UNIVERSITY OF SUSSEX | BUSINESS SCHOOL

ECONOMICS

Working Paper Series

No. 6-2024

Effects of a teacher training reform in Guatemala

Maria Pia Iocco

Department of Economics, University of Sussex, Falmer, BN1 9SL, UK
Economics & Institute for Policy Research (IPR), University of Bath, Claverton Down, Bath BA2 7AY

M.Iocco-Barias@sussex.ac.uk

Abstract: This paper studies the effects of an educational reform in Guatemala that modified the training of primary teachers from three years at the secondary level (grades 10 to 12 of a diversified cycle in high school) to a combination of two years of high school and three at a university, obtaining a Bachelor of Education (B.Ed.) before being able to apply to become a primary school teacher. Exploiting the timing of the implementation and an unaffected group of students as controls, I analyse the effects at the student levels in terms of enrolment and performance during their high school years and the effects on official teachers' colleges regarding performance due to the opportunity of financial aid for their students. Results show a decrease in enrolment for primary teaching students, negative but not always significant results in math, and mixed results in reading. Besides, I also observed a change in the characteristics of aspiring educators. Official teachers' colleges experienced an initial increase in their primary teaching performance compared to other types of schools, but the effect faded after a couple of years, becoming negative.

JEL codes: I210, I250, I280

Keywords: teacher training, teacher recruiting, policy reform, primary teachers, Guatemala

Effects of a teacher training reform in Guatemala

Maria Pia Iocco *

February 2024
Work in Progress

Abstract This paper studies the effects of an educational reform in Guatemala that modified the training of primary teachers from three years at the secondary level (grades 10 to 12 of a diversified cycle in high school) to a combination of two years of high school and three at a university, obtaining a Bachelor of Education (B.Ed.) before being able to apply to become a primary school teacher. Exploiting the timing of the implementation and an unaffected group of students as controls, I analyse the effects at the student levels in terms of enrolment and performance during their high school years and the effects on official teachers' colleges regarding performance due to the opportunity of financial aid for their students. Results show a decrease in enrolment for primary teaching students, negative but not always significant results in math, and mixed results in reading. Besides, I also observed a change in the characteristics of aspiring educators. Official teachers' colleges experienced an initial increase in their primary teaching performance compared to other types of schools, but the effect faded after a couple of years, becoming negative.

*University of Sussex, University of Bath. e-mail: mi275@sussex.ac.uk

1 Introduction

Many countries in Latin America require specialisation of their students during the last years of high school[1]. Guatemala offers a not-so-common option: An education track[2] that allows pupils to start their training to become a school teacher during their 10th grade. Given the importance of teachers in the education production function (Hanushek and Rivkin, 2010; Chetty et al., 2014), it is crucial to understand which students choose this option and in which institutions they decide to complete their education programme.

Teacher training in Latin America dates back to the 19th century, with the foundation of the teachers' colleges (*escuelas normales* in Spanish) destined to train future educators at the secondary level. Several countries opened their first teachers' colleges before the 20th century: Mexico and Peru in 1822, Honduras in 1836, Chile in 1842, Ecuador in 1889, etc., initiating a long history of teacher formation in the region (IESALC, 2007).

With the implementation of neoliberal policies in Latin America, teachers' colleges migrated to the tertiary level by being incorporated by universities or by creating pedagogical institutes. In Chile, teachers' colleges were closed during the dictatorship; in Bolivia, there was a consolidation of higher pedagogical institutes; while in Argentina, there is a dual system of universities and higher institutes.

In Central America, as of 2005, Panama, Costa Rica, and El Salvador had eliminated secondary-level teachers' colleges and moved them into universities or higher institutes. Honduras and Nicaragua still had eight and two teachers' colleges, respectively, but with a clear policy of transforming them into tertiary-level centres. Only Guatemala relied mainly on teachers' colleges, with 369 (Ministry of Education, 2012).

Following the trend of moving the primary teaching training in the region to the tertiary level, in 2013, Guatemala implemented a reform to increase primary teachers' schooling from the secondary to the tertiary level. This reform shortened the high-school training from three to two years, but it made it mandatory to obtain a bachelor's degree in education that lasts three years at the university level, extending the formation from three to five years.

[1] According to Acosta (2021), at least Argentina, Costa Rica, Ecuador, Honduras, Mexico, and Uruguay have diversified cycles during secondary years.

[2] I use the terms track, programme, and major interchangeably.

Using public databases from agencies of the Ministry of Education, including the individual-level scores in a mandatory high-school exit test named *Graduandos*, this paper aims to analyse some of the effects this policy had on two levels: The students applying to become primary school teachers, and the official schools forming teachers (teachers' colleges).

Exploiting the implementation time, along with a group of unaffected students as controls, I analyse the reform's effects on primary teaching students during their secondary studies, focusing on enrolment and performance. At the institutional level, the outcome is performance, and the focus is on official teachers' colleges.

Results show a drop in primary teaching students at the departmental level compared to vocational path pupils. Regarding performance, there are mixed immediate results depending on the subject. Still, the results are negative and significant three and four years after the reform's implementation for math and weakly significant for reading. Interestingly, I also observed a change in the socioeconomic characteristics of the aspiring primary teachers, with more men and students coming from households with more advantaged backgrounds.

In the case of the official teachers' colleges, they saw an initial increase in their math and reading performance that faded over time, becoming negative (but not always significant),

This paper contributes to the literature in multiple ways: First, it adds to the broad literature analysing teaching reforms in Latin America, a region with low student achievement and a learning crisis. Second, it assesses the effects of transferring teacher formation from the secondary to the tertiary level, a topic that has not received much attention. Finally, it also contributes to the educational literature in lower-middle developing countries of the region, which is scarce, by focusing on Guatemala, a country with low results in international assessments of student performance.

The rest of the paper is organised as follows: Section 2 explains the educational context in Guatemala and the policy reform. Section 3 reviews the related literature. Section 4 provides an overview of the data used in this paper. Section 5 includes descriptive statistics. Section 6 details the empirical strategy. Section 7 contains the student-level results, while Section 8 has the school-level results. Section 9 presents the conclusions.

2 Context and policy reform

The educational system in Guatemala comprises up to 12 years. The first six years correspond to primary school and are mandatory. The following three years of middle school are called "basic secondary school", follow a standard curriculum, and are also mandatory. The final years are part of the diversified cycle that lasts one to three years depending on the selected track (there were five before the reform: Academic, teaching, secretarial studies, technical, and vocational) and are not compulsory (the enrolment rate drops significantly after middle school[3]).

According to OREALC/UNESCO (2013), only Guatemala, Haiti, Honduras, Nicaragua, and Suriname still trained their primary teachers at the upper secondary level (mostly in teachers' colleges) instead of at the tertiary level. Primary and pre-primary teachers were formed during the last three[4] years of the diversified cycle. After completing this training, and only with twelve years of schooling and no tertiary formation, graduates could apply to teach in public schools.

In 2007, a new curriculum was approved for the initial training of primary educators. With that in mind, in January 2009, a series of technical committees were created to design the implementation of these changes. During that process, the new *Modelo Formacion Inicial Docente* (MFID) was introduced, and which was later used as a cornerstone for the *Estrategia para una Educación de Calidad para la Niñez y Juventud Guatemalteca*, that included other topics such as infrastructure and inclusion.

The MFID component aimed to increase primary teachers' level of schooling to the tertiary level, while the reform had the goal of better prepare students for a globalised society (Ministry of Education, 2015). This new model, besides the modifications to the curriculum, introduced a series of other changes for aspiring primary school teachers:

1. Applicants would have to follow the academic (or baccalaureate) track with a specialisation in education, physical education, musical education, or education for production and development, instead of the former teaching tracks. These tracks would last two years and are taught by high schools (including former teachers' colleges), and institutes.

[3]In 2018 the net enrolment rate for the diversified cycle was 23.9% for men and 25.9% for women. For the basic level, it was 43.9%, and 42.6% (Aceña and Menchú, 2019)

[4]Between 2004 and 2007, it lasted four years.

2. After these two years, students move to the University of San Carlos[5] (the only public university in the country) for a Bachelor of Education (B.Ed.). Applicants to the B.Ed. must have completed one of the education specialisations during the diversified cycle. Therefore, this reform extended the duration of the training for primary teachers from three to five years.

However, pre-primary teachers were not included in the reform, allowing them to follow the three-year, high-school level programme instead. This is due to a country's shortage of pre-primary school teachers and a low pre-primary enrolment rate compared to primary grades (Ministry of Education, 2015).

Schoolteachers already placed in schools could access professional development programmes taught by regional universities, including both primary and pre-primary educators (Ministry of Education, 2012).

The first cohort affected by this change started grade 10 at the beginning[6] of 2013, their undergraduate in 2015, graduated with a B.Ed. in 2017 and joined the labour market in 2018. However, there is an overlap due to the modification of the length of the programme: One cohort did three years following the old track in 2012, 2013, and 2014, while another generation did two years in 2013 and 2014. All graduated high school by the end of 2014.

The expected effect of this reform is to reduce enrolment. By making the training more lengthy, requiring students to go to a university in the capital, and having to pay tuition fees, it decreases the incentives to do the teaching track. However, for students who do not want to teach but are attracted due to its employability numbers, the expected sign is positive: They do not have to go through university, and their formation now is shorter. Overall, the expected effect is negative.

In terms of performance, it is unclear: On one hand, it has very similar arguments to enrolment, and the best students could prefer other tracks that prepare them for other (better paid) degrees. On the other hand, aspiring primary teachers must go through a university application process and complete a degree, which could disincentivise low-performers or students with more vocational orientations to choose the teaching track.

The reform introduced financial aid for some students to pursue their B.Ed, depending on

[5]Originally, this was the only university offering the program, but other private institutions also started offering bachelor's degrees in education.

[6]In Guatemala, the academic year runs from February to November.

their teachers' college. This first post-reform generation, which graduated in 2014, had their application costs to the university paid by the Ministry of Education, intending to incentivise and guarantee their access to the B.Ed. This benefit only applied to students who graduated from official teachers' colleges. The scholarship also included an annual tuition waiver of Q. 8,800.00[7] to each student enrolled in the B.Ed. programme at the University of San Carlos (Ministry of Education, 2015).

Here, the expected sign of the effect is positive for primary teaching students in official teachers' colleges since they can access aid unavailable to every type of school. This could increase the applications (or enrolment) into these types of institutions, as well as the performance of the students in them.

3 Related literature

Differential training at the secondary level has various modalities, based mainly on geographic location: In the United States of America and Canada, within-school ability tracking is widespread, while in Europe and Latin America, different school curricula are available to the students to choose from or apply to. While tracking can start early (in Austria and Germany starts at age ten), most OECD countries in 2004 began differentiation at age fifteen or sixteen (Woessmann, 2009).

Countries in Latin America often offer academic, vocational, technical, social sciences, humanities, arts, or other similar pathways to students in their last years of secondary school. For instance, in Mexico, students have three options: Academic/general, technical, or vocational (Avitabile et al., 2015). In Chile, students in grade 11 choose between Scientific-Humanities or Technical-Professional institutions, and within those, students specialise in subjects (biology, literature, arts, etc.) or areas (accounting, electricity, nursing, etc.). Nevertheless, many schools in Guatemala offer another option that is popular amongst pupils: Teaching.

There is a strong feminization of the teaching profession in America Latina, where 68.5% of the educators are women (OREALC/UNESCO, 2013), a figure that has not dropped below 60% in three decades (Elacqua et al., 2018). One of the reasons behind these numbers is the economic benefits.

[7]Equivalent to USD 1,136 as of March 2014

For men in OECD countries, being an educator is not economically beneficial since the actual salaries of male teachers (aged 25-64) are 76% (primary-level) to 85% (secondary-level) of the earnings of their full-time, full-year male workers. Women's average actual salary is equal to or higher than other full-time, tertiary-level educated women (OECD, 2021).

In the case of Latin America, several studies have shown teachers in the region do not receive high benefits; they tend to have lower monthly wages compared to their tertiary-educated peers in other professions (Bruns and Luque, 2014; Mizala and Ñopo, 2016; Elacqua et al., 2018; OREALC/UNESCO, 2013). Besides, promotions are usually linked to seniority alone instead of performance (Bruns and Luque, 2014). Facts that potentially discourage highly skilled individuals from joining the teaching profession.

This is a key aspect: The teaching occupation does not attract the best students in Latin America (Elacqua et al., 2018; Bruns and Luque, 2014), and a handful of studies have documented the adverse selection between abilities and a teaching degree in the region (de Hoyos et al., 2018; Elacqua et al., 2018). This is not unique to this territory since it has also been documented in the United States of America, where the literature has found negative self-selection regarding skills (Manski, 1985; Webbink, 1999; Podgursky et al., 2004; Hanushek and Pace, 1986).

However, there are well-known cases in which only the best students get accepted into the education programmes: Finland and Singapore (Louzano and Moriconi, 2014; Puryear, 2015; Barber and Mourshed, 2007). However, a few papers have studied the decline in developed countries in the skills of the teacher force (Nickell and Quintini, 2002; Corcoran et al., 2022; Fredriksson and Öckert, 2007).

On top of this negative selection into majoring in education, there is some evidence that this gap widens during tertiary programmes. Balcázar Salazar and Ñopo (2015) conclude that teachers' skills deteriorate in quantitative reasoning, but not in their mother tongue, compared to university students in other majors.

Estrada and Lombardi (2020) analyse the gap in cognitive skills between teachers and other tertiary-degree holders in Chile, Ecuador, Mexico, and Peru using the Programme for the International Assessment of Adult Competencies (PIAAC) results. The comparison is the four Latin American countries with the 17 OECD countries with average reading and math scores above the OECD mean of 205. Their conclusions include that teachers in the region

have low absolute levels of cognitive skills, which is a combination of a low level amongst the population and a negative gap between teaching degree holders and other tertiary degree holders (a teacher skills gap).

In the case of Guatemala, before the MFID reform, teaching was a familiar track for students from low-income households and rural areas due to its direct access to the labour market (López Rivas and Cortez Sic, 2016). As mentioned before, it was popular: Around 18,000 graduated from high school with a degree in primary teaching. However, this led to an oversupply since the educational system only hired 2,500 each year (Ministry of Education, 2015). The profile of these aspiring schoolteachers has also been researched: Secondary teaching students often come from poor households and have inadequate training in rural, alternative, or low-quality institutions (López Rivas and Cortez Sic, 2016), which is consistent with what has been documented in the region.

And the performance of these Guatemalan teachers is low. According to Cruz and Santos (2014), who evaluated the performance of pre-primary and primary teachers applying for a position in the public system between 2009 and 2014, the correct percentage in reading ranged from 44.41% in 2010 to 50.4% in 2014. In math, it varied from 33.87% in 2010 to 47.87% in 2009. The last subject evaluated, teaching pedagogy practices, ranged from 41.26% in 2010 to 74.17% in 2009.

Besides, Latin American and Caribbean countries stand by a lack of strict admission requirements for their teacher training programmes (Elacqua et al., 2018; Bruns and Luque, 2014). A few policies have been implemented to attract better students and raise the quality of their education.

The Dominican Republic instated a similar reform to the Guatemalan one in 1997, raising the bar for teacher training to three years of university formation. This increased the costs for aspiring school teachers and their salaries at entry. Eighty-five per cent of all teachers had acquired their degree. Still, the country scored at the bottom of the Second Regional Comparative Explanatory Study (SERCE) in reading and math (Bruns and Luque, 2014), suggesting no link between teachers' credentials and student achievement.

Today, only a few countries in the region (Guatemala, Haiti, Honduras, Nicaragua, and Suriname) still provide teacher training at the secondary level. These countries are also experiencing a push toward tertiary-level preparation (OREALC/UNESCO, 2013; Ministry

of Education, 2012). Nicaragua and Honduras[8] have deliberately implemented policies to transform their teachers' colleges (Hernández, 2006)

According to Alvarez and Majmudar (2001), there were four types of teachers in the region of Latin America: Uncertified teachers, normal schools graduates (upper secondary school), teachers' colleges and pedagogical institutes graduates (tertiary-level centres), and university graduates. In Guatemala, 95% of teachers at that time had secondary normal school training.

Teachers' colleges at the secondary level (*escuelas normales*) were widespread in Latin America and, for several decades, were one of the main channels to form teachers in the region, with an initial emphasis on humanities. In the last few decades, they have transitioned to tertiary-level centres (pedagogy institutes or other types), universities, or have closed.

Using Guatemala's government's definition that any school offering the teacher track is a teachers' college (as opposed to the definition that these are schools where every student is preparing to become a teacher), in 2011, there were 614 schools managed by the Ministry of Education (Meza, 2013).

Mexico is a country that historically has relied on teachers' colleges as the core of their teacher training. Even when the teachers' colleges have been criticised due to their allegedly low performance and low quality of academic staff, the *Servicio Profesional Docente* (a series of activities and evaluations applied since the academic year 2014-2015 for teachers wanting to join, continue, or get a promotion in the public teacher labour force) showed that applicants coming from teachers' colleges, especially the public ones, were more qualified to fill the primary teacher positions, compared to applicants form the national pedagogy university (*Universidad Pedagogica Nacional*) or other tertiary institutions (Medrano Camacho et al., 2018)

[8]Honduras approved in 2012 the Fundamental Law of Education that required new teachers to have a university degree, and already placed teachers to obtain it, although there are no deadlines.

4 Data

4.1 Databases

In Guatemala, there is a mandatory high-school exit test (depending on the track, at the end of their 10th to 12th grade) called *Graduandos*. It has been in place since 2006, with a pilot in 2005. The DIGEDUCA (an agency of the Ministry of Education) oversees its implementation. The *Graduandos* test is not a high-stakes examination since it is not used to determine graduation from the diversified cycle, nor admission to public or private universities (these institutions have their own admission tests in a decentralized system).

The database is public, at the student level (without any identification number), and available on DIGEDUCA's website. Besides math and reading scores, it contains the student's basic sociodemographic characteristics (gender, age, rural/urban area), family (mother and father's attendance to school, dwelling characteristics), and school information (identification variables, location, type of funding/management).

I can only observe students graduating and taking the test. I do not have enrolment, either at the beginning or end of the academic year, so I use the graduation numbers as enrolment. Given that the assessment is mandatory to finish high school, it should be similar to end-of-the-year enrolment.

The data contains the five broad tracks (academic, teaching, secretarial, technical, and vocational) for 2010 and 2011 (before the reform), and a detailed track code and name from 2012 onward, indicating the baccalaureate in education or other teaching specialisation. Another source of information is the directory of tracks approved by the DIGEDUCA, which contains the school's name, the detailed code track, and its length. And for teaching paths, it also has when the new two-year programmes were approved.

At the institution level, the *Graduandos* test also identifies the teachers' colleges (either because at least one student is graduating from the teaching track or every student in that school is).

The choice of using 2010 onward (instead of 2006) is twofold: It comes from the fact that the teaching track has suffered some modifications in the last decades: Between 2004 and 2006, it lasted four years. In 2007 several specialisations were eliminated, and its length

was shortened to three years in double shifts, and four in single shifts. And since 2009, a standardised length of three years was implemented. The other reason is the lack of a detailed teaching code distinguishing primary and pre-primary students.

4.2 Outcome variables

Applicants are evaluated in two subjects: Math and reading, and the database contain three sets of scores: Performance, achievement, and measure. Performance has four categories: 'Unsatisfactory', 'must improve', 'satisfactory', and 'excellent'. Achievement is a binary variable stating if the achievement is enough or not. The relation between these two variables is straightforward: The lowest two categories of the performance scale correspond to no achievement.

The third variable (measure) corresponds to the estimated skills in math (reading). This scale is related to the fact that the *Graduandos* test is not grounded in the Classical Theory of Tests but in the Item Response Theory (IRT). Hence, the estimated ability of a student on a subject depends on the difficulty of the item and the student's skills[9]. The final scale is presented in logits (or *log-oddsunits*) (Santos Solares and Cruz Grünebaum, 2015). There is also a direct relationship with the other two variables: The classification of satisfactory or unsatisfactory is based on the measure score, and the cutoff varies per year and subject. Table 1 and Table 2 show the summary statistics of the measure variable for each subject, by *Graduandos* year. Figure 1 shows the distribution for the test scores in 2011.

[Table 1 Here]

[Table 2 Here]

[Figure 1 Here]

4.3 Data limitations

The main limitation of the database is that I cannot distinguish between primary and pre-primary students before 2012. Still, I can differentiate them from that year onward (and I can always observe students in the broad teaching training track). The DIGEDUCA responded that they did not collect the detailed name or code of the track before 2012.

[9]The model fitted is the Rasch Model. The formula is $P_{is} = \frac{e^{(\theta_s - \beta_i)}}{1+e^{(\theta_s - \beta_i)}}$. Where P_{is} is the likelihood that student s answers correctly the item i. θ_s is the student's ability and β_i is the item's difficulty.

Another source of limitation is grade retention. The database only contains information on whether the students retook grades in primary schooling (grades one to six) but not during middle or high school. So I assume there is no repetition in the analysis described in Section 6.

Since the years 2010 and 2011 do not contain a code track, I cannot accurately identify the length for every student in the secretarial track (which lasts two years for regular courses but three for bilingual ones), and in the academic path in 2010, which has a variable duration of 1 to 3 years. Partly because of this, I do not use them as control groups.

At the school level, I use test takers to identify the number of schools open. However, it could happen that no student is graduating that year, but the school is still in place.

Besides the *Graduandos* test, teachers wanting to work in the public sector must take a test called *Evaluacion Diagnostica Docente*, which measures performance in Spanish and mathematics. The data is not publicly available[10]. Besides, according to the Ministry of Education (2015), the examinations are not comparable across years.

5 Descriptive statistics

5.1 Graduandos test takers

Each year, an almost always rising number of students take the *Graduandos* test. At the beginning of the period, it was slightly above 117,000. The peak of 171,000 in 2014 is due to an increasing number of students graduating from the teaching track, as seen in Table 3.

[Table 3 Here]

In 2010, around half of the students were on the academic (baccalaureate) track. Less than 15% were graduating from the teaching track (either in primary or pre-primary paths).

[Figure 2 Here]

The peak for this major was in 2014, when two cohorts took the exit test simultaneously (the one that did the 3-year track starting in 2012 and the one that did the 2-year programme

[10]DIGEDUCA only shared the databases from 2015 onward, without any pre-reform data.

beginning in 2013), reaching a peak of 30.6% of the total number of test takers. In 2015, the number of students on the teaching path dropped to 21,504 students (14.4%) and continued declining to 17,461 (10.7%) in 2019, as can be seen in Figure 2.

Splitting the cohorts after 2012 allows us to see the number of primary and pre-primary students, as seen in Table 4. In 2010 and 2011, there was no way to differentiate between pre and primary teaching test-takers. In 2012 and 2013, before the reform, it was possible to distinguish between them, and we observed that primary teachers comprised more than 75% of education students in these two years. Since 2014, we could also see if the primary-teaching test takers followed the old or the new track, noting that since 2015 (the first year with no overlapping), the proportion of pre-primary students now makes up most of the education pupils.

[Table 4 Here]

In 2012, 25,041 students graduated from the primary teaching track, spread across the 23 departments of the country. This equates to an average departmental enrolment of 1,089 students. The average departmental enrolment for pre-primary students in the same year was 258.

5.2 Performance (achievement) by track

As mentioned before, the *Graduandos* test is not a high-stakes examination, which can translate into the score not accurately reflecting the students' knowledge or ability. Another point to mention is that tracks have different lengths, which means that students are at the end of their secondary studies but have different years of schooling. However, the comparison is relevant since I am interested in the difference between the teaching tracks and the other tracks at the end of secondary schooling.

[Figure 3 Here]

Math achievement is overall low. The highest performance path is the academic one, which only surpassed the 15% mark in 2019. Hence, 85% of students in these programmes did not reach a satisfactory score. As a group, students in the teaching track consistently performed third, behind vocational students, and did not reach the 10% achievement. The number of students in technical tracks has dropped, so their averages are not consistent anymore (in the latter years, the number of students was 7).

[Figure 4 Here]

Reading achievement has higher values, with the highest performance groups (academic and vocational students) scoring more than 35% of achievement in 2019. The teaching group lags behind them, with a consistent difference of 5 to 8 percentage points.

5.3 Teachers' colleges

In 2010, there were 436 teachers' colleges (where at least one student graduated from a teaching pathway). Moreover, in 267 of them, every student graduating followed a teaching track. In 2019, the numbers had increased to 754 and 303, respectively. The total number of other educational institutions (not offering teaching majors) rose from 2,401 to 3,693 in the same period, showing the country's rapid expansion of schooling institutions.

Of these 436 in 2010, 92 were official, ten were municipal, 290 were private (66.5%), and 22 were cooperatives[11]. The figures were increasing: In 2011, there were 468, and in 2012 the number jumped to 528. Most of the schools are private, and this pattern has not changed during the last decade, where in 2019, 510 of the 734 (69%) schools were from this type.

On the other hand, municipal teachers' colleges have not experienced the same growth boom: Between 2010 and 2013, there were ten teachers' colleges graduating students. In the case of official schools, there was an increase of 47% of facilities in the same period, rising from 92 in 2010 to 135 in 2013.

Enrolment of teaching students is presented in Table 5. In 2010, the 92 official teachers' colleges graduated 6,404 students from the teaching major, averaging 69.6 per educational centre. The other three types of institutions are smaller. For instance, in 2013, cooperatives graduated 18.6%, municipals 30.4%, and privates 56.7% less per school than official colleges.

[Table 5 Here]

Lastly, the performance of the different teachers' colleges is also presented. The following table shows the average math (reading) performance of the teaching students in the four types of teachers' colleges, not including students following other tracks in the same schools if there are.

[Table 6 Here]

[11]There are four types of educational centres: Officials (also known as public), Municipals, Cooperatives (non-profit schools funded by the Ministry of Education, the municipality, and the families), and Privates (also regulated and overseen by the Ministry of Education.)

[Table 7 Here]

Students in official teachers' colleges perform higher than their peers in other schools in math and reading (although in math, the difference with the private institutions is narrow, and private students scored higher in 2010).

5.4 Comparing teaching and other students in SES

Teaching and non-teaching students might differ in many aspects. Using the socioeconomic status and other variables, I compare pupils graduating in these groups in 2012 (before the new programmes were in place). As shown in Table 8, teaching students are older, more likely to be women, more likely to live in rural areas, less likely to attend private schools, and their mothers were less likely to have attended school. Teaching applicants are also slightly more likely to have retaken a year during the primary level[12]. Finally, non-education students have, on average, one more electronic appliance (out of nine). These findings are consistent with the literature, where the teaching profession in Latin America is primarily female, and with the fact that the teaching track is popular among rural sectors in Guatemala.

[Table 8 Here]

6 **Empirical strategy**

I am interested in two outcomes: Enrolment and performance at the student level, and performance at the school level. At the individual layer, the interest group is students in the primary teaching track. At the institutional level, the focus is on official teachers' colleges (as opposed to the other three types). This decision is because, besides the traditional restrictions these types of colleges face, I want to see if some effects stem from the financial aid announced by the Ministry of Education to these students to pursue their B.Ed., as explained in section 2.

[12]Repetition levels are high in the country. According to Bos et al. (2018), 36% of the students stated in the PISA for development evaluation to have retaken a year in the primary or secondary level.

6.1 Years and cohorts

Even though the *Graduandos* data is available from 2006 to 2019, as explained earlier, I chose to use it from 2010 to 2019 since the years 2008 and 2009 do not contain the detailed code track needed to analyse the effects on primary students, so I excluded those years.

However, since the election of the track is in the 10th grade (and not when they take the test), I reconstruct the cohorts based on the year they started grade 10. To do this, I use the duration of their track. This is one of the limitations mentioned above since I do not have information on grade repetition or periods out of school. I assume that the student was not retained during the diversified cycle.

Because of this, my grade-10 data goes from 2008 to 2018. I decided not to use 2018 because students following a three-year track starting in 2018 would graduate in 2020, so I do not observe the outcomes of the whole cohort. I am also dropping the observations of students in grade 10 before 2010 since I cannot differentiate between primary and pre-primary students, which is the core of my analysis.

In summary, the core of my analysis is based on students who were (supposedly) starting grade 10 between 2010 and 2017, inclusive.

6.2 Control group

The selection of the control group involved some ruling out: As mentioned before, not all the programmes in secretarial or academic tracks contain their lengths, so I cannot reconstruct when they were in grade 10[13]. Technical majors were phasing out during the reform, as seen in Table 3. A subset of the teaching students, pre-primary, were not affected by the reform, but given that their programme is the most similar to primary teaching, there is a concern for students choosing that major instead, potentially biasing the results upwards.

The best option is then students in the vocational track: This track was not affected by the reform, and it is not similar to teaching[14], and as shown in Figures 3 and 4, their

[13]For instance, bilingual secretarial programmes last one year longer than other secretarial paths, but I have no manner to identify them.

[14]In 2012, before the reform, the most common topics or professions within vocational were accounting (50%), business administration (21%), automotive mechanics (6%), business administration and informatics

performance had a stable difference with teaching students, and the graduation numbers (Table 3) were rising, a trend similar to the overall graduation numbers in Guatemala.

However, I still compare the pupils' enrolment in the pre-primary teaching track to evaluate spillovers. Besides being a similar programme unaffected by the reform, this is related to a policy aspect mentioned earlier: The pre-primary pathway was deliberately not included due to low enrolment and insufficient teachers. Thus, I would like to see how these numbers were affected.

6.3 Student-level strategy

To assess the reform's effect on the number of students who choose the primary teaching track, I use a Difference-in-Differences (DiD) approach at the department level (23 of them[15]). I construct a panel from the repeated cross-sectional where each cell is a combination of year in grade 10, track, and enrolment. I estimate a dynamic Twoway Fixed Effect specification to allow for heterogeneous treatment across time. For enrolment, the empirical estimation would be:

$$y_{ijd} = \alpha + \gamma_j + \phi_d + \sum_{t=t_0}^{t=-2} \beta_t D_{ijd} + \sum_{t=0}^{t=T} \beta_t D_{ijd} + x_{ijd} + \epsilon_{ijd} \tag{1}$$

Where d indexes departments, i indexes tracks, and j indexes years. y_{ijd} is the number of students in grade 10 in the track i in year j in department d. Treated corresponds to one for students in the primary teaching track, while it is zero for students in the vocational major. The treatment indicator is D_{ijd} which is $1(treated_i = 1) \times (year_j = t)$. γ_j and ϕ_d are department and time effects, x_{ijd} is a vector of demographic characteristics of the students related to educational performance such as gender composition, area, region, etc., at the department level, and ϵ_{ijd} is the error component at the same level. The parameter of interest is β_t, which represents the effects of the reform on the enrolment of primary teaching students.

The databases contain the socioeconomic characteristics of the students and their families.

(4%), and marketing and advertising (2%)

[15]There are 22 departments in Guatemala, but Guatemala City is reported separately from its department in the educational data.

In the first specification, I do not include them. However, as a robustness check, I use variables that are correlated with human capital development and investment, such as age, gender, area (urban/rural), ethnic minority, mom's educational status (attended or not), repeater status during primary school (yes/no), and type of school (official, municipal, private, or cooperative).

Unfortunately, there is no question about income or the household head's employment status. However, there are some questions about the dwelling (floors, walls, water supply, electricity connection, etc.). A proxy for income is the number of electronic appliances. The questionnaire contains questions (yes/no) about nine appliances (television, fridge, stereo, VHS/DVD player, washing machine, tumble dryer, microwave, computer, and video game console). I construct a variable based on these answers, ranging from 0 to 9.

I use the DiD model with repeated cross-sections (at the individual level) for the effects on performance. I also use a dynamic TWFE to allow for heterogeneous effects across time. Same as above, I compare cohorts based on when they were in grade 10 instead of when they graduated.

The specification is the following:

$$y_{ij} = \alpha + \gamma_j + \phi_d + \sum_{t=t_0}^{t=-2} \beta_t D_{ij} + \sum_{t=0}^{t=T} \beta_t D_{ij} + x_{ij} + \epsilon_{ij} \tag{2}$$

Where y_{ij} is the outcome of student i in year j. The treatment indicator is D_{ij} which is $1(treated_i = 1) \times (year_j = t)$. γ_j and ϕ_d are department and time effects, x_{ij} is a vector of demographic characteristics of the students related to educational performance such as gender composition, area, region, etc., at the individual level, and ϵ_{ij} is the error component at the same level. The parameter of interest is β_t, which represents the effects of the reform on the performance of primary teaching students.

Finally, I take advantage of the overlapping of two cohorts to analyse the difference in performance between the new and the old tracks who graduated in 2014. This empirical strategy is a means-comparison (no causal effect) between these two groups to assess the training of the first cohort who followed the new curriculum against the last one during the teaching track. I also conducted a series of OLS regressions to assess the change in socioeconomic characteristics of the aspiring primary teachers. I run the same specification

for each year separately, starting from students in grade 10 in 2010 to 2017.

$$y_i = \alpha_i + x_i + \epsilon_i \tag{3}$$

y_i is a binary variable indicating if the student chose the primary teaching track ($y_i = 1$) or the vocational track ($y_i = 0$). x_i is a vector of socioeconomic characteristics and ϵ_i is an error component. Same as with the mean-comparisons approach, this is not a causal assessment, but it would shed light on the change in the student's profile who chose the primary teaching track before and after the reform as compared to the vocational major.

6.4 School-level strategy

The indicators related to the performance of primary teaching students are analysed at the school level, with the official teachers' colleges as the treated group and the other three types of schools as controls. I constructed a panel of schools where at least one student chose the primary teaching track from 2010 to 2017.

The specification is the following:

$$Y_{sj} = \alpha + \phi_s + \gamma_j + \delta_d + \sum_{t=t_0}^{t=-2} \beta_t D_{sj} + \sum_{t=0}^{t=T} \beta_t D_{sj} + X_{sj} + \epsilon_{sj} \tag{4}$$

Where s indexes schools and j indexes years. Y_{sj} is the performance of primary teaching students in school type s in grade 10 in year j. α is a constant. The treatment indicator is D_{sj} which is $1(treated_s = 1) \times (year_j = t)$. γ_j and ϕ_d are time and school effects, δ_d is a vector of department dummies to control for geographic variation, X_{sj} is a vector of demographic characteristics of the students related to educational performance such as gender composition, area, region, etc., at the school level, and ϵ_{sj} is the error component at the same level. The parameter of interest is β_t, which represents the effects of the reform on the performance of primary teaching students in official teachers' colleges.

7 Student-level results

7.1 Student level: Enrolment

Table 9 contains the enrolment in teaching tracks by the year in which students were in grade 10 instead of by the year they took the *Graduandos*. We can observe that between 2010 and 2012, students enrolled in primary teaching more often than in pre-primary teaching. This trend reversed in 2013 (the first year after the reform), when the number in pre-primary modules rose to 13,010 while 10,269 students chose the primary major.

[Table 9 Here]

Figure 5 shows the impacts on student enrolment. The treatment group is students in primary teaching, while the control group is vocational pupils. Before the reform, we cannot reject that there were parallel trends. After the reform, we can observe that the average enrolment in primary teaching tracks dropped by around 1,500 students compared to the control. As seen in Table 9, in 2012, the last year pre-reform, the primary teaching students in grade 10 were 35,009 spread across the 23 departments of the country, averaging 1,522 per zone. The reason why the decrease is so high compared to the initial numbers is a combination of a sharp drop in primary teaching pupils, but also an increase in the number of students enrolling in the vocational track (Figure 6 shows the average departmental enrolment number for groups across years).

Figure A1 in the appendix contains estimations with other specifications, showing similar results. Table A1 shows the mean value of the covariates used.

[Figure 5 Here]

[Figure 6 Here]

7.2 Student level: Performance

The DiD estimations for math and reading measure (in logits) are shown in Figure 7. As before, the treated group is primary teaching students, while the control group is vocational students. Both estimations do not contain covariates, and errors are clustered at the department level. I have added departmental dummies to control for regional variation.

In the case of math (left figure), we cannot reject the possibility of parallel trends before

the reform. After its implementation, the effects are negative but not always significant: In the first and third year post-reform, the coefficients are not significant. However, in years two, four and five, the coefficients are negative and significant, at around -0.2 (-20%).

Regarding reading, there is insufficient evidence to reject the assumption of parallel trends before the event. Immediate results are somewhat mixed. For the first year post-reform, the coefficient is placed around zero and insignificant. It drops to negative and significant the following year, then to positive but insignificant. Only in years four and five do we observe two consecutive coefficients with the same direction and magnitude, at around -0.09 or 9%, although the significance is weak for year five.

Figure A2 contains other specifications for both subjects. Table A2 in the appendix contains the estimations mean value of the covariates at the individual level.

[Figure 7 Here]

7.3 Differences in teacher rosters

Following the decrease in enrolment, and the mixed but slightly negative results in performance, I explore the sociodemographic characteristics of aspiring primary teachers.

First, I exploit the fact that the new and old tracks have different lengths, which created an overlapping situation: In 2014, the last cohort of the old tracks and the first cohort of the new tracks took the *Graduandos* concurrently. This allows me to directly compare primary teaching students who went through the teaching path before and after the reform.

Table 10 below shows the mean comparison between these two groups in 2014. Column one contains the mean for students graduating with the new primary major, while column two is their standard deviation. Columns three and four are the mean and standard deviation for students in the old programme, and columns five and six compute the difference and the $t - statistic$. The first two rows are for performance variables (measure). Given that the new track is one year shorter, the expectation is that new students perform worse in both subjects. However, this is not the case in math (-0.20 for old majors and -0.14 for new ones, with a difference statistically significant). Regarding reading, the difference is only -0.01 and not significant. This is consistent with the results found in section 7.2, where the immediate outcomes are very close to zero.

The other rows compare students' and families' socioeconomic characteristics. In the case of the new tracks, there is a greater proportion of men in a predominately feminine profession. Students are younger (which is a mechanical effect of the shorter training), more likely to graduate from official schools, less prone to have retaken a year in primary, and more likely to belong to one of the ethnic minorities. Lastly, new students come from households with fewer electronic appliances, which is a proxy for income.

There are several confounding effects: New cohorts are one year younger, and their preparation is one year shorter, which should negatively impact their performance. However, the new curriculum is more similar to the academic track (that historically performs better), with a positive expected impact. In addition, extending the formation made it more costly to students, which could have changed their profile.

To explore this, I ran the regressions as specified in section 6.3. Figure 8 includes the plots for these ten socioeconomic characteristics. The first interesting result is that the coefficient for gender [1=Male] changes from negative to positive, drawing more males into a highly feminized profession in Latin America. The drop in the age coefficient is mechanical since the new programmes are shorter. The other set of interesting results is the change in the types of schools: The coefficient for private increases, while it decreases for municipal and cooperatives. There is also a higher estimation for repeaters, a low coefficient for students from ethnic minorities, and a rise in the coefficient for electronic appliances (although still negative).

[Table 10 Here]

[Figure 8 Here]

7.4 Spillover effects

In this section, I explore one of the reform's spillover effects: The change in the enrolment of aspiring pre-primary teachers, who were intentionally left out due to the low enrolment of children in this schooling level.

To assess this, I use the same empirical strategy of Section 6.3, but now the treated group is pre-primary teaching students, and the control group continues to be those in the vocational major. The expected sign would be positive since pre-primary teaching is a close substitute for primary teaching, especially after the drop in primary teaching enrolment due to the reform. However, I did not find an increase in pre-primary teaching enrolment;

even more, I observed some negative coefficients in the latter years, as shown in Figure 9. Putting together these results with Table 9, we see that the number of pre-primary students increased, but less than the number of vocational students (Figure 6 already shows the rise in their enrolment).

[Figure 9 Here]

8 School-level results

8.1 School performance

The last main outcome is the performance of primary teaching students in the different types of colleges. Figure 10 plots the coefficients for primary students' performance (using the variable measure) in the different types of institutions. The upper figures show the estimations for math (errors clustered at the municipal level on the left and unclustered on the right), and the bottom plots do the same for reading. Covariates are not included.

Right after the reform, there was a positive effect on the performance of primary teaching students in official teachers' colleges in both subjects that declined along with time. Five years after the reform the coefficient is negative and significant for reading, and negative but not significant for math.

Table A3 contains other specifications as a robustness check, and conclusions remain the same.

[Figure 10 Here]

9 Conclusion

This paper adds to the literature on self-selection in the teaching profession and on public policies to improve the quality of teachers and schools in Latin America and the Caribbean. Especially in Central America, where some teachers' colleges still function at the secondary level, but there is a tendency to push teacher training into the tertiary level.

The MFDI reform introduced in Guatemala to increase primary teachers' schooling level had a series of effects on the outcomes of enrolment and performance at the student and school levels. Using a Difference-in-Differences strategy and an unaffected group of students as control, I find a negative impact on enrolment at the department level on primary teaching students compared to students in vocational pathways, and this is robust to the different specifications. This result supports the idea that teacher training became more lengthy, disincentivising students to follow it. There seems to be no spillover effect on the enrolment of pre-primary teaching students, a close track unaffected by the reform.

Regarding reading and math performance, the effects are mixed. In math, the effects are negative every year after the reform, although not significant for years one and three. In years four and five, the drop is about 20%. In the case of reading, the results are mixed: There is no effect in the first year, then a negative and significant in the second year, then positive and not significant in the third year, but negative in years four and five (however, the coefficient for year five is weakly significant).

Putting these results together, this paper provides evidence that the reform only had a partial success: It was able to decrease the enrolment of primary teachers, who experienced an oversupply in the country before, but it did not attract better performers into the teaching profession.

However, it did change the socioeconomic characteristics of aspiring primary teachers. Using a means comparison strategy, I observed that, among other characteristics, students choosing teaching post-reform are more likely to be male (in a highly feminized profession), and more likely to come from a household with more electronic appliances, which is a proxy for income, in a country were teaching was a common major in rural and under-served areas.

At the school level, there are changes as well. Official teachers' colleges, which allowed primary teaching students to apply for financial aid for their B.Ed., saw an initial positive impact on their math and reading scores: The coefficients are positive and significant for

the first two years post-reform for math, and one year for reading. However, there is a downward trend over time, and by the fifth year, the results are negative but insignificant for math (of around 5%), and negative and significant (around 9%) for reading. This is puzzling since the expected sign of financial aid is positive (as it is at the beginning), but other factors could have affected these results later on.

I contribute to the literature in several ways. First, I add to the discussion on teacher recruitment and training and Latin America, and how to attract high-performers into these programmes. The analysis of this Guatemalan reform, which has not been evaluated before, sheds some light on how the process of transferring teaching training from secondary-level teachers' colleges to tertiary centres has affected enrolment and performance. Again, this is relevant since this is a widespread trend in Latin America, and for instance, the Dominican Republic implemented a similar policy in the past. And second, I explore how these reforms also change the characteristics of the applicants. In this case, the attracting more men, but also the economic characteristics of the aspiring teachers.

The long-term objective of these teacher recruitment and training reforms is to increase student learning. Further research is needed to understand how this change impacted not only the aspiring primary teachers during their secondary schooling, but also when they finish their training and apply to become teachers in the educational system, and lastly, how this impacted their students in their learning outcomes by being taught by teachers with tertiary degrees.

References

Aceña, M. d. C. and Menchú, W. (2019). El Sistema Educativo en Guatemala. Technical report, CIEN.

Acosta, F. (2021). Diversificación de la estructura de la escuela secundaria y segmentación educativa en América Latina. Technical Report Documentos de Proyectos (LC/TS.2021/106, Comisión Económica para América Latina y el Caribe (CEPAL.

Alvarez, B. and Majmudar, J. (2001). Teachers in Latin America: Who is preparing our children for the knowledge century? Technical Report 32440, World Bank, DC.

Avitabile, C., Bobba, M., and Pariguana, M. (2015). *High School Track Choice and Financial Constraints: Evidence from Urban Mexico*. Policy Research Working Papers. The World Bank.

Balcázar Salazar, C. and Ñopo, H. (2015). Broken Gears: The Value Added of Higher Education on Teachers'Academic Achievement.

Barber, M. and Mourshed, M. (2007). How the World's Best-performing School Systems Come out on Top. Technical report, McKinsey & Company.

Bos, M. S., Vegas, E., Viteri, A., and Zoido, P. (2018). Guatemala: ¿Un punto de partida para la mejora?

Bruns, B. and Luque, J. (2014). *Great Teachers: How to Raise Student Learning in Latin America and the Caribbean*. The World Bank.

Chetty, R., Friedman, J. N., and Rockoff, J. E. (2014). Measuring the Impacts of Teachers II: Teacher Value-Added and Student Outcomes in Adulthood. *American Economic Review*, 104(9):2633–2679.

Corcoran, S. P., Evans, W. N., and Schwab, R. M. (2022). Changing Labor-Market Opportunities for Women and the Quality of Teachers, 1957-2000. *TEACHER QUALITY*, 94(2):7.

Cruz, A. and Santos, J. (2014). Informe de los resultados de la evaluación de docentes optantes a plaza 2009'2014.

de Hoyos, R., Estrada, R., and Vargas, M. J. (2018). *Predicting Individual Wellbeing Through Test Scores: Evidence from a National Assessment in Mexico*. World Bank, Washington, DC.

Elacqua, G., Hincapié, D., Vegas, E., Alfonso, M., Motalva, V., and Paredes, D. (2018). *¿Por qué se perdió el prestigio docente y cómo recuperarlo?* Inter-American Development Bank.

Estrada, R. and Lombardi, M. (2020). Skills and selection into teaching: Evidence from Latin America. Technical report, CAF, Caracas.

Fredriksson, P. and Öckert, B. (2007). The supply of skills to the teacher profession. page 23.

Hanushek, E. A. and Pace, R. (1986). Who Chooses To Teach (and Why)? *Economics of Education Review*, page 17.

Hanushek, E. A. and Rivkin, S. G. (2010). Generalizations about Using Value-Added Measures of Teacher Quality. *American Economic Review*, 100(2):267–271.

Hernández, B. A. (2006). Censo de Escuelas Normales en Guatemala 2004. page 80.

IESALC (2007). Informe Sobre la Educación Superior en América Latina y el Caribe 2000-2005. Technical report, UNESCO.

Louzano, P. and Moriconi, G. M. (2014). Visión de la docencia y características de los sistemas de formación docente en Finlandia, Singapur y Estados Unidos. In *Temas críticos para formular nuevas políticas docentes en América Latina y el Caribe: el debate actual*. UNESCO/OREALC.

López Rivas, O. H. and Cortez Sic, J. E. (2016). Las Escuelas Normales en Guatemala Origen y desarrollo, crisis y situación actual. *REVISTA HISTORIA DE LA EDUCACIÓN LATINOAMERICANA*, 18(26):71–89.

Manski, C. (1985). Academic Ability, Earnings, and the Decision to Become a Teacher: Evidence From the National Longitudinal Study of the High School Class of 1972. Technical Report w1539, National Bureau of Economic Research, Cambridge, MA.

Medrano Camacho, V., Ángeles Méndez, E., and Morales Hernández, M. (2018). La educación Normal en México. Elementos para su análisis. *Perfiles Educativos*, 40(160):192–208.

Meza, F. (2013). Políticas Docentes en Centroamérica. Tendencias Nacionales: Guatemala. Technical report.

Ministry of Education (2012). Plan de Implementación Estratégica de Educación 2012 – 2016.

Ministry of Education (2015). Informe de Línea de Base. Formación Inicial Docente.

Mizala, A. and Ñopo, H. (2016). Measuring the relative pay of school teachers in Latin America 1997–2007. *International Journal of Educational Development*, 47(C):20–32. Publisher: Elsevier.

Nickell, S. and Quintini, G. (2002). The Consequences of the Decline in Public Sector Pay in Britain: A Little Bit of Evidence. *The Economic Journal*, 112(477):F107–F118.

OECD (2021). *Education at a Glance 2021: OECD Indicators*. Education at a Glance. OECD.

OREALC/UNESCO (2013). *Background and criteria for teacher-policy development in Latin America and the Caribbean*. Regional Strategic Project On Teachers. Santiago, Chile.

Podgursky, M., Monroe, R., and Watson, D. (2004). The academic quality of public school teachers: an analysis of entry and exit behavior. *Economics of Education Review*, 23(5):507–518.

Puryear, J. (2015). Producing High-Quality Teachers in Latin America. Technical report, Inter-American Dialogue.

Santos Solares, J. A. and Cruz Grünebaum, A. A. (2015). Procedimiento de Calificación TRI. Technical report, DIGEDUCA, Guatemala.

Webbink, H. (1999). *Student decisions and consequences*. PhD thesis, Universiteit van Amsterdam, Amsterdam.

Woessmann, L. (2009). International Evidence on School Tracking: A Review. *ifo Institut für Wirtschaftsforschung an der Universität München*, 07(1):26–34.

10 Tables and Figures

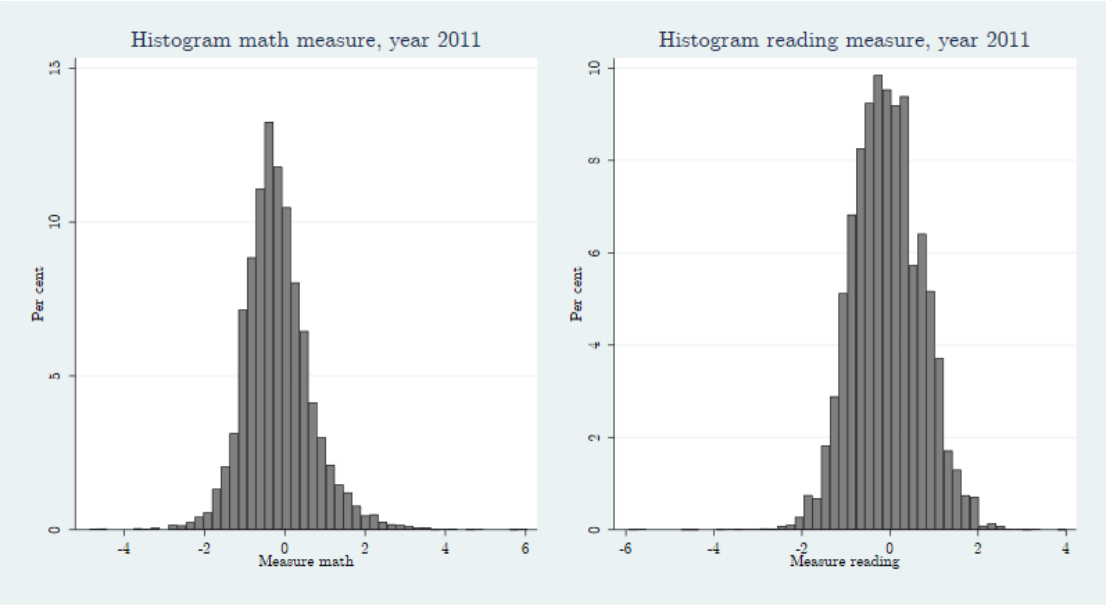

Figure 1: Measure histogram

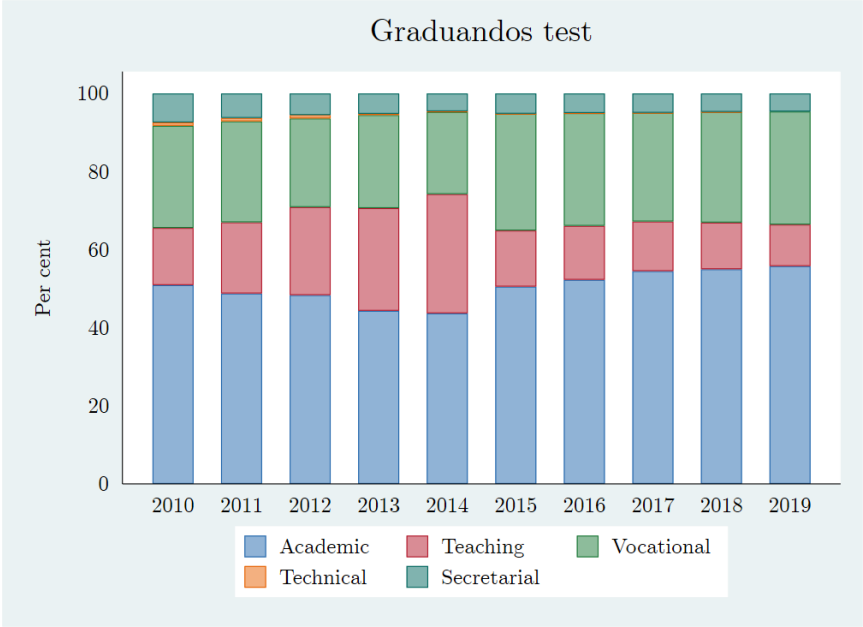

Figure 2: Proportion by track

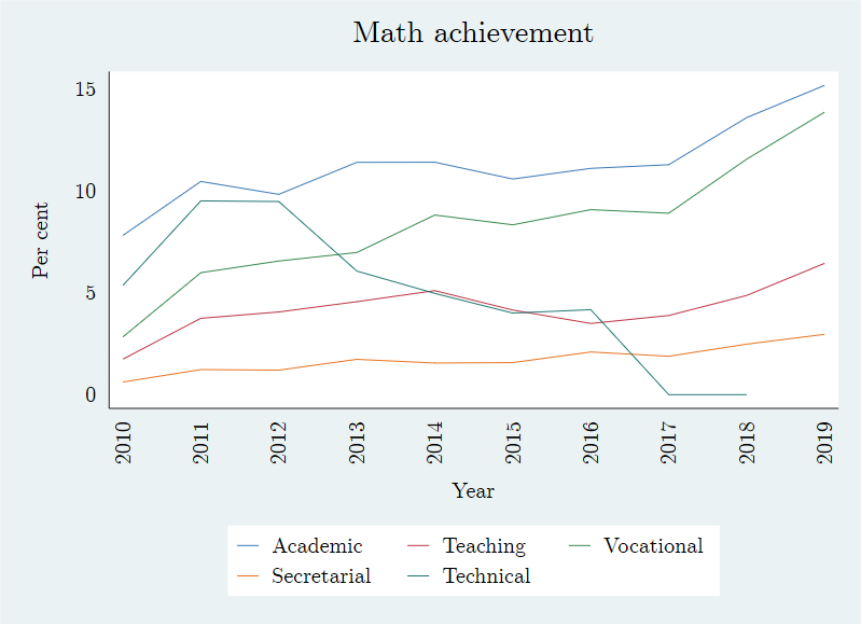

Figure 3: Math achievement

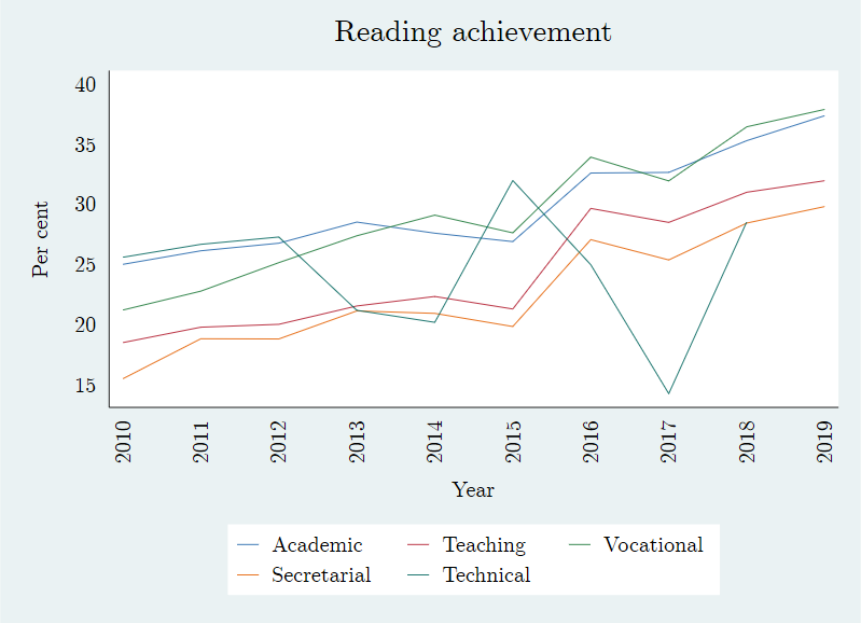

Figure 4: Reading achievement

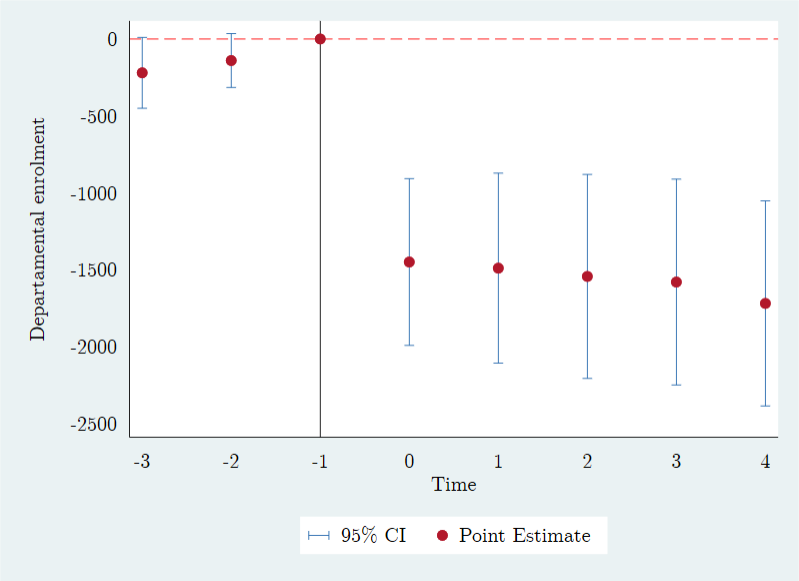

Figure 5: Effects on primary teaching departmental enrolment

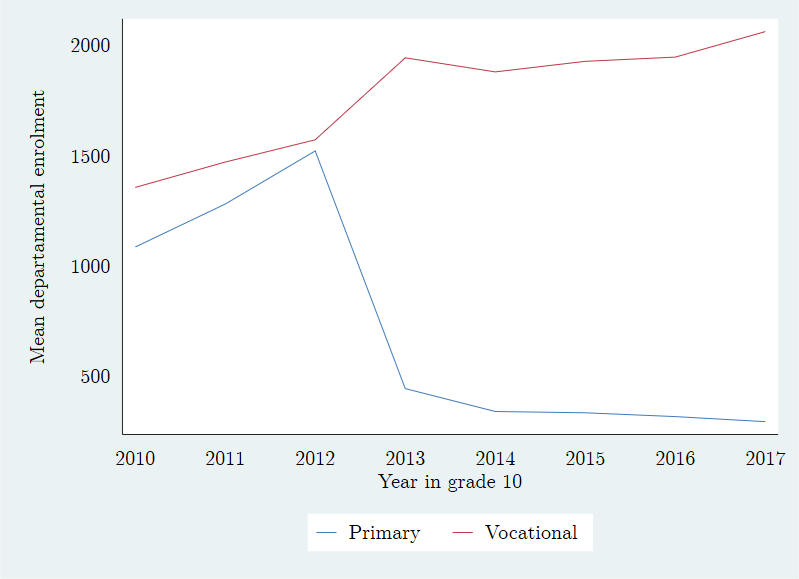

Figure 6: Mean primary teaching and vocational departmental enrolment

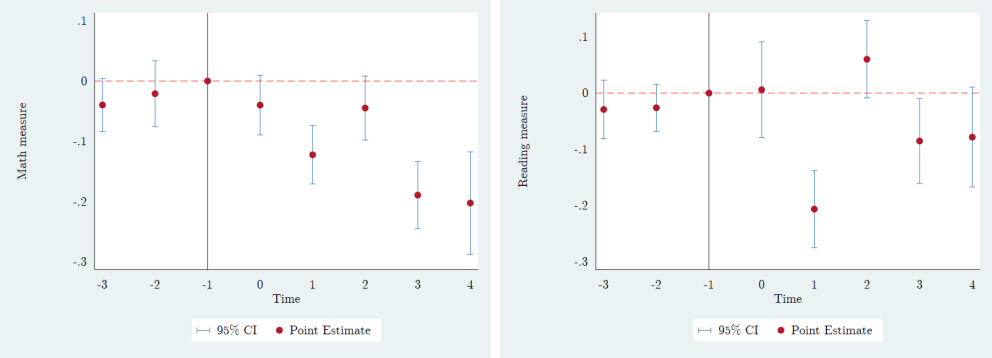

Figure 7: Effects on math and reading performance

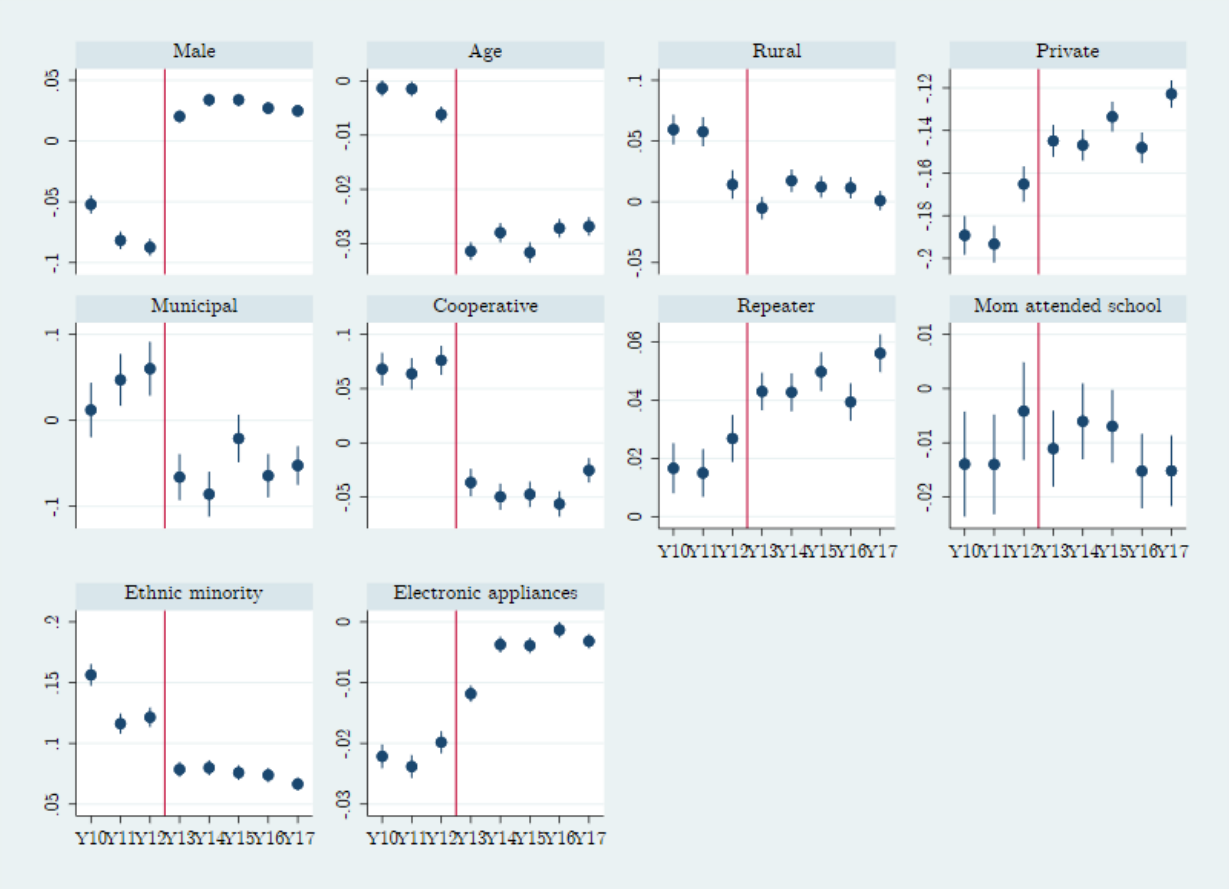

Figure 8: OLS regressions by year in grade 10

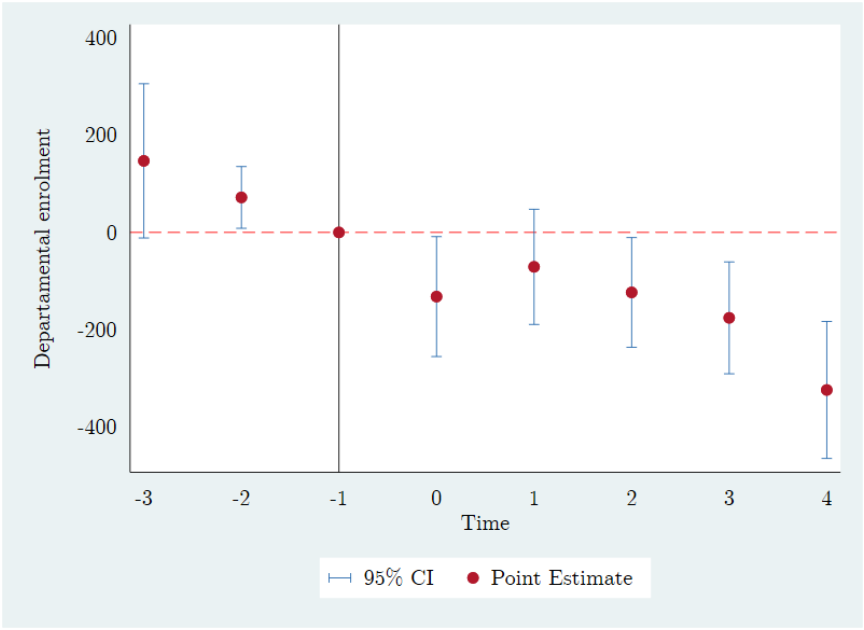

Figure 9: Spillover effects on pre-primary enrolment

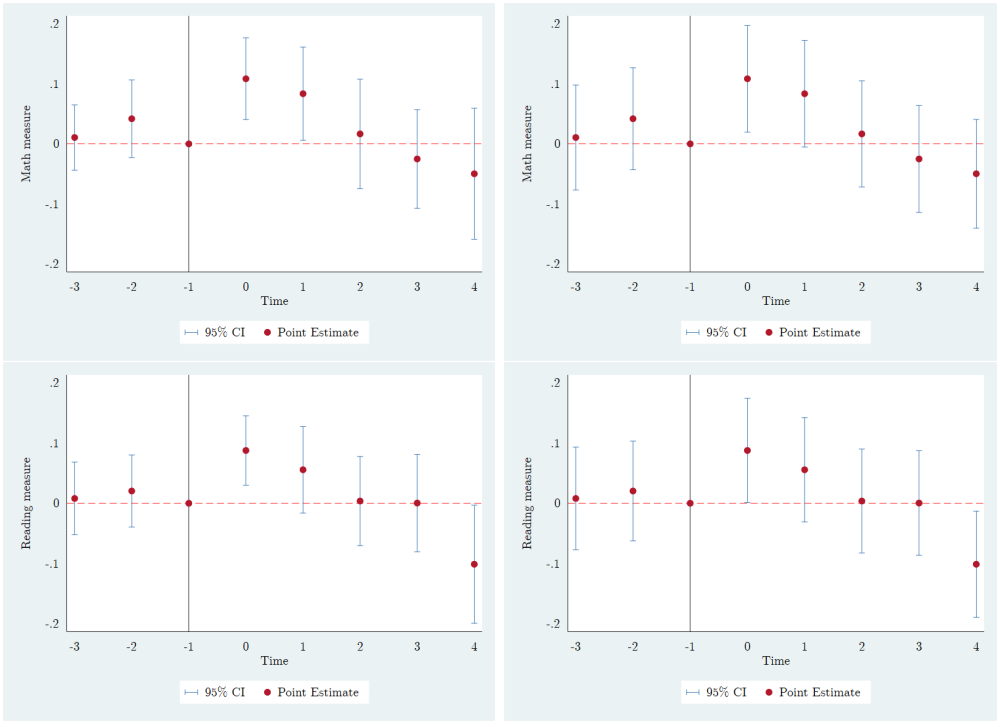

Figure 10: Effects on primary teaching performance in official teachers' colleges

Table 1: Outcome: Math measure (logits)

	Mean	Sd	Min	Max	No.
2010	-0.13	0.69	-4.49	6.13	117,892
2011	-0.18	0.85	-4.87	6.04	123,450
2012	-0.17	0.83	-4.87	6.03	137,466
2013	-0.18	0.89	-4.86	6.01	141,930
2014	-0.13	0.86	-5.02	5.92	171,993
2015	-0.11	0.86	-5.01	5.92	149,652
2016	-0.02	0.84	-4.98	6.05	149,815
2017	-0.06	0.89	-5.02	6.06	158,962
2018	0.05	0.95	-5.04	6.21	158,161
2019	0.11	0.97	-5.00	6.03	163,825

Notes: Source: DIGEDUCA.

Table 2: Outcome: Reading measure (logits)

	Mean	Sd	Min	Max	No.
2010	-0.15	0.88	-6.35	5.29	117,892
2011	-0.06	0.77	-5.94	4.00	123,450
2012	-0.05	0.77	-5.63	4.00	137,466
2013	-0.06	0.82	-5.80	4.07	141,930
2014	-0.04	0.81	-5.86	5.02	171,993
2015	-0.04	0.81	-5.85	4.98	149,652
2016	0.20	0.85	-5.23	5.59	149,815
2017	0.17	0.87	-5.33	5.40	158,962
2018	0.26	0.88	-5.22	5.40	158,161
2019	0.29	0.92	-5.33	5.35	163,825

Notes: Source: DIGEDUCA.

Table 3: Test takers by year and track

Year	Academic	Secretarial	Teaching	Technician	Vocational	Total
2010	60,027	8,746	17,271	1,009	30,839	117,892
2011	60,201	7,740	22,516	1,064	31,925	123,446
2012	66,470	7,582	30,985	1,206	31,223	137,466
2013	62,930	7,404	37,319	429	33,848	141,930
2014	75,137	7,868	52,523	282	36,183	171,993
2015	75,620	7,763	21,504	25	44,740	149,652
2016	78,311	7,506	20,713	24	43,261	149,815
2017	86,644	7,863	20,200	7	44,248	158,962
2018	86,967	7,465	18,903	7	44,819	158,161
2019	91,364	7,571	17,461	0	47,429	163,825
Total	743,671	77,508	259,395	4,053	388,515	1,473,142

Notes: Source: DIGEDUCA. Students following the academic track with an emphasis on education are classified under the teaching programme.

Table 4: Breakdown of teaching tracks

Year	(Pre & Primary)	(Pre)	(Primary)	(Primary, new)	(Primary, old)	(unknown)	Total
2010	17,271	0	0	0	0	0	17,271
2011	22,516	0	0	0	0	0	22,516
2012	0	5,944	25,041	0	0	0	30,985
2013	0	6,852	29,663	0	0	804	37,319
2014	0	7,516	0	9,627	35,194	186	52,523
2015	0	13,010	0	7,872	615	7	21,504
2016	0	12,953	0	7,748	12	0	20,713
2017	0	12,841	0	7,354	3	2	20,200
2018	0	12,077	0	6,825	0	1	18,903
2019	0	11,320	0	6,018	0	123	17,461
Total	39,787	82,513	54,704	45,444	35,824	1,123	259,395

Notes: In 2010 and 2011, there was no code to differentiate between primary and pre-primary teaching students. Students following the academic track with emphasis on education are classified under the teacher programme. Unknown cases are mostly misclassified students (from other tracks).

Table 5: Teacher's College enrolment by sector

Year	Cooperative	Municipal	Official	Private
2010	35.5	28.7	69.6	31.1
2011	47.4	38.9	86.4	36.3
2012	69.8	52.9	106.8	43.6
2013	77.8	66.5	95.6	41.4
2014	110.5	71.6	147.7	53.0
2015	44.3	27.4	57.5	24.3
2016	39.7	27.0	54.6	21.7
2017	34.6	23.6	53.6	19.3
2018	31.5	19.2	49.3	18.4
2019	25.2	21.2	47.1	15.7

Notes: Average enrolment is calculated as the mean of teaching students (or academic students with emphasis on education) by year and sector, conditional on the school being a teachers' college (having teaching students).

Table 6: Math achievement by type of teachers' college

Year	Cooperative	Municipal	Official	Private	Total
2010	0.38%	0.35%	1.85%	1.94%	1.74%
2011	1.21%	0.77%	4.83%	3.54%	3.74%
2012	2.92%	1.52%	5.09%	3.68%	4.06%
2013	1.60%	2.86%	5.65%	4.52%	4.56%
2014	2.82%	2.54%	6.09%	5.05%	5.10%
2015	3.68%	1.37%	5.04%	3.72%	4.15%
2016	1.72%	0.46%	4.47%	3.30%	3.49%
2017	2.18%	0.47%	4.36%	4.01%	3.89%
2018	2.02%	2.08%	5.34%	5.29%	4.87%
2019	1.47%	2.83%	7.19%	7.13%	6.44%

Notes: Math achievement is computed as the average of the binary variable achievement of students in teaching programmes (teaching or academic with an emphasis on education).

Table 7: Reading achievement by type of teachers' college

Year	Cooperative	Municipal	Official	Private	Total
2010	11.30%	8.01%	22.89%	17.02%	18.53%
2011	11.12%	12.37%	23.92%	18.74%	19.81%
2012	12.16%	16.54%	24.50%	18.90%	20.05%
2013	13.00%	16.69%	25.74%	20.81%	21.57%
2014	14.85%	15.36%	26.87%	21.35%	22.36%
2015	11.72%	10.50%	26.62%	20.20%	21.32%
2016	16.95%	21.30%	35.26%	29.04%	29.68%
2017	15.85%	19.34%	32.16%	28.89%	28.51%
2018	17.10%	22.92%	34.71%	31.77%	31.03%
2019	16.92%	18.87%	36.20%	32.38%	31.99%

Notes: Reading achievement is computed as the average of the binary variable achievement of students in teaching programmes (teaching or academic with an emphasis on education).

Table 8: SES education and non-education students

	(1) Education		(2) Non-Education		(3) Difference	
	Mean	Sd	Mean	Sd	Diff	t-statistic
1[Male]	0.34	0.47	0.56	0.50	0.21***	(69.14)
Age (years)	19.31	2.81	19.87	4.81	0.56***	(25.75)
1[Urban]	0.86	0.35	0.92	0.27	0.06***	(30.04)
1[Rural]	0.14	0.35	0.08	0.27	-0.06***	(-30.04)
1[Official teachers' college]	0.35	0.48	0.17	0.37	-0.19***	(-63.53)
1[Private teachers' college]	0.51	0.50	0.80	0.40	0.29***	(92.08)
1[Municipal teachers' college]	0.02	0.13	0.01	0.10	-0.01***	(-7.47)
1[Cooperative teachers' college]	0.12	0.32	0.03	0.16	-0.09***	(-48.58)
1[Repeater]	0.32	0.47	0.31	0.46	-0.01***	(-2.65)
1[Mom attended school]	0.71	0.45	0.78	0.41	0.08***	(25.66)
1[Electronic appliances]	3.79	2.20	4.79	2.27	0.99***	(69.64)
Observations	30985		106481		137466	

Notes: Students graduating in 2012 (before the reform). Electronic appliances' range goes from 0 to 9 and it is the sum of nine binary questions. Estimates are significant at the *10%, **5%, and ***1% level.

Table 9: Teaching enrolment by year in grade 10

Year in Grade 10	Teaching (Pre & Pri)	Teaching (Pre)	Teaching (Primary)	Teaching (unknown)	Total
2008	17,271	0	0	0	17,271
2009	22,516	0	0	0	22,516
2010	0	5,944	25,003	0	30,947
2011	0	6,852	29,476	34	36,362
2012	0	7,516	35,009	240	42,765
2013	0	13,010	10,269	29	23,308
2014	0	12,953	7,884	6	20,843
2015	0	12,841	7,751	2	20,594
2016	0	12,077	7,354	1	19,432
2017	0	11,320	6,825	0	18,145

Table 10: Comparison of teaching students in 2014

	(1) New		(2) Old		(3) Difference	
	Mean	Sd	Mean	Sd	Diff	t-statistic
Measure Math	-0.14	0.72	-0.20	0.72	-0.06***	(-7.33)
Measure Reading	-0.09	0.77	-0.10	0.75	-0.01	(-1.14)
1[Male]	0.52	0.50	0.42	0.49	-0.10***	(-17.44)
Age (years)	17.54	1.78	19.06	2.62	1.51***	(66.05)
1[Urban]	0.87	0.34	0.87	0.33	0.01**	(2.01)
1[Rural]	0.13	0.34	0.13	0.33	-0.01**	(-2.01)
1[Official teachers' college]	0.41	0.49	0.33	0.47	-0.08***	(-14.79)
1[Private teachers' college]	0.44	0.50	0.52	0.50	0.09***	(15.20)
1[Municipal teachers' college]	0.01	0.12	0.02	0.13	0.00**	(2.09)
1[Cooperative teachers' college]	0.14	0.35	0.13	0.34	-0.01*	(-1.76)
1[Repeater]	0.31	0.46	0.33	0.47	0.02***	(4.04)
1[Mom attended school]	0.73	0.44	0.73	0.45	-0.01	(-1.13)
1[Ethnic minority]	0.50	0.50	0.43	0.49	-0.07***	(-12.62)
Electronic appliances	3.63	2.11	3.71	2.12	0.08***	(3.12)
Observations	9627		35194		44821	

Notes: Electronic appliances' range goes from 0 to 9 and it is the sum of nine binary questions. Estimates are significant at the *10%, **5%, and ***1% level

A Appendix

Student enrolment

The base estimation shown in Section 7.1 for enrolment does not contain covariates, and the errors are clustered at the regional level (one administrative level above the department).

Here I present the plots for other specifications to ensure robust results. The upper left figure is the same in the paper's body, where we observe a drop of around 1,500 students in primary teaching. The upper right plot contains the same estimation, with the errors unclustered, and we observe more precise estimates and the same conclusions.

The bottom left figure includes covariates and errors unclustered. This vector is included at the department-track-grade level, and it contains the variables presented in Table A1, which also includes the mean values for the year 2010. It does not change the conclusions from the base model. Finally, the bottom right figure contains the dependent variable in logarithm instead of level, with unclustered errors and no covariates. The impact is around -0.2.

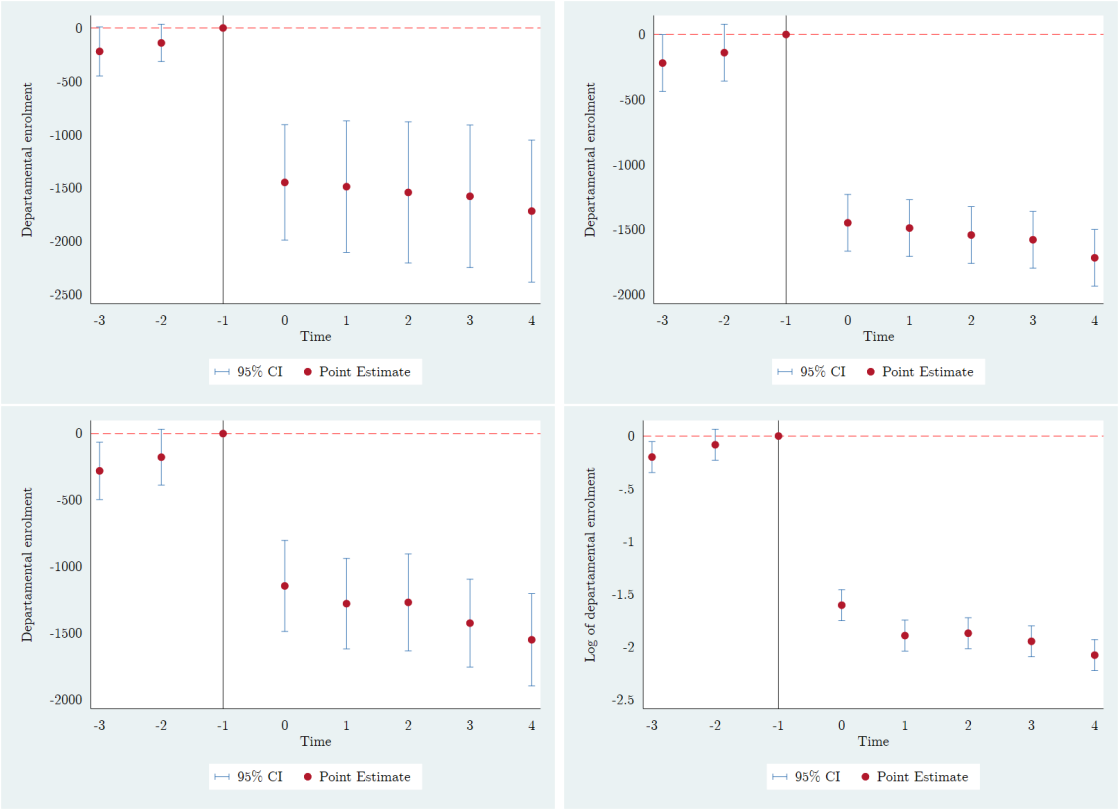

Figure A1: Other specifications for student enrolment

Table A1: Controls at the department-track level

	(1) (Primary) Mean	Vocational Mean	Total Mean
Prop. Male	0.41	0.52	0.47
Average age	19.36	19.20	19.27
Prop. Rural	0.15	0.08	0.11
1[Municipal Teachers' College]	0.49	0.73	0.62
1[Private Teachers' College]	0.02	0.01	0.02
1[Cooperative Teachers' College]	0.13	0.06	0.09
Prop. Repeaters	0.33	0.28	0.30
Prop. Mom attended school	0.69	0.77	0.74
Prop. Ethnic minority	0.45	0.26	0.35
Average appliances	3.63	4.47	4.10

Notes: Means of control variables included in the department-level estimations in eq. 1 in year 2010.

Student performance

Similarly, the main estimation presented in Section 7.2 for performance does not contain covariates but does include departmental dummies, and the errors are clustered at the department level (one administrative level below regions).

So, I present the plots for alternative specifications to ensure robust results. The upper left figure is the same in the paper's body, with the results for math performance. The upper right plot contains the same estimation with the inclusion of covariates, and we observe more precise estimates and the same conclusions, although the coefficients before the reform are shifted upwards. We observe the same pattern for reading (bottom figures), where the inclusion of controls leads to more precise estimations, with the pre-reform coefficients shifted upwards.

This control vector is included at the individual level, and it contains the variables presented in Table A2, which also includes the mean values for the year 2010.

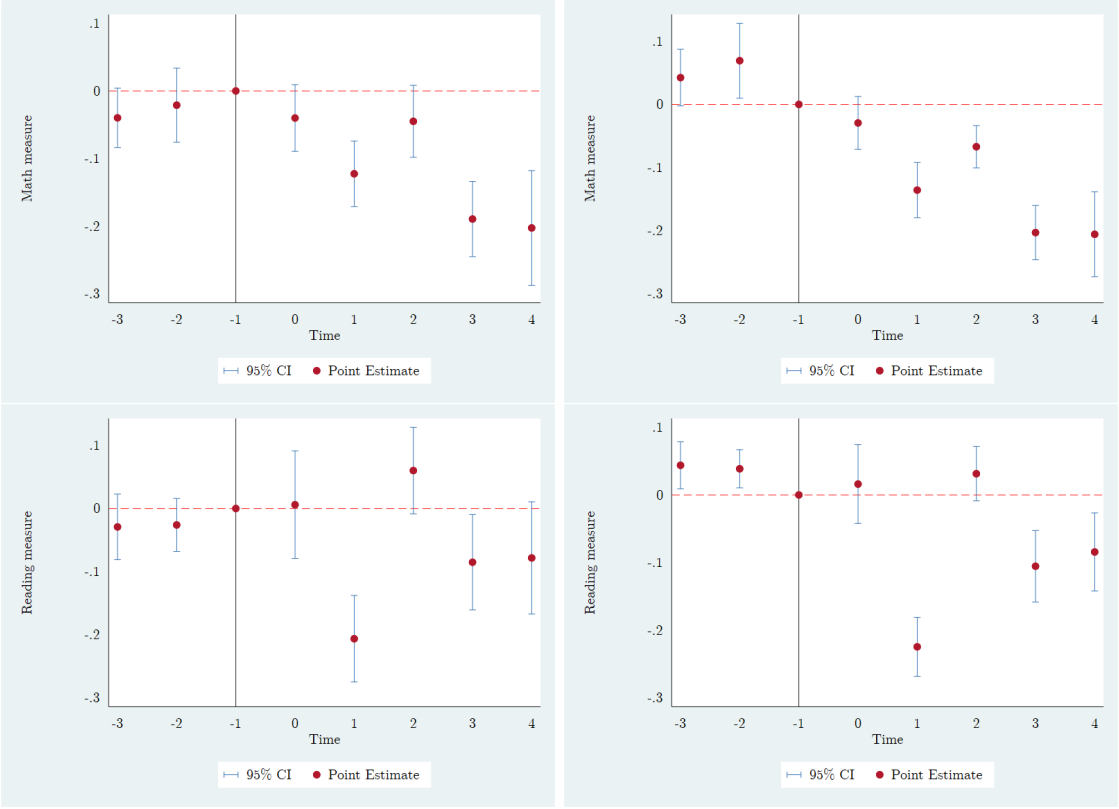

Figure A2: Math and reading performance

Table A2: Controls at the student-level

	(1) (Pre) Mean	(2) (Primary) Mean	(3) Vocational Mean	(4) Total Mean
Male	0.05	0.41	0.52	0.43
Age	19.10	19.36	19.20	19.25
Rural	0.12	0.15	0.08	0.11
Private	0.61	0.49	0.73	0.62
Municipal	0.00	0.02	0.01	0.02
Cooperative	0.04	0.13	0.06	0.09
Repeater	0.29	0.33	0.28	0.30
Mom attended school	0.80	0.69	0.77	0.74
Ethnic minority	0.28	0.45	0.26	0.34
Appliances	4.48	3.63	4.47	4.13

Notes: Means of control variables included in the student-level estimations in eq. 1 and eq. 2 for students in grade 10 in 2010.

School performance

In this appendix, I run some alternative specifications to evaluate the robustness of the results plotted in Section 8.1. Besides the specifications included in the paper's body (with the errors unclustered or clustered at the municipal level), here I show an alternative model with the department dummies. The left figure corresponds to math and the right one to reading. Conclusions remain the same as the baseline model, with no strong effects on performance on either subject.

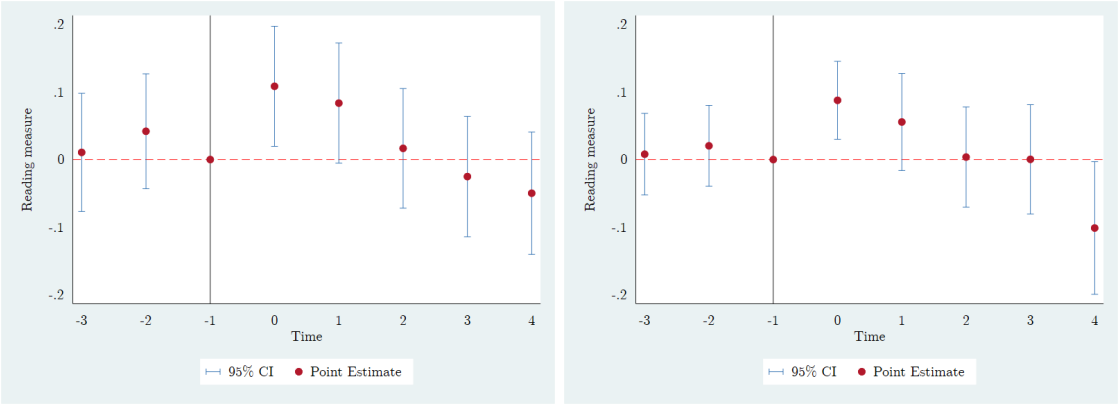

Figure A3: Primary teaching performance in official teachers' colleges