmer, R. (2016). Does investing in school capital infrastructure improve student achievement? *Economics of Education Review*, 53:143–158.

Jackson, C. K. (2012). School competition and teacher labor markets: Evidence from charter school entry in north carolina. *Journal of Public Economics*, 96(5-6):431–448.

Kazianga, H., Levy, D., Linden, L. L., and Sloan, M. (2013). The effects of "girl-friendly" schools: Evidence from the bright school construction program in burkina faso. *American Economic Journal: Applied Economics*, 5(3):41–62.

Kazianga, H., Linden, L. L., Protik, A., and Sloan, M. (2019). The medium-term impacts of girl-friendly schools: Seven-year evidence from school construction in burkina faso. Working Paper 26006, National Bureau of Economic Research.

Lafortune, J. and Schonholzer, D. (2022). The impact of school facility investments on students and homeowners: Evidence from los angeles. *American Economic Journal: Applied Economics*, 14(3):254–289.

Martorell, P., Stange, K., and McFarlin Jr, I. (2016). Investing in schools: capital spending, facility conditions, and student achievement. *Journal of Public Economics*, 140:13–29.

MINEDU (2013). Informe final de evaluación de diseño y ejecución de presupuesto del programa nacional de infraestructura educativa (pronied).

Neilson, C. A. and Zimmerman, S. D. (2014). The effect of school construction on test scores, school enrollment, and home prices. *Journal of Public Economics*, 120(C):18–31.

Roman, A. and Ramirez, A. (2018). ¿el mito sigue vivo?: Privatización y diferenciación social en la educación peruana.

Rossetto, L. and Aniceto, M. T. (2020). School competition and performance indicators: evidence from the creation of federal education institutions in brazil. *International Journal of Educational Development*, 77:102211.

Saavedra, J. and Gutierrez, M. (2020). Peru: A wholesale reform fueled by an obsession with learning and equity. *Audacious education purposes: How governments transform the goals of education systems*, pages 153–180.

Sanz, P. (2014). ´we don´t need the state´: a study of the habitus formation process through school choice in peru´s rising middle class. a qualitative study of school choice. (tesis doctoral). university of bath, bath, uk.

Slungaard, K. (2022). The effect of charter school openings on traditional public schools in massachusetts and north carolina. *American Economic Journal: Economic Policy*, 14(2):445–474.

Velasquez, D. (2023). Transit infrastructure, couples' commuting choices, and gender inequality.

A Additional Figures and Tables

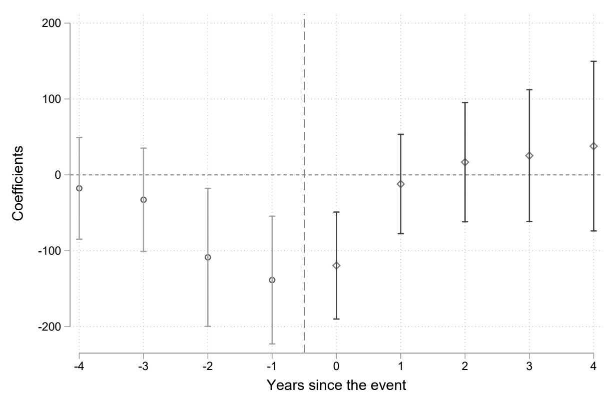
Table A.1: Direct Effects on Enrollment

	Total enrollment (1)	Log(total enrollment) (2)
Treat*Open	-24.198 (31.660)	0.004 (0.070)
Dep. Var. Mean	1,083.02	7.43
Observations	1,719	1,719
School FE	Yes	Yes
Year FE	Yes	Yes

SOURCES.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).
NOTE.— Standard errors in parentheses. Errors clustered at the school level.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

Figure A.1: Direct Dynamic Effects on Enrollment

(a) Enrollment



SOURCE.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).

Table A.2: Balance table for the emblematic schools

	Control			Treatment		
		(1)			(2)	
	n	Mean	SD	n	Mean	SD
A. ***School outcomes***						
School exit	944	0.01	0.09	540	0.01	0.09
Total enrollment	944	945.52	612.25	540	1274.45	733.22
Panel B. ***Student's Achievement***						
Dropout (%)	928	4.03	3.02	534	3.76	3.59
Math z-score	257	0.25	0.86	144	0.28	0.79
Reading z-score	257	0.15	0.82	145	0.35	0.67
C. ***Teaching Staff***						
Number of teachers	911	16.81	25.64	532	19.66	23.28
Number of students per teacher	911	272.71	383.72	532	267.94	411.91
Female (%)	911	50.90	31.06	532	52.84	30.47
With higher education (%)	618	99.45	5.88	384	99.66	2.18
With tenure (%)	776	70.22	36.76	476	71.21	35.08
With management positions (%)	911	26.72	34.61	532	18.44	31.16
D. ***Infrastructure variables***						
Access to basic services	924	0.93	0.25	532	0.93	0.25
Number of classrooms	922	30.09	13.06	531	39.37	16.96
Classrooms in good condition (%)	922	49.61	36.21	531	52.14	37.99
Has teacher rooms	926	0.58	0.49	531	0.75	0.43
Has library	926	0.89	0.32	531	0.89	0.32
Has laboratory	928	0.66	0.47	532	0.71	0.45
Has administrative building	924	0.88	0.33	531	0.92	0.27

SOURCES.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).
NOTE.— The table shows the averages for the control and treatment groups for the sample of emblematic schools during baseline (2006-2009). All variables are calculated using information from the School Census, with the exception of the z-scores, which use information from the Student Census Evaluation.

Table A.3: Balance table for the competing schools (buffer 2 km)

	Public schools						Private schools					
	Control			Treatment			Control			Treatment		
	n	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD
A. ***School outcomes***												
School exit	6265	0.03	0.16	4499	0.02	0.13	14347	0.20	0.40	14425	0.21	0.40
Total enrollment	6265	482.71	382.29	4499	491.10	374.52	14347	82.63	119.22	14425	101.31	148.78
B. ***Student's Achievement***												
Dropout (%)	6014	5.43	5.16	4363	5.26	5.09	10935	2.34	4.81	11038	2.41	5.34
Math z-score	2728	0.01	0.92	2075	0.02	0.85	4181	0.21	0.86	4079	0.38	0.86
Reading z-score	2734	-0.09	0.81	2074	0.06	0.77	4174	0.44	0.78	4075	0.70	0.76
C. ***Teaching Staff***												
Number of teachers	5815	10.17	12.60	4296	12.37	15.35	9635	7.37	7.63	10051	8.72	10.47
Number of students per teacher	5815	156.49	227.42	4296	135.32	209.57	9635	34.72	70.44	10051	37.54	68.00
Female (%)	5815	51.03	33.21	4296	52.61	31.91	9635	52.24	34.07	10051	53.64	33.66
With higher education (%)	3956	99.45	5.70	3035	99.38	5.40	7520	99.74	2.94	7819	99.62	3.93
With tenure (%)	4908	66.91	40.82	3780	70.72	38.16	8258	30.22	41.11	8687	36.34	42.56
With management positions (%)	5815	27.87	35.26	4296	23.18	32.74	9635	23.26	34.37	10051	22.32	33.88
D. ***Infrastructure variables***												
Access to basic services	6038	0.84	0.36	4363	0.90	0.30	10950	0.94	0.24	10822	0.93	0.26
Number of clasrooms	6035	16.90	9.86	4346	17.97	11.00	10936	11.28	6.78	10763	12.93	8.96
Classrooms in good condition (%)	6035	54.68	37.72	4345	59.15	38.03	10936	94.47	17.95	10752	96.56	13.82
Has teacher rooms	6037	0.38	0.49	4369	0.42	0.49	10959	0.55	0.50	10857	0.64	0.48
Has library	6036	0.63	0.48	4363	0.65	0.48	10955	0.55	0.50	10840	0.60	0.49
Has laboratory	6042	0.33	0.47	4374	0.36	0.48	10975	0.23	0.42	10925	0.29	0.46
Has administrative building	6034	0.78	0.42	4360	0.78	0.41	10950	0.88	0.32	10807	0.88	0.32

SOURCES.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).
NOTE.— The table shows the averages for the control and treatment groups for the sample of competing public and private schools (in the buffer of 2km) during baseline (2006-2009). All variables are calculated using information from the School Census, with the exception of the z-scores, which use information from the Student Census Evaluation.

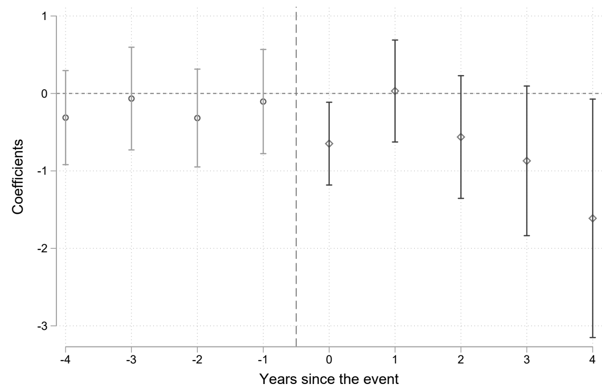
Table A.4: Commuting Distance to School

	N	Mean	SD	Min	Max
A. Total					
Walking distance (km)	45,516	1.17	1.01	0.00	4.83
Distance traveled by bicycle (km)	914	3.92	2.61	0.00	10.00
Distance traveled by motorcycle (km)	3,191	4.06	2.56	0.00	13.75
Distance traveled by car (km)	2,637	4.44	3.20	0.00	13.75
Distance traveled by bus (km)	4,473	4.57	3.42	0.00	14.00
Average distance traveled (km)	53,146	1.64	1.77	0.00	14.00
B. Main cities					
Walking distance (km)	4,387	1.13	0.97	0.00	4.58
Distance traveled by bicycle (km)	98	4.40	2.74	0.00	10.00
Distance traveled by motorcycle (km)	697	4.20	2.57	0.00	13.75
Distance traveled by car (km)	503	4.77	3.28	0.00	13.75
Distance traveled by bus (km)	1,118	5.33	3.02	0.00	13.75
Average distance traveled (km)	5,958	2.25	2.29	0.00	12.50
C. Non-main cities					
Walking distance (km)	41,129	1.17	1.01	0.00	4.83
Distance traveled by bicycle (km)	816	3.86	2.60	0.00	10.00
Distance traveled by motorcycle (km)	2,494	4.01	2.56	0.00	13.75
Distance traveled by car (km)	2,134	4.38	3.18	0.00	13.75
Distance traveled by bus (km)	3,355	4.31	3.51	0.00	14.00
Average distance traveled (km)	47,188	1.57	1.68	0.00	14.00

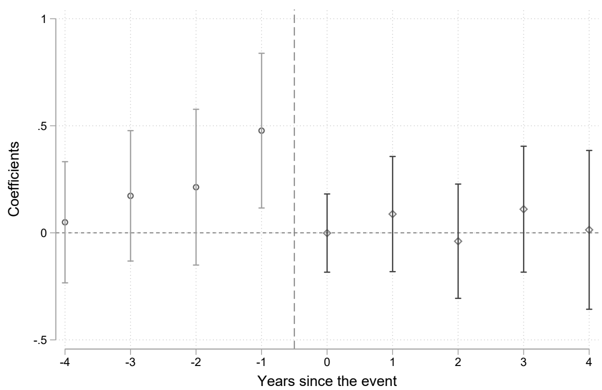
SOURCES.— National Survey of Budget Programs 2011-2014.
NOTE.— Table shows the distance (in km) traveled from home to school, assuming different speeds for each type of transportation. Following Velasquez (2023) it is considered that the average speed of transporting oneself by motorcycle, car and bus is approximately 15 km/h, while mobilizing by foot and bicycle is 5 and 12 km/h respectively.

Figure A.2: Direct Dynamic Effects on Students' Achievement

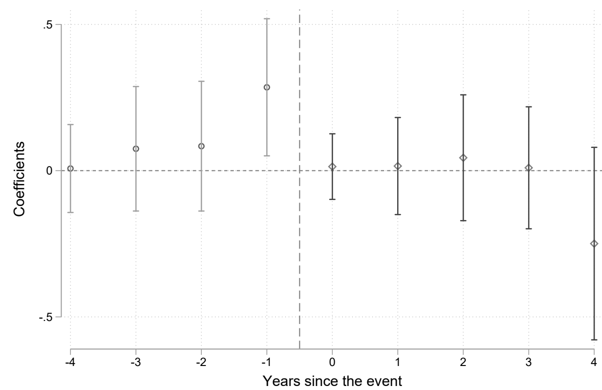
(a) Dropout (%)



(b) Math z-score



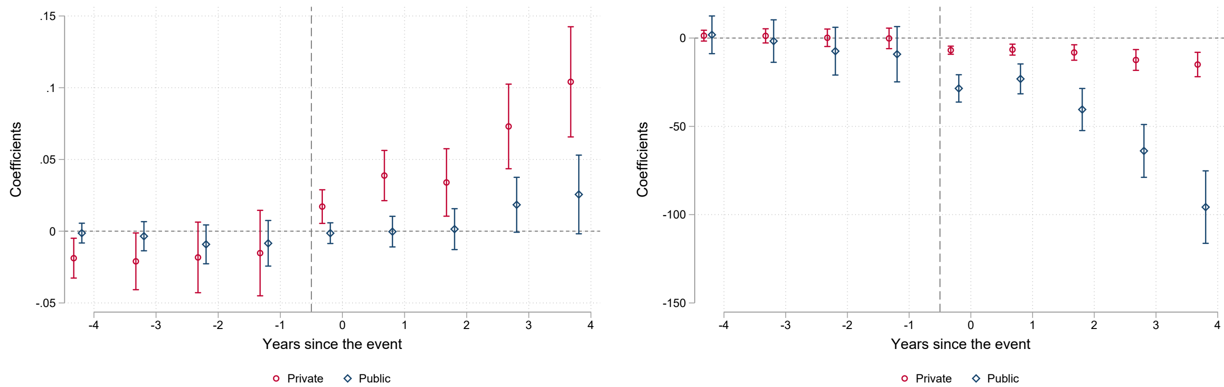
(c) Reading z-score



SOURCE.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).

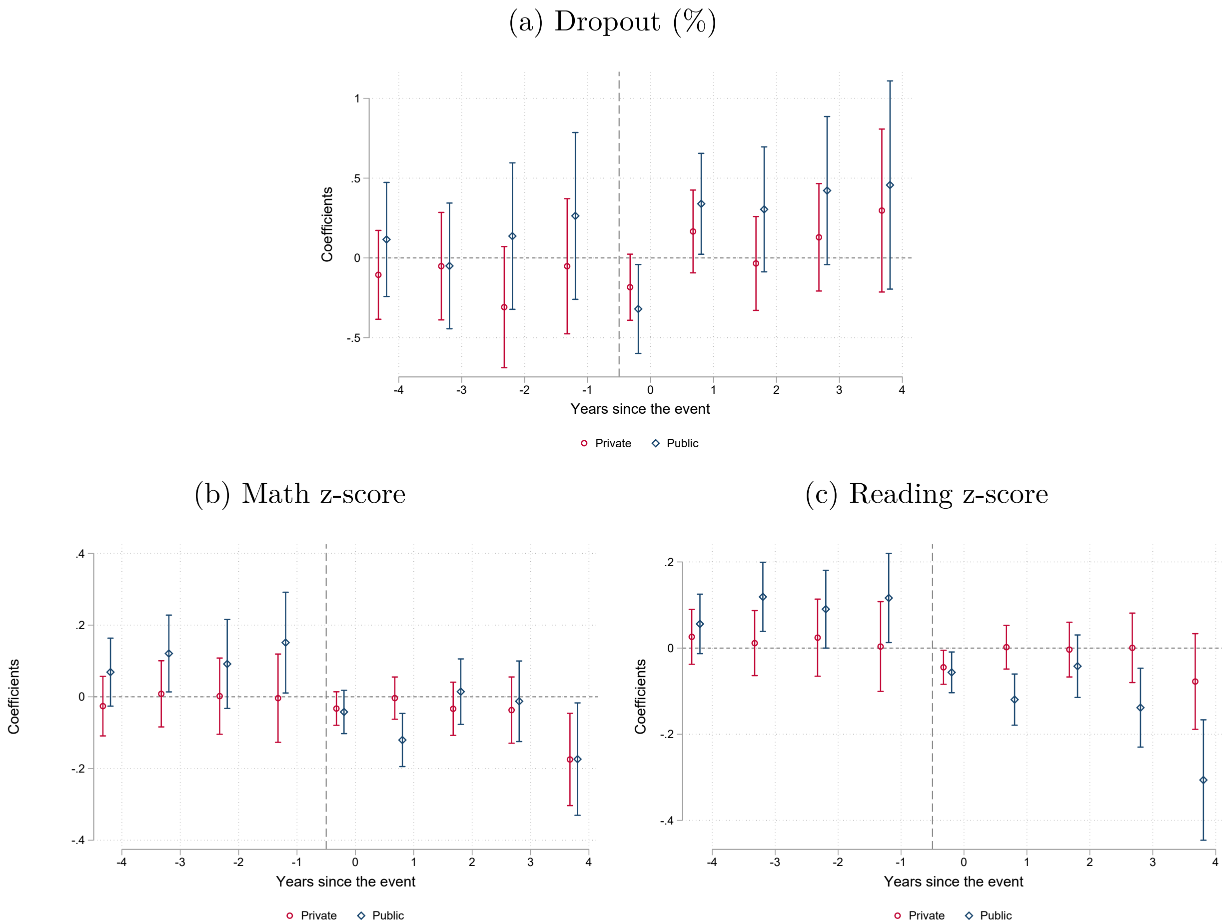
Figure A.3: Spillover Dynamic Effects on Enrollment and School Exit

(a) Exit school (b) Enrollment



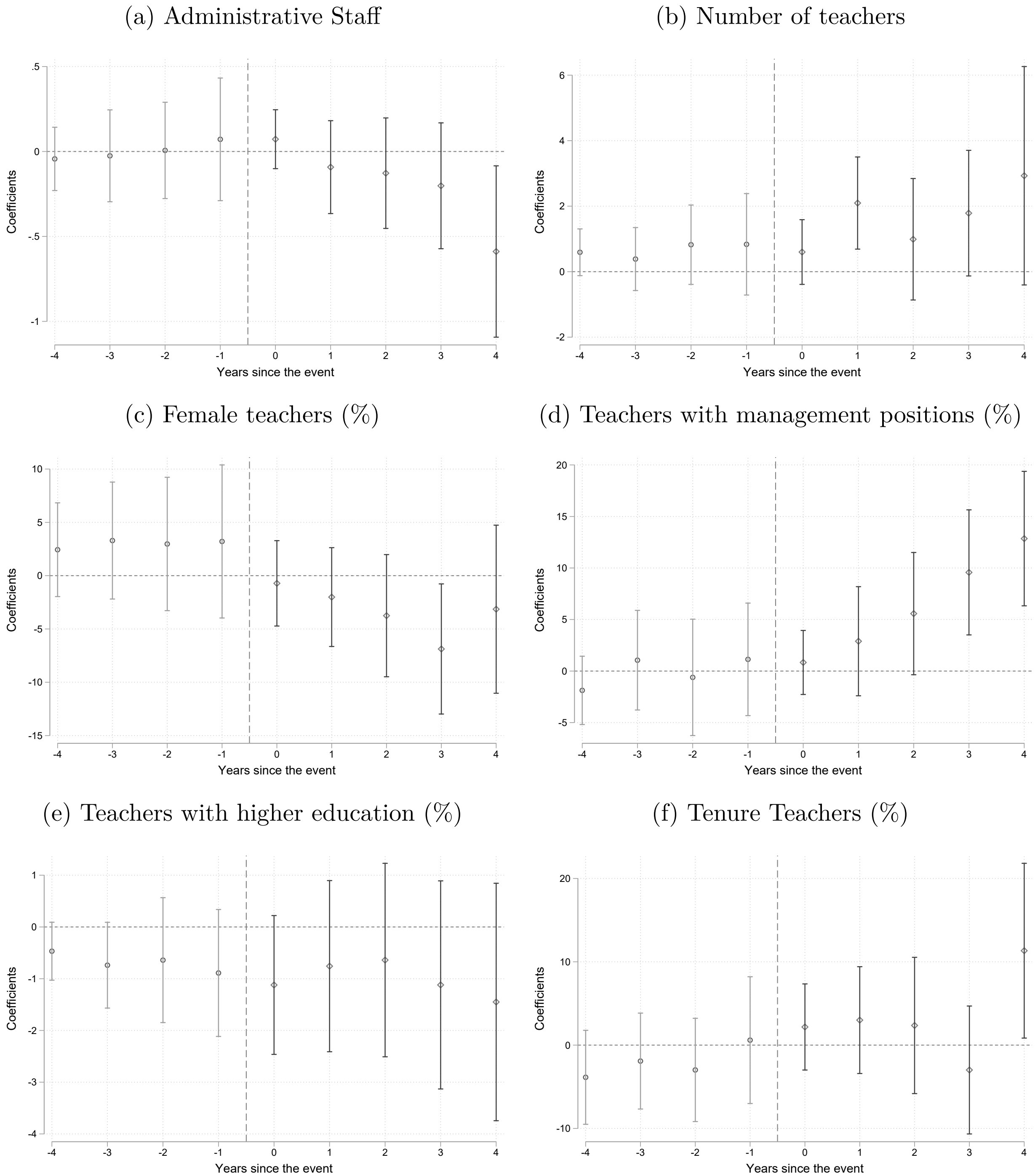
SOURCE.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).

Figure A.4: Spillover Dynamic Effects on educational achievement of competing schools



SOURCE.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).

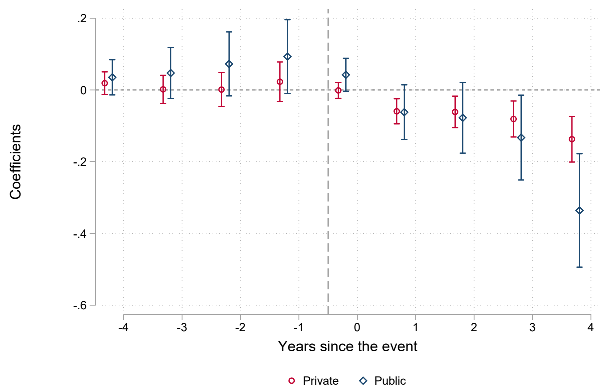
Figure A.5: Direct Dynamic Effects on Teaching Staff



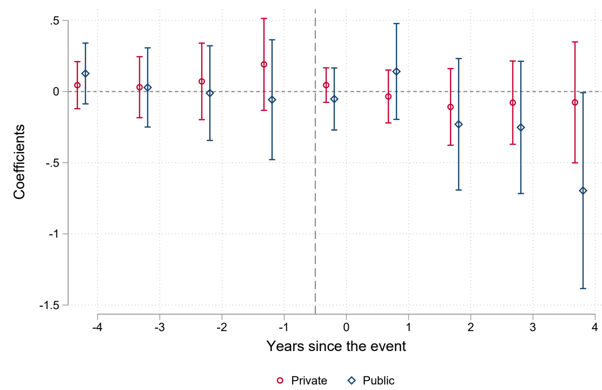
SOURCE.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).

Figure A.6: Spillover Dynamic Effects on Teaching Staff

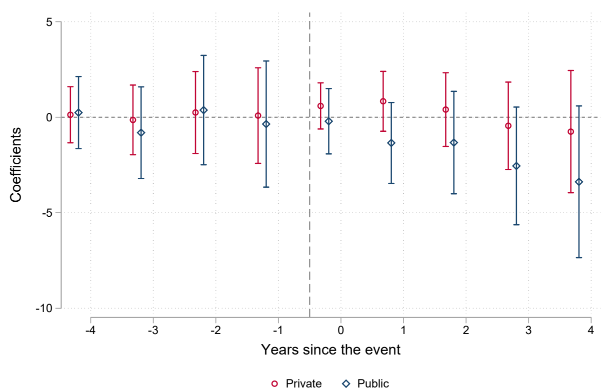
(a) Administrative Staff



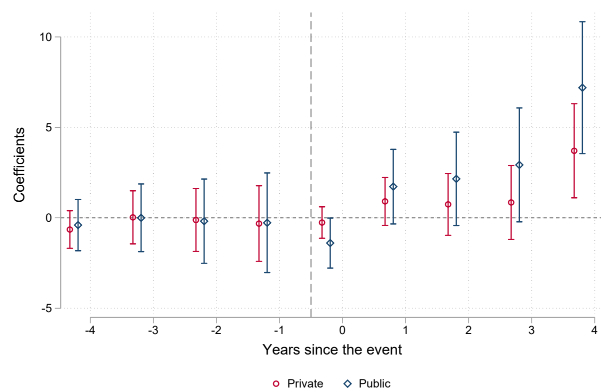
(b) Number of teachers



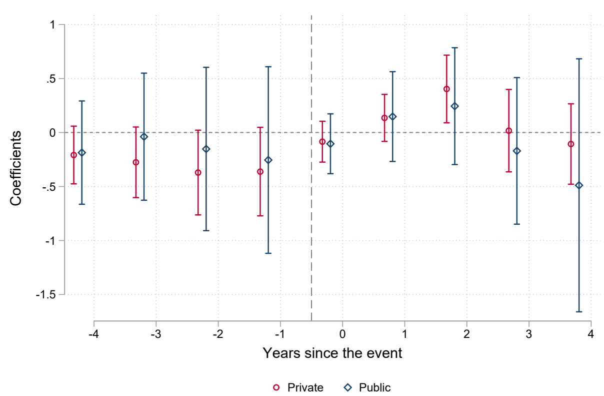
(c) Female teachers (%)



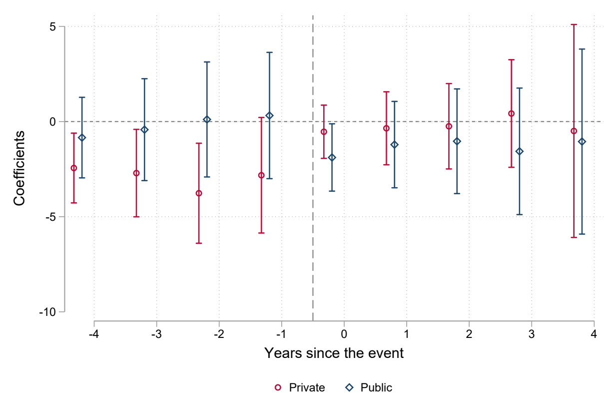
(d) Teachers with management positions (%)



(e) Teachers with higher education (%)



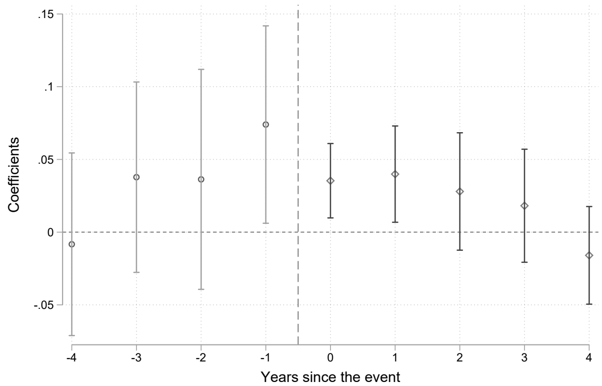
(f) Tenure Teachers (%)



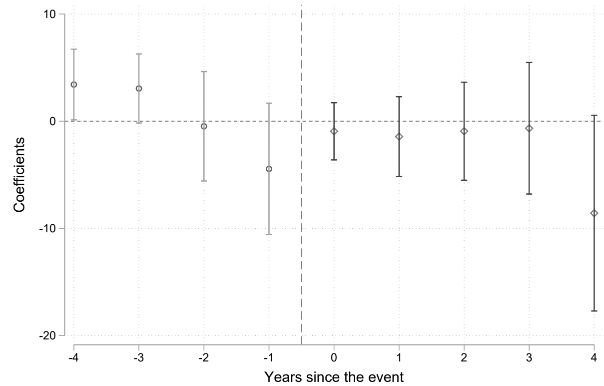
SOURCE.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).

Figure A.7: Direct Dynamic Effects on Infrastructure

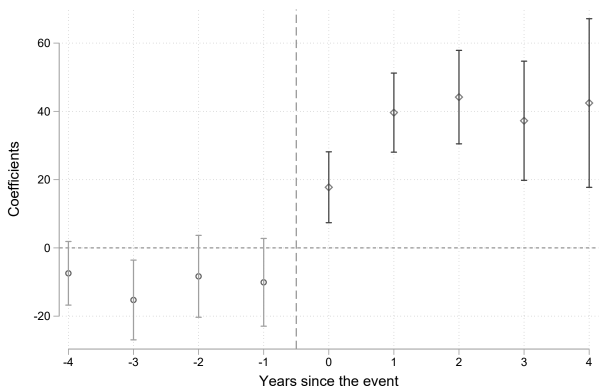
(a) Access to basic services



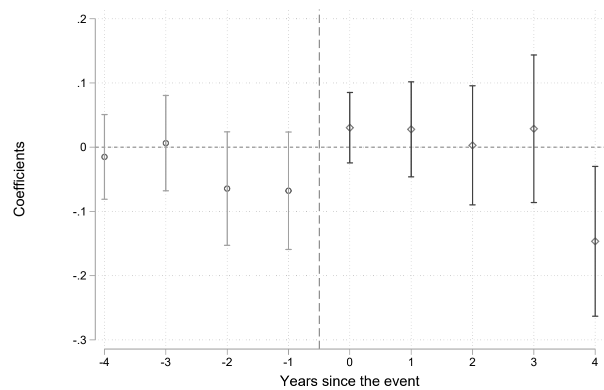
(b) Number of classrooms



(c) Classrooms in good condition (%)



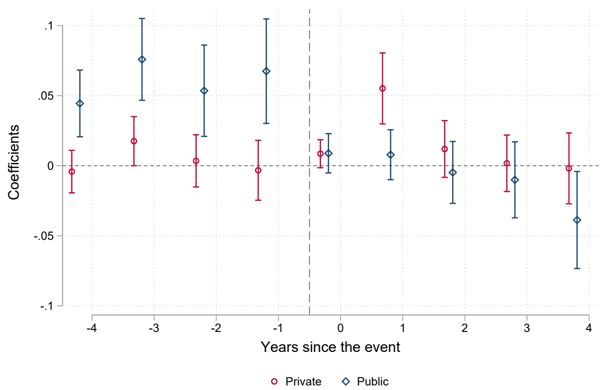
(d) Auxiliary areas (%)



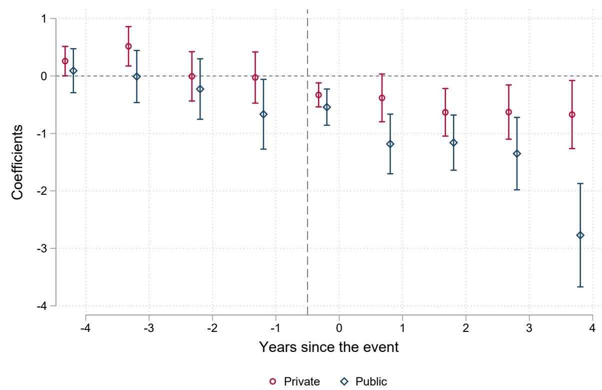
SOURCE.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).

Figure A.8: Spillover Dynamic Effects on Infrastructure

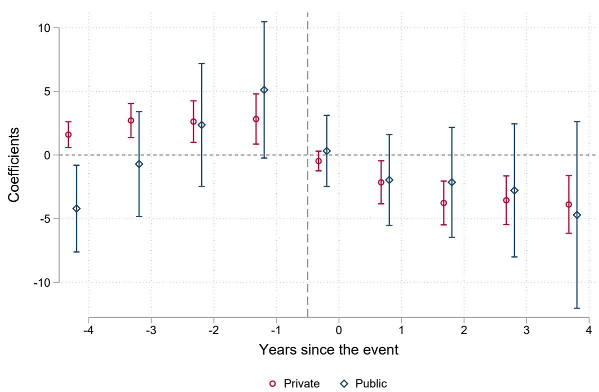
(a) Access to basic services



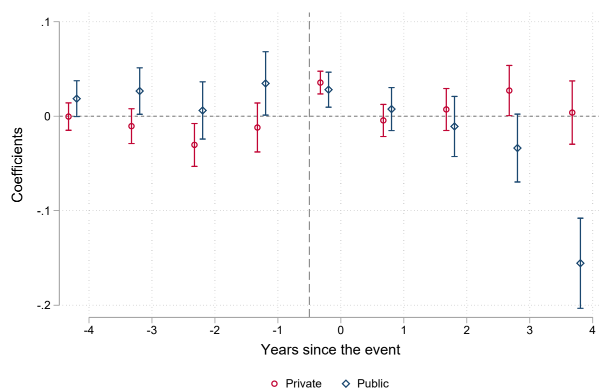
(b) Number of classrooms



(c) Classrooms in good condition (%)



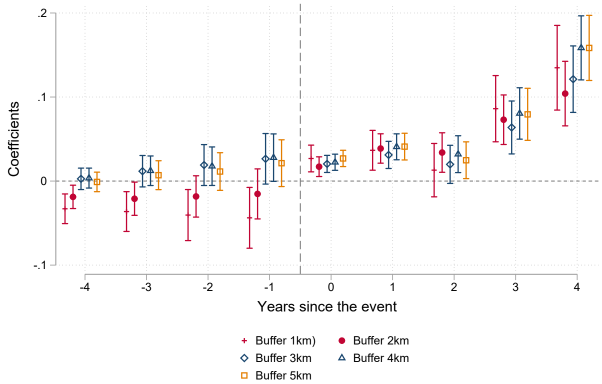
(d) Auxiliary areas (%)



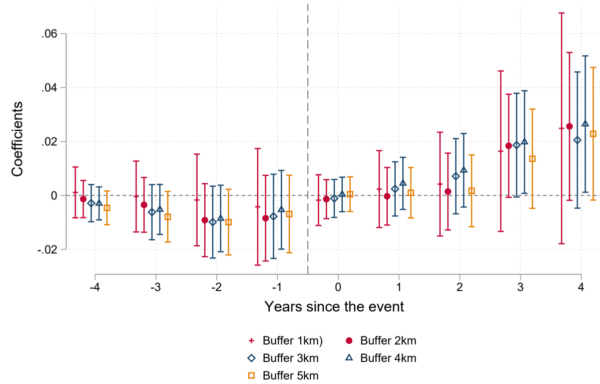
SOURCE.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).

Figure A.9: Spillover Dynamic Effects on School Exit and Enrollment for different relevant markets

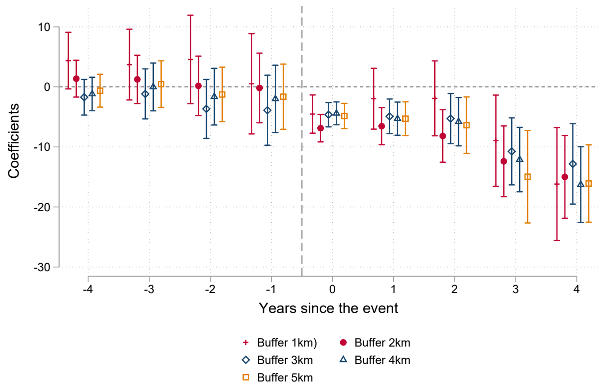
(a) School Exit - Private schools



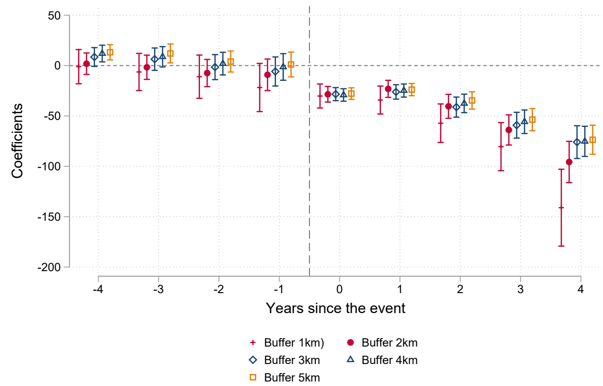
(b) School Exit - Public schools



(c) Enrollment - Private schools



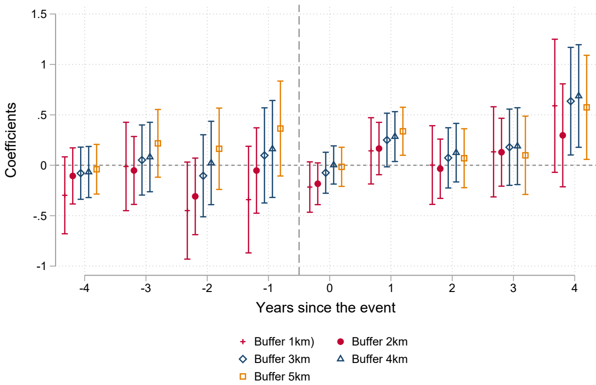
(d) Enrollment - Public schools



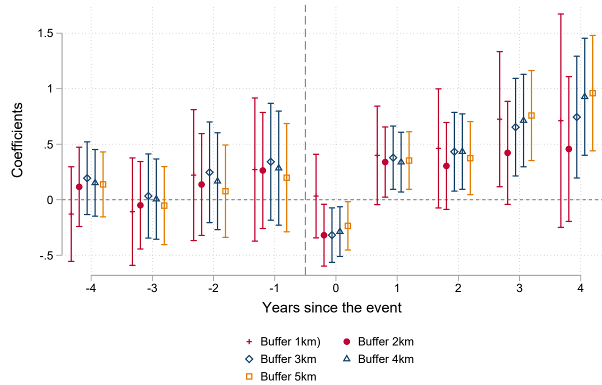
SOURCE.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).

Figure A.10: Spillover Dynamic Effects on Dropout (%) and Test Scores for different relevant markets

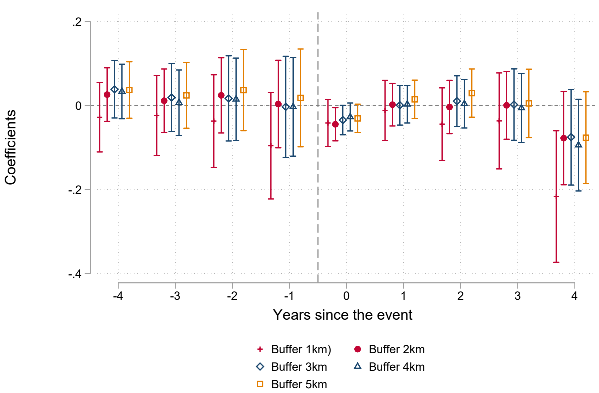
(a) Dropout - Private schools



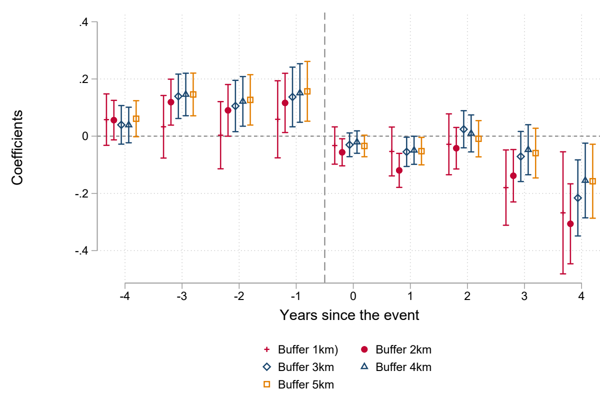
(b) Dropout - Public schools



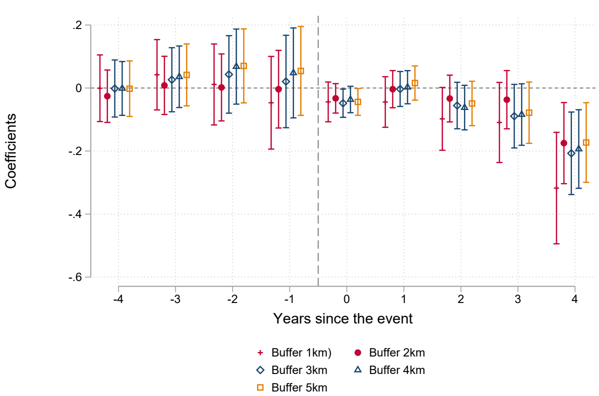
(c) Reading z-score - Private schools



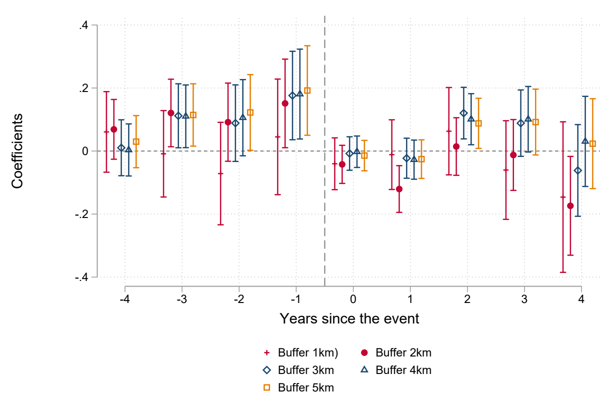
(d) Reading z-score in Public schools



(e) Math z-score - Private schools



(f) Math z-score - Public schools



SOURCE.— The School Census (2006-2014) and the Student Census Evaluation (2007-2014).

B Additional Details of the Emblematic School Program

The Emblematic School Program was created in 2009[16] in a context of international crisis. The list of participating schools was progressively built from MONTH 2009 to MONTH 2011. The program started with a total of 20 participating schools, but other 218 schools were incorporated: 45 schools during 2009, 126 during 2010, and 64 during 2011 (Figure B.1).

On July 2011, the Anti-Corruption Investigation Commission was created to investigate potential corruption activities during the Government from 2006 to 2011.[17] In July 2012, the Commission found evidence of collusion between private companies and central government officials. Consequently, the Commission recommended that the administration of the program changed. In 2013, the construction projects that were under execution continued to be carried out under the administration of the Office of School Infrastructure (OINFE) at MINEDU. In a similar manner, school construction projects that had the technical approval (or were close to get it) could also be executed by the OINFE. Finally, school construction projects that did not have the technical approval could be later executed by the local governments or by MINEDU, if prioritized. During 2013, only 3 new schools projects were initiated. The National Education Infrastructure Program (PRONIED) was created and started operating since September 2014,[18] motivated by the non-completion of the construction work in schools. The timeline of the Program is summarized in the following Figure B.2. By the end of 2014, only 91 out of the 238 schools had completed at least its first construction project. Figure B.3 shows the spatial distribution of these schools, categorized according to the year when their first construction project was completed and available to students.

[16]See Urgent Decree N° 004-2009 - *Creation of the National Program for the Recovery of Emblematic and Centenary Public Schools*

[17]More details can be found here.

[18]Supreme Decree N.° 001-2014-MINEDU - *Ministry of Education.*

Figure B.1: Incorporation of Schools to the Emblematic School Program

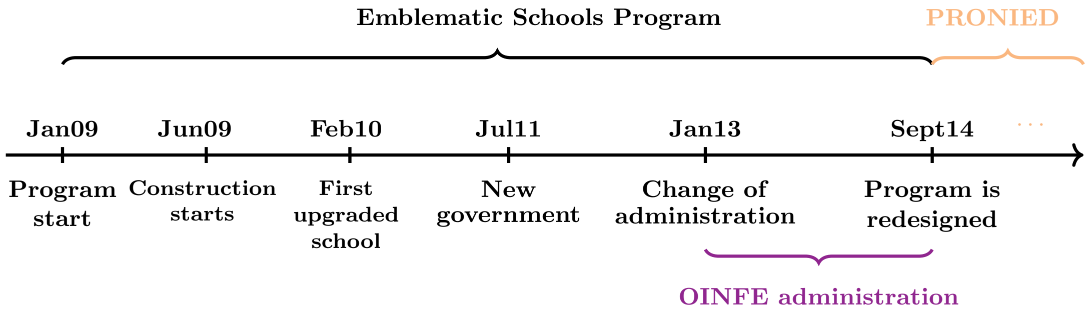
(a) 2009

(b) 2010

(c) 2011

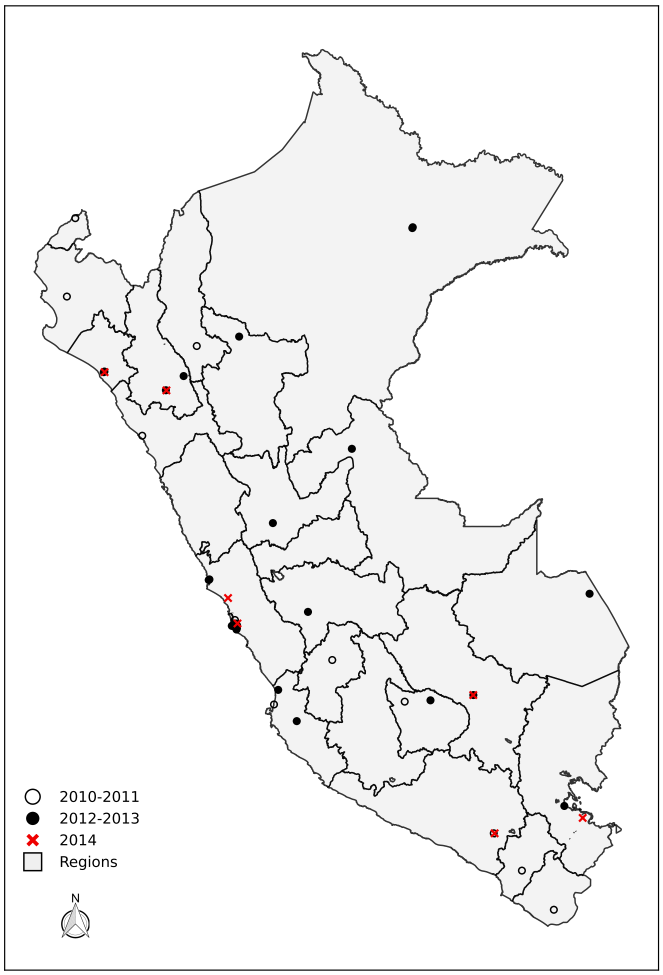
SOURCE.— Emblematic School Program Administrative Data.
NOTE.—

Figure B.2: Timeline of the Emblematic Schools Program



SOURCE.— Regulations related to the Emblematic School Program.
NOTE.— The figure shows the timeline of the start-up, implementation and closure of the Emblematic Schools Program. Each light blue line between 2009-2011 indicates a month in which schools were incorporated into the program: 5 months in 2009, 4 months in 2010 and 3 months in 2011.

Figure B.3: Spatial distribution of the 93 treated Emblematic Schools, by Year of First Completed Construction Project



SOURCE.— Emblematic School Program administrative data.
NOTE.— The map shows the spatial distribution of the 93 treated educational institutions treated by the Emblematic Schools Program, according to the year of its first completed construction project.