# Is more time in school worth it?

## Effects of two-shift schooling on test performance from a longitudinal study in Colombia

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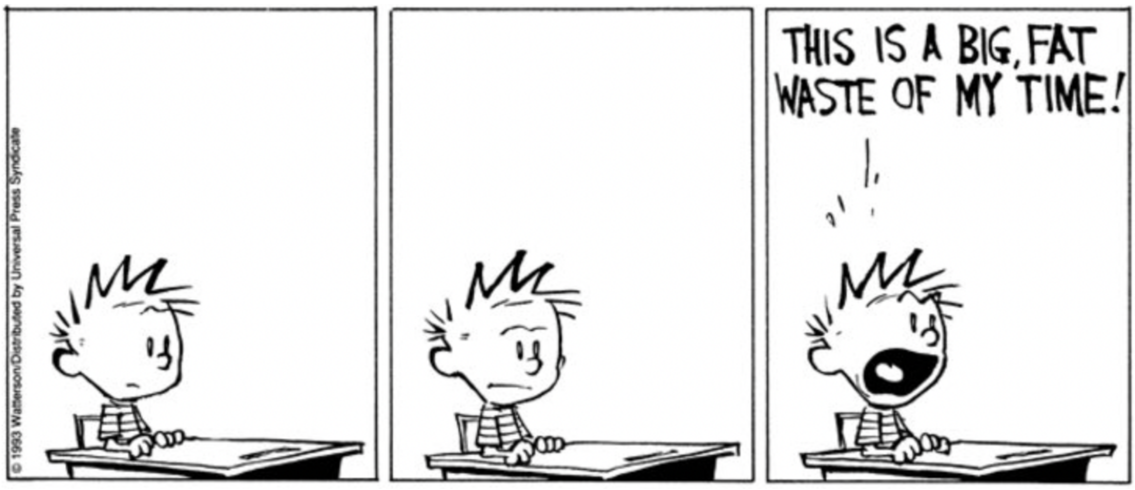


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**Executive summary**

In an effort to improve coverage of the school system at the primary and secondary education levels, schools in various countries have introduced partial school days. This policy is supposed to allow two or more shifts of students to use the same infrastructure and be instructed by the same teachers, but reduces the amount of time children spend in school. Despite some positive effects on coverage, two-shift schooling has negative impacts on various learning outcomes, such as students' performance on standardized tests. Using longitudinal data form *Pruebas Saber* in Colombia, this paper explores the impact of a full day of school on performance in the mathematics and language scores. Initial OLS regression results are contrasted with fixed effects models. Some effect heterogeneity is explored as well.

Positive and statistically significant effects are found across all models. However, there are considerable variations in the size of the effect. First, effects on the mathematics scores are consistently larger than effects on language. Second, full-day schooling is found to make more of a difference in context where resources outside the classroom are less available, such as public schools which tend to be underfunded, rural areas which tend to be underserved by public services, and in children from disadvantaged backgrounds. Differences in school quality have surprising interaction effects with the length of the school day. Additional instruction time is shown to make the most difference at both ends of the quality spectrum.

*Keywords: Education, two-shift schooling, length of school day, Pruebas Saber, standardised test performance*

## 1. Introduction: not all schools are created equal

Most children in Colombia go to school and this is no small achievement. In the last few decades access to primary and secondary education, and with it school enrolment rates, have grown significantly, after being worryingly low for very long. This is the result of multiple efforts and strategies that, although beneficial overall, have sometimes widened the differences between the kind of school experience different children have, and the opportunities their school life therefore awards them. One such element of differentiation is the amount of time different children spend in school each school day. To compensate for heavy budgetary constraints that made the investment in the school sector required to ensure every child a school place impossible to meet, two-shift schooling was introduced. The purported doubling of the capacity of schools that adopted this policy is dubious for reasons that will be explained in what follows. But more importantly, the effects that reducing the amount of instruction time children get on their learning is understudied. Moreover, the implications that this policy has on the ability of the school system to be a contributing factor in efforts to increase social equality are often overlooked.

On the whole, "while there is a large literature that provides evidence about the effect of school inputs in the education production function, there is only limited evidence on the effects of time in school on student outcomes, and even less evidence showing that interventions that increase the length of the school day will improve learning outcomes" (Hincapie, 2016, p. 1). So, to contribute to the discussion about how different school arrangements relate to the reduction of social inequalities, as well as the research about the impact of additional time of instruction on learning outcomes, this text will examine the effects of partial-day schooling on performance in standardized testing. Using panel data from a test given to students in the last years of high school in Colombia, I will explore what effects this difference in the number of hours in school certain children get to have has on what they learn. Concretely, I would like to know what the impact of full-day schooling is on standardized test performance. I will first offer a brief review of literature relevant to the importance of time in school in general, and of partial day schooling in particular. I will then present the motivations behind the policy of two shift schooling, the main arguments for and against it, as well as some previous empirical evidence of its effects on educational attainment. Before introducing the data and statistical methods I will be working with, I will offer some contextual elements about Colombia and some the characteristics of its school-age children. Then I will present results of my statistical analysis and a discussion of them vis a vis the literature. Finally, I will offer some concluding remarks about the implications of my findings and open avenues for future research.

## 2. Schools: the best thing since sliced bread?

### 2.1. Initial theoretical considerations

There is an unusual amount of consensus amongst politicians, policy makers, parents, etc. about how important schooling and education are. However, in many ways, consensus stops there. In the discussion about the relationship between education systems and social inequalities, for example, education sociologists, as well as policymakers, tend to cluster around two general opinions. On the one hand, hopefuls of the school system, alongside meritocracy enthusiasts, describe education as the best vehicle for social mobility, the one true driver of social change which can lessen social inequalities on all fronts. These authors argue that "schools serve a compensatory function, acting as a 'great equalizer' that reduces initial inequalities between social classes" (Jennings et al., 2015, p. 58). The hope is that schools can "somehow modify the inequality in educational outcomes created by birth (i.e., created by the family of origin and observable across characteristics such as race, ethnicity, and socioeconomic status)" (Sørensen and Morgan, 2006, p. 142). And this line of argument is behind the justification of many policy choices that aim to expand and improve school systems.

On the other side of the argument, social and cultural reproduction theorists point to the extent to which birth circumstances predict many aspects of the education someone gets -from the amount of education they are likely to have over their lifetime, to the type of schools they choose to visit. Moreover, they point out that schools "perpetuate or exacerbate disparities in family background, because children from more privileged families attend better schools and have better experiences within any given school than do less privileged children (Bourdieu and Passeron 1977; Bowles and Gintis 1976; Lareau 2003)" (Jennings et al., 2015, p. 58). These authors do not, however, discourage schooling in general. It is understood that on an individual level widening access to education does make everyone better off, regardless of their circumstances. However, "educational arrangements can amplify the effect of socioeconomic background on achievement through educational practices" (Montt, 2011, p. 63) and thereby have the potential of increasing inequalities between different social groups. Not all schools, nor schooling experiences are the same. So, while in general everyone profits from education, some profit a whole lot more. This sort of double bind of the social effects of education and schools on society makes it critical to know, when examining concrete education policy choices, how they might trace back to existing and future inequalities. Thus, it is key to understand how to turn schools into places where everyone learns in equal measure and is equally able to take advantage of what is taught.

In that effort, another element of frequent disagreement are evaluations and test scores. Here to, one side of the argument would hail them as an objective way to organize students, distribute praise to those better deserving of it, and make sure special attention is given to those who need it. On the other side, critics not only of test scores but of resulting meritocratic systems -understood as the idea that differences in opportunities are justified as long as they derive from differences in ability- point out that what we evaluate depends on what we value, and that is neither objective nor neutral. As Will Atkinson puts it, although test scores are often thought of as a measure of intelligence, "intelligence, when we [...] recognize it as a social endowment passed on through socialization, as cultural capital, is [social] class" (Atkinson, 2015, p.120). The discussion around meritocracy is a fascinating one, that has gotten some traction in education sociology over the last few years, and that I believe should be an integral part of the conversation around how to turn schools into places that help us build a more equitable society. It could thus not go unmentioned. However, it exceeds the aims of this paper, for which we will have to be content with a more pragmatic approach. While I acknowledge that test scores are very imperfect measures of learning, as well as problematic instruments for the distribution of opportunities, they effectively condition access to many such opportunities, from scholarships, to access to higher education. Flawed as they might be, they are important and worth considering.

### 2.2. Why we should care about how much time children spend in school

As mentioned above, even very critical voices of schools and the school system are usually not in favor of dismantling them altogether. Despite their failures, and even beyond their role as places of intellectual development and learning, schools are key social institutions. They "are charged with many tasks: the preservation of order through the socialization of children, the maintenance of a productive labor force, the promotion of tolerance, the cultivation of talent, and the prevention of crime and loitering" (Sørensen and Morgan, 2006, p. 137). Especially in tough contexts where children outside of school are less protected, they provide shelter against domestic and sexual violence, as well as substance abuse and juvenile delinquency (Ovalle et al. 2018). Through school meal programs, they provide nutrition many children are not able to get elsewhere. For young girls, being in school often reduces the risk of early and unwanted pregnancies (Rodríguez-Vignoli and Cavenaghi 2014). In conflict ridden areas, like Colombia, schools also prevent recruitment of minors into armed groups. These outcomes depend specifically on being in school and for the most part exceed the question about the quality of schooling a child is receiving. Thus, a critical element when thinking about school systems is how much time children will spend in them, not only over their lifespans but each day.

The platitude that given the benefits of schooling, societies should strive to get as many kids to school as they can, is faced in low-income countries with limited institutional capacities by the equally obvious limits in resources available for it. For a long time now, but critically in the 1960', with the reasons for increasing schooling in poor countries, low- and middle-income countries made big and desperately needed commitments to increasing the coverage of their schooling systems. Various strategies (with various degrees of success) were implemented to this end, one of which is the introduction of partial school days, which are the main interest of this text. The intuition behind this solution is that given the high costs of school infrastructure and the limited availability of educators, existing resources should be made to serve as efficiently as possible, by providing schooling to as many children as possible. Thus, under this model, the same classrooms and the same teachers accommodate two or more shifts per day - typically a morning and an afternoon shift, but in some cases also even morning, afternoon, night, and Saturday shifts.

Research that looks specifically at the effects of partial day schooling is somewhat limited, and results are often difficult to compare because what each study measures vary significantly. While there seems to be solid evidence in favor of schooling, the literature here tends to focus on the benefits that come from going from not attending school at all and getting enrolled. The effects of having different lengths of a school day, on the other hand, seem to be somewhat unexplored. This might be due in part to the fact that partial schooldays have been implemented mostly in the global South and therefore do not feature as prominently in education sociology or policy research. Nonetheless, some theory is available, that will contribute to the interpretation of my own results.

Defenders of this measure argue that it has great advantages for contexts with limited resources that cluster around the following main points. First, the existing resources are used more efficiently, since available teachers can teach more pupils and the existing infrastructure can be used to serve a larger population. Second, in areas where enrollment rates are very high, it can reduce overcrowding in classrooms, while in areas where there are insufficient school places it can increase access through the increased number of school places available. For teachers, salaries can increase without increasing unit costs if they are paid somewhat more for teaching two shifts instead of one. Finally, "pupils can perform productive work during the day (because they attend school only morning, afternoon or at night), thus reducing the opportunity costs of attending schooling" (Linden, 2001, p. 2). Concerning the role of schools as vehicles to reduce social inequality, they propose that while it is true that "generally double-shift schools serve poorer or disadvantaged populations" (Linden, 2001, p. 7), far from being an issue, this offers the possibility of designing specially targeted measures.

These arguments focus on the effects of partial schooldays on the economic aspects of the school system, and some external factors. Regarding the role of schools as a place of learning and cognitive preparation, proponents of this measure tend to cite a lack of good evidence about how this measure impacts achievement for students. They claim that performance differences between students of different shifts, or between those who attend full-day schooling and those who do not, can be explained by differences in their socio-economic status or other qualities of the schools they attend (Linden, 2001, Herrán and Rodríguez, 2000). Furthermore, they point to the wide differences between the time children spend in school and studying worldwide. For them, "what is important is time on task rather than hours of instruction -that is, learning time rather than time in the classroom spent on administrative matters, being disrupted by other pupils, and so on" (Linden, 2001, p. 5).

Critics of these measures, on their part, question the intended economic benefits of the measure, pointing out that although the same school infrastructure is used by more pupils, the expected savings on all other areas often end up being very small. Experiences in Hong Kong, Singapore, and Zimbabwe, for example, show that teachers for each shift are almost entirely different because teacher unions rarely accept the increase in workload that comes from taking on two shifts without substantial pay increases. Moreover, this increase in the demand for teachers is often found to create big disparities in the quality of professionals who chose to work at the different shifts, with teachers who take on the afternoon shifts being notably less well educated and having higher absenteeism rates (Bonilla 2011). Both of these things are true of the Colombian case.

Regarding the increase in coverage that double-shift schooling undoubtedly offers, critics of the measure point out that the benefits of having more school places notwithstanding, introducing partial day schooling can create disparities in the quality of the education certain children receive. As partial day schools tend to serve more disadvantaged children, have more limited resources, and employ less prepared teachers, the effects in the reduction of social inequalities that the broadening of the school system produces are thus somewhat offset by the differences. Thus, the achievement of the increases in coverage should not be overly celebrated, but rather followed with concrete policies dedicated to increasing the overall quality of schooling. As the Colombian case shows, these measures might even end up being more costly than what the investment in the expansion of full-day schooling could have been[1].

In what pertains to the academic performance of students in partial day schooling, opponents note that although lowering the opportunity costs of going to school (for example by offering children the chance to take up part-time employment simultaneously) increases the likelihood of children staying enrolled, children who work do worse in school than their peers who can fully dedicate to their studies. Here, again, the benefits of leveling the playing field by offering more families the chance to keep their kids in school

[1] In 2011, as part of a series of working papers on regional economy sponsored by the Colombian Central Bank, Leonardo Bonilla Mejía published a study contrasting the expected savings from the introduction of double shift schooling, with the actual expenditure in the education sector in Colombia. He concludes that, due to the imperfect implementation of this policy (in particular, the fact that not all schools that offer partial school days do in fact accommodate two shifts of students and due to the additional costs in teacher salaries), the additional costs of extending full-day schooling to every child in Colombia would be much smaller than some anticipate. It would also, in Bonilla's view, be well worth it if one considers the costs in human capital of having a less well educated population.

are somewhat offset by the disparities in circumstances under which different children study.

Regarding the argument about the relative importance of the 'time on task' versus the hours of instruction, although most authors agree that it is indeed the case, some draw very different conclusions from that with regards to partial day schooling. If time on task is what impacts academic performance the most, and given that children from disadvantaged backgrounds are less likely to have an appropriate setting to work on homework outside of school are also more likely to attend partial day schooling, then it is precisely for them that more time spent in school is important. Rather than proving that children can do without a couple of extra hours in school, somewhat longer school days might be the way to ensure that children have enough time on task to learn what they need to learn (Dobbie and Fryer 2011, Marcotte 2007). Guillermo Montt suggests that efforts to increase equality of opportunity should be understood as

> "a call for intense schooling that is independent of a child's social environment, such that greater intensity reduces inequalities that exist prior to children's entrance into primary schools, and which are reinforced by their out-of-school experiences. To the extent that this intensity is equally distributed, achievement inequality will be reduced. Features of intense schooling include the total amount of time dedicated to instruction, the overall quality of teachers, the overall class size of the schools, the overall resource quality, and public expenditure on education. An earlier entrance into the school system, a lengthier school year, and a lengthier school day are all signs of increased intensity of schooling because students have greater exposure to structured and homogeneous learning environments" (2011, p. 52).

### 2.3. Prior empirical evidence on double shift schooling: research in Colombia and other countries

As I mentioned before, studies about the effects on student's performance of more time in school in general, and partial versus full-day schooling in particular, are limited. Also, their results are very mixed and not always straightforwardly comparable. Nevertheless, some prior findings should be mentioned. Data from the Program for

International Student Assessment (PISA) scores has been used to show that time of instruction was positively correlated to test scores. Although this was the case "both in developed and developing countries […] the estimated effect for developing countries was much lower than the effect size in developed countries" (Hincapie, 2016, p. 4). Also, the effects of additional time in school were found to change depending on classroom environment (Hincapie, 2016).

In Argentina, attendance to full-day schooling was linked to significantly higher rates of graduation (21% more compared to peers in partial-day schooling). These effects were found to be strongest in students from disadvantaged backgrounds.

Also, the UNESCO International Institute for Education Planning compiled and compared various such international experiences with double shift schooling and offers a good overview of some other the results. In the case of Brazil, "holding all variables except day/night shift constant (e.g. socioeconomic status, teacher experience, educational inputs, etc.), night school students perform no differently than day school counterparts" (Bray, 2008, p. 54). However, there is a clear selection into partial-day schooling for students from lower socio-economic backgrounds and there is no evidence about how they compare to students attending full-day schooling.

Evidence from various regions in India, Niger, and Senegal show only a marginal advantage in the performance of students in full-day schooling. However, further research found that "double-shifts, despite the moderate effects in a single school year, penalize rather sensitively the learning of pupils over the long term" (Bray, 2008, p. 55).

Chile is one of the most studied cases for double-shift schooling because it implemented a partial-day schooling system for some years to reach the goal of having full coverage at the high school level, but then gradually extended the hours in those schools until all schools had full-length days. Various studies report that instituting the full-length school day had positive effects on various metrics, such as the reduction of teenage pregnancy, dropout rates, and arrests before the age of 25. It also had "positive impacts on academic results, especially among recipients of educational vouchers" (Bonilla, 2011, p. 4). This supports the idea that underprivileged students might be the ones who benefit the most from having a uniform, full-day schooling instituted.

In Colombia there are three studies that have assessed the effects of two shift schooling on test performance. In 2011 Leonardo Bonilla Mejía evaluated the effect of attending full-day schooling on the ICFES test (the equivalent at the time of Pruebas Saber 11). Bonilla finds that “attending single-shift schools has a positive impact on academic performance, particularly if compared to students attending the afternoon shift. It can then be stated that the double school day does not only generate inequality among those who have the opportunity to study in full-day schools, but also between those in the morning and those in the afternoon shifts.” (2011, p. 35). This study concentrates, however, not so much on the impact for students, but on the costs of the double shift schooling policy.

In 2013 Garcia, Fernandez, and Weiss conducted a study of the effects of full-day schooling on early dropout and grade repetition, and found the probability of both to decrease when students changed to full-day schooling. This study, however, does not offer insights into individual student’s performance beyond failing to be promoted to the next grade.

In 2016, Diana Hincapie used data from test scores in the $5^{th}$ and $9^{th}$ grade, aggregated by school, to assess the impact of full-day schooling on achievement. She finds that “that among schools that changed the length of the school day between 2002 and 2009, the cohorts exposed to full school days have test scores that are about one tenth of a standard deviation higher than cohorts that attended half school days” (p. 21). Hincapie finds a larger effect in math test scores than in language ones, which she posits might stem from schools playing “a larger role in teaching math relative to language, since language skills are often shaped by the home environment” (p. 22). She also finds that the effects are larger for students in the $9^{th}$ grade, than for those in $5^{th}$ grade. Hincapie suggests that this might be due to older students in full-day schools “spending less time exposed to risk factors outside of school, which ultimately translates into better academic achievement” (p. 22). For students who, by the time of the study, had spent longer in full-day schools, these results could also be explained by the aggregate effects over the years of having more instruction hours, but the study does not explore this possibility. Finally, Hincapie finds that the impacts of extending the school day are largest for the poorest schools and those in rural areas. To the best of my knowledge, since 2016 there has been no additional research on the effects of two-shift schooling in Colombia.

## 2.4. Country context

### 2.4.1. How it came to two-shift schooling in Colombia

Two-shift schooling was introduced in Colombia in 1965, with a decree that allowed high schools in the five biggest cities to run two parallel sections, one in the morning and the other in the afternoon. While students in full-day schooling would have seven hours of instruction per day, partial-day students would have between four and five. Decree 280 of 1966 extended this possibility to all schools in the country, at all levels (Bonilla 2011). This was a response to the concern about the very low levels of education for large sections of the population in Colombia, as well as the severe financial constrains for public investment in the sector. Just as an illustration, in the 1950's Colombians who lived in major cities had on average just a little over four years of schooling, and those in rural areas just over two years. By 1964 the literacy rate for people older than 15 years was just above 70% in Colombia, while in the United States it was above 98%[2] (Wasserman, 2021 and NCES, 1993).

Over the following decades, the double-shift policy coincided with more public attention devoted to the field of education worldwide, as well as with larger investments in public education in Colombia and an increase in access to schooling at all levels. This all led to undoubtedly positive outcomes in overall enrollment to school and average education levels. By the year 2000, the average years of school attended by people in urban areas was 8,3 years, and 4,4 for rural areas. The trend continued: in 2017 the average Colombian would have attended school for 9,7 years in urban areas and 6 years in rural areas (Wasserman 2021). While this still puts Colombia well below other countries in the region, the positive trend is clear. But the expectations towards what schooling has to deliver have also increased, and with issues of coverage of the school system increasingly resolved, attention turned towards the quality of the education imparted.

In 1994, the Colombian government tasked a small group of high-level intellectuals, politicians and policy makers -known as the Experts Mission- with drafting a comprehensive proposal of reforms in the field of education that would allow the country to face the challenges of the twenty-first century. With regards to two-shift

[2] As in Colombia, in the U.S. racial disparities impact literacy scores, so although by 1960 the average literacy rate was above 98%, it was only above 92% for non-whites (NCES 1993). This disparity is significant, but does not negate the comparison with Colombia.

schooling, the mission advised that all schools in Colombia become full-day schools, as a part of the much-needed efforts to improve the quality of education in Colombia. While policy makers agree to adopting this recommendation and legislation to that end is introduced in the following years, by 2002 remaining coverage gaps as well as budgetary issues make it so that partial-day schooling is accepted again. Ever since, efforts to extend and equalize the length of the school day have been slow at best, and in many cases are not even being planned for.

### 2.4.2. How does two-shift schooling look like at the moment

At the national level, in 2019, 10.161.081 students were matriculated in all grade levels in Colombia, which corresponds to a net enrolment rate of 85% (gross rate of 96%)[3] (SIMAT 2021). However, only 27, 9% of them attended a full-length school day. Almost half (47.5%) studied only in the morning and 18.2% only in the afternoon. A small part studied at night (2.8%) or on the weekend (3.7%). The distribution of schools in these different school day lengths is revealing about the underlying inequalities of the school system in Colombia. Public schools make up 81% of all schools but account for only 63% of schools that offer a full-length school day. Rural schools are also overrepresented among those offering part-time schooling. Also, beyond the rural-urban divide, full-day schooling is unevenly distributed across regions. Just as an illustration, while 46% of children enrolled in school in Bogotá attend a full-length school day, as well as 43% in the department of Caldas and 32% in Antioquia, in Guainía it is only 7%, 4% in Arauca and in Vaupés none of the almost 10.000 children of school age have access to full-day schooling.

As is to be expected, these disparities will also appear in the sample with which I conducted the analysis that follows, and I'll discuss some specifics below. One thing merits mention here. As noted by Bonilla (2011), across all sectors and areas there are many more students enrolled for the morning shift than the afternoon one. This is

[3] Enrolment rates can be confusing in Colombia, because both the net and the gross enrolment to school are calculated. Gross rates correspond to the proportion of all children who should be attending a certain grade level who are actually enrolled at that grade. Because some children will be enrolled at levels below or above what is expected given their age (for example children who have to repeat a year) this rate can go over 100 percent and is not always very informative. Net rates, on their part, measure enrollment only as a proportion of children of the appropriate age for each level and can thus never go beyond 100% (Wasserman 2021).

significant because as we noted before, one important argument in favor of part-time schooling is the possibility of using the same infrastructure to accommodate more children. This disparity in enrolment suggests, however, that many schools that offer a morning shift, don't actually offer an afternoon one. Policy recommendations following from the analysis of the impact of the partial school day on academic achievement should thus also acknowledge the limitations of transforming these austerity-inspired measures into actual savings for the state.

### 2.5. Theory and hypothesis

The available literature offers important insights into the impact of two-shift schooling on how students perform on standardized tests in Colombia. However, they do not include two important elements that my analysis strives to integrate. First, because data disaggregated at the student level was not available at the time, they offer results at the school or district level. While these are very valuable, they do not allow for explorations into the importance of individual level factors for test performance, such as family background, socioeconomic status, or gender. Second, they do not include any measures of school quality that might contribute to understanding the impact of this additional time in school. Rather, they mostly interpret the average performance of students as a measure of school quality, which I think is a flawed approach. Good schools might not be the ones with the best students, but rather those doing the most for the ones they have. Besides updating the results of the impact of full-day schooling on test performance, I hope to contribute to the literature in the two aspects just mentioned.

As such, my main hypothesis (H1) is that the lengthening of the school day will lead to better results in standardized testing. As supporting hypothesis, which the model refinement will help me test, I expect to find disparities in the effect of full-day schooling. I expect to find that rural and public schools will have larger effects than urban and private ones (H2). I also expect that a lower socioeconomic status, both at the individual as at the school level, will be correlated to a larger effect of the lengthening of the school day on test performance (H3). Finally, I also expect to find that differences in school quality impact the size of the effect of full-day schooling on test performance. I anticipate that schools with a higher quality measure will be better able to translate the additional instruction time into better results in standardized testing, and therefore the results of this analysis will be greater there (H4).

## 3. Data and Analytical Sample

### 3.1. Data

#### 3.1.1. Pruebas Saber

For this analysis, I will use data collected by the Colombian Institute for the Evaluation of Education (ICFES), the entity charged with administering all standardized testing in schools. Specifically, I used data from Pruebas Saber, a standardized test designed to test the performance of students and schools throughout the basic and secondary education cycles. In accordance with these cycles, tests are administered at grades 3º, 5º, 9º, and 11º. At different grades, they evaluate students across a range of subjects, but language and mathematics are evaluated at all stages. These tests are conducted yearly, on a census basis, for which all students of the pertinent grade level are tested. Additional testing is done on a sample basis, for which a nationally representative group of educational establishments, both official and private, as well as urban and rural, are chosen. I will also use data compiled by ICFES about the quality of schools in Colombia and gathered in the 'synthetic index of education quality' (ISCE, from its name in Spanish).

#### 3.1.2. Analytical sample

For this study, I used data from Pruebas Saber 9 from 2017 and Pruebas Saber 11 from 2019. The reason for this selection is that before 2017 disaggregated data at the student level was not available, which limited the possibilities of analysis to the school, district, or regional levels. From 2017 onwards a variable on individual identification for each student was added to the database, which made panel data analysis, and within individual comparisons possible. The initial sample consisted of 87.452 observations, but my study population is somewhat smaller. First, I excluded from my sample all observations that corresponded to students for whom I only had data for one of the two years considered. I also excluded incomplete cases, i.e., observations with missing values in any of the variables I was interested in. The final sample is a balanced panel, consisting of students who took Pruebas Saber 9 in 2017 and Pruebas Saber 11 in either the summer or winter term of 2019. It contains 32.581 persons and 65.162 person-years.

## 3.2. Description of variables and sample statistics. What do I know about the students in my sample?

### 3.2.1. Dependent variables

As dependent variables, I will use performance in mathematics and performance in language. This are ordinal variables, coded with values 1 to 4, with 1 - insufficient, 2 - minimum, 3 - satisfactory, and 4 - advanced. Although I also included a variable for the pooled results of both subjects and will report it, to be able to explore differences in the effects of length of instruction on different subjects I will mostly comment on each subject's results. As we will see later, these differences might point towards certain schools' priorities and how they spend additional instruction time and are overall indicative of the disparities in the effects of lengthening instruction time. Figures 1 and 2 show the proportion of students in each performance level in the language and mathematics tests for either full school days or partial school days.

Figure 1. Performance in language by length of school day

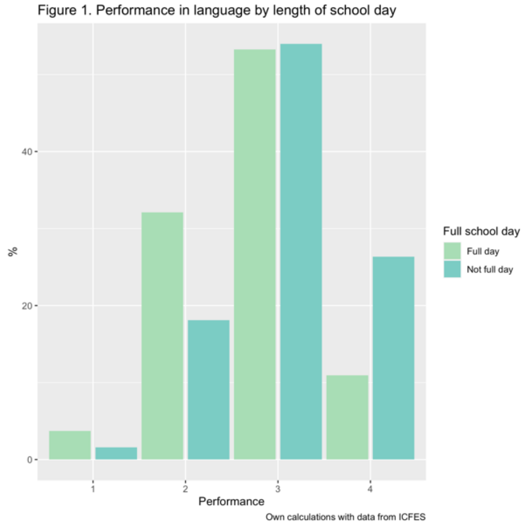
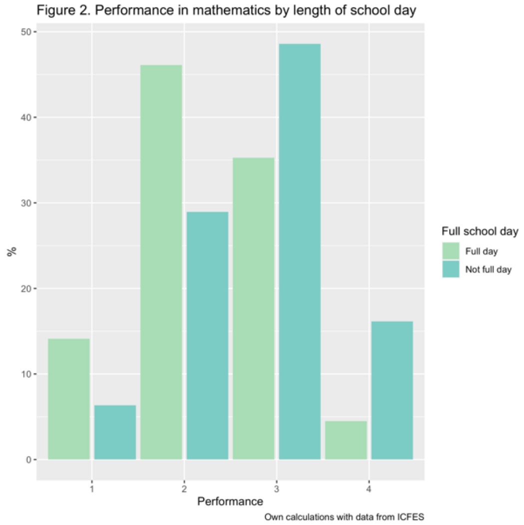



Figure 2. Performance in mathematics by length of school day




### 3.2.2. Independent variables

The independent variables included in the analysis fall into two categories. A first set corresponds to school-level characteristics, that should help account for differences in the types of institutions children in the data study at. A second set corresponds to individual-level characteristics, that account for some traits of each individual's life circumstances. Although the list of variables I included is clearly not exhaustive of all elements that affect student performance and my choices were partly limited by the availability of data, I believe it does offer a first look at the elements that the question of the length of the school day should take into account. Below, I will offer specific motivations based on the literature for including these variables.

Table 1 shows sample statistics for both sets of independent variables included in the analysis. In Appendix 1 I also include figures about the distribution of each variable among the different school day lengths, to offer an initial characterization of the schools and children I will be conducting the subsequent analysis on.

Table 1. Sample statistics for main independent variables

| | | | | | (N=65162) |
|---|---|---|---|---|---|
| School level variables | **Full School day** | | Individual level variables | **Gender** | |
| | 0 - Non full day | 49940 (76.6%) | | 0 - Boy | 29297 (45.0%) |
| | 1 - Full day | 15222 (23.4%) | | 1 - Girl | 35865 (55.0%) |
| | **School sector** | | | **Student SES** | |
| | 0 - Private | 15751 (24.2%) | | 1 | 5804 (8.9%) |
| | 1 - Public | 49411 (75.8%) | | 2 | 25161 (38.6%) |
| | **School area** | | | 3 | 26595 (40.8%) |
| | 0 - Rural | 5645 (8.7%) | | 4 | 7602 (11.7%) |
| | 1 - Urban | 59517 (91.3%) | | **Education of the Mother** | |
| | **School SES** | | | Some primary | 3073 (4.7%) |
| | 1 | 763 (1.2%) | | Full primary | 7556 (11.6%) |
| | 2 | 21919 (33.6%) | | Some secondary | 4812 (7.4%) |
| | 3 | 35060 (53.8%) | | Full secondary | 25363 (38.9%) |
| | 4 | 7420 (11.4%) | | Some technical | 1331 (2.0%) |
| | 5 | 0 (0%) | | Full technical | 9457 (14.5%) |
| | **School Quality** | | | Some professional | 969 (1.5%) |
| | Low | 18398 (28.2%) | | Full professional | 7560 (11.6%) |
| | Medium | 25665 (39.4%) | | Masters or more | 5041 (7.7%) |
| | High | 21099 (32.4%) | | **Education of the Father** | |
| | | | | Some primary | 4562 (7.0%) |
| | | | | Full primary | 9271 (14.2%) |
| | | | | Some secondary | 5230 (8.0%) |
| | | | | Full secondary | 24871 (38.2%) |
| | | | | Some technical | 1015 (1.6%) |
| | | | | Full technical | 7877 (12.1%) |
| | | | | Some professional | 914 (1.4%) |
| | | | | Full professional | 6588 (10.1%) |
| | | | | Masters or more | 4834 (7.4%) |

Own calculations with data from ICFES

As can be seen there, over 76% of observations correspond to children who do not have full school days. Following models will be done with this binary variable, but Table 2 offers more detail into the distribution of different types of school days. Data in my sample follow a similar pattern as the national picture, with a few minor differences. As for the complete population of students in Colombia, over half of the students in my sample attend school only in the morning (53.8% at the national level) and 22.7% only in the afternoon (20.6% at the national level). A much smaller fraction of students in my sample goes to school only on weekends or at night (0.4% and 0.2% respectively) compared to the national level (3.1% and 4.2% respectively). This is likely due to the fact that these students attending night or weekend schooling are less likely to participate in testing.

Table 2. Proportion of students by length of school day

| | (N=65162) |
|---|---|
| **Length of school day** | |
| Afternoon | 14802 (22.7%) |
| Full Day | 15222 (23.4%) |
| Morning | 34747 (53.3%) |
| Night | 275 (0.4%) |
| Saturday | 116 (0.2%) |

Own calculations with data from ICFES

#### 3.2.2.1. School-level variables

As a first school-level characteristic, I included a variable that accounts for the sector the school belongs to (coded 1 for public schools and 0 for private ones). In Colombia, private schools account for 19% of students enrolled at all grade levels. In my sample they are just over 24% but account for 57% of observations for full-day schooling. Public schools are overrepresented in all other types of schools, making up the vast majority of night schools (96%), afternoon schools (91%), morning (84%), and weekend schools (81%).

The school area variable is coded 1 for urban schools and 0 for rural ones. At the national level, 76% of schools are located in urban areas. In my sample, however, they represent over 91% of all observations. As with students attending night or weekend schooling, this disparity might be explained by the limited willingness and ability to participate in standardized testing of schools in remote areas. Within my sample, rural schools are slightly overrepresented in morning schools, and overrepresented in weekend schooling, while urban schools are overrepresented among schools offering full-length school days and afternoon schooling.

I also included a variable indicative of the socioeconomic status (SES) of schools. This measure, calculated by ICFES as an index, corresponds to the average socioeconomic status of students in that specific school and is coded 1 to 5, with 1 corresponding to the lowest socioeconomic level and 5 to the highest. It takes into account elements of human, social and material capital. My final sample contains no observations with a school-SES of 5. As was to be expected, upper-middle-class schools (SES of 4) are overrepresented among the full-length schools, making up just over 11% of the sample, but more than 34% of the full-day observations.

Finally, with help of the ISCE dataset, I included a variable that offers a measure of quality for each school. This index, compiled by ICFES, takes four components into account: progress (a measure of students in each school at the lowest and highest performance levels in standardized tests), performance (average performance of students in standardized tests), efficiency (rate of students who approve the requirements to be promoted to the next grade), and school environment (calculated based on questions about the classroom environment and tracking of learning processes) (ICFES 2016). In addition to providing a multifaceted and comparable measure of school quality for all schools in Colombia, the ISCE reports include a minimum improvement goal (MMMA from its name in Spanish) for each institution, that contributes to the school administrations' capacities to build improvement plans. The measure reported by ICFES gives each school a numeric ISCE tan ranges between 0 (lowest) and 10 (highest). For this analysis, I converted this variable into three categories: low, medium, and high quality.[4]

28,23% of schools in the sample fall in the low-quality category, 39,39% are of medium quality, and 32,38% of high quality. As could be expected, high-quality schools are grossly overrepresented in full-day schooling. Both medium and low-quality schools are underrepresented in that category. The biggest portion of schools in these quality levels are morning schools, making up 63% of all low-quality schools, and 58% of all medium-quality ones.

[4] ICFES offers no substantial interpretation of the values of ISCE, as the measure is not intended to reflect the fulfillment of specific requirements, but rather the position of a concrete school in the Colombian context. Therefore, to establish the three categories I will use in this analysis, the cuts were calculated by dividing the full range of values in my sample (between 2.6 and 8.8) into three. The full detail is available in the as part of my code here: https://github.com/isabeldebrigard/Thesis.git.

#### 3.2.2.2. Individual-level variables

At the individual level, I included a variable for the gender of the student, which includes female or male as possible answers. Girls make up over 55% of my sample, but only 52.6% of full-day students. Boys, on their part, are overrepresented in night and weekend schooling, which could be indicative of them being more likely to be employed during the week.

I also included a variable for the individual student's socioeconomic status, coded 1 (lowest) to 4 (highest). This variable corresponds to an index developed by ICFES, based on questions about the living conditions of students, as well as parental occupation and level of education. Typically, a student with an SES of 1 will have no computer, access to the internet, television, or books at home. They will live in a house without basic appliances, their parents will most likely have little formal education (particularly mothers of these children tend to only have finished primary education), and access to highly nutritious food is limited. At the SES 2 level, most families have acquired a television, but many still have no access to the internet or a computer. These mothers have typically completed high school, but fathers mostly only primary education. At the SES 3 level, you start to see some access to higher education for the parents, and fathers are more likely to own small businesses than work in manual labor. These children report eating highly nutritious meals on a daily basis. Finally, at the SES 4 level families will typically have a computer with internet access at home, as well as a car. Parents will mostly have some graduate degree and some even postgraduate education. (ICFES 2016) At all levels, the education of the parents is a strong predictor of the socio-economic level of the student. As was to be expected from that correlation and the cycles that perpetuate class roles, students with higher socioeconomic status are overrepresented in full-day schooling. Conversely, students at the lower end of the distribution are overrepresented amongst morning and afternoon schooling, and more so in night and weekend schools.

Variables for the education levels of both parents were also included, ranging from some primary education to a completed masters degree or more. On average, mothers are slightly more educated than fathers. As was to be expected, in general, as one increases the education level parents, children are more likely to be in full-day schooling. Children of parents with technical education and above are overrepresented in full-day schooling while children of parents with just some primary education are heavily overrepresented in night and weekend schools.

### 3.3. Method and research strategy

To get an initial sense of how additional time in school might impact test performance I will conduct two OLS regressions: a naïve model and one with controls. Because these results are likely to suffer from some omitted variable bias, and to take advantage of the within-individual comparisons that panel data allows for, I will then use a fixed-effects model. These will be the most reliable results and the ones my analysis will focus on. Finally, to study effect heterogeneity and as set of robustness tests for the results of the fixed effects model, I will run fixed-effects models on subgroups of the sample according to some time-constant traits.

As the main results will be those of the fixed effects models, it is important to mention which observations will be driving those results. From the complete sample, the observations that drive the results of that model are the ones that correspond to students who changed from partial to full-day schooling. More will be said in the presentation of the results of the model about what characterizes this group of children and how representative they are of the full sample. Suffice it here to say that they make up 13% of all observations sample, which corresponds to 4292 children and twice as many observations. This is both a sufficiently relevant portion of the complete sample, as a large enough amount of observations to have the desired statistical power.

## 4. Results and discussion

### 4.1. Model results

#### 4.1.1. Naïve OLS

In a first step, I estimated a naïve model for the effect of a full or partial day of schooling on test results. Models 1 to 3, reported in Table 3, show results for the language test (Model 1), for the mathematics tests (Model 2), and for the pooled results (Model 3). All models suggest a positive impact on test scores of having a full day of school. This effect is slightly larger for the mathematics scores, where a full-length school day improves test scores by 0.4 points, while language scores improve only by 0.3 points. All estimators in this model are significant at a 0.01 level but are likely to be biased on account of the omission of key variables. R2 values range from 0.039 to 0.061, and as such, it is clear that these models fail to capture a large portion of the variation of my variable of interest.

**Table 3. OLS - Effects of full schoool days on test scores (naïve estimators)**

| | *Dependent variable:* | | |
|---|---|---|---|
| | Test scores<br>Mathematics<br>(1) | Test scores<br>Language<br>(2) | Test scores<br>Pooled performance<br>(3) |
| Full-day schooling | $0.444^{***}$ | $0.336^{***}$ | $0.780^{***}$ |
| | (0.007) | (0.007) | (0.012) |
| Constant | $2.301^{***}$ | $2.715^{***}$ | $5.016^{***}$ |
| | (0.003) | (0.003) | (0.006) |
| Observations | 65,162 | 65,162 | 65,162 |
| $R^2$ | 0.056 | 0.039 | 0.061 |
| Adjusted $R^2$ | 0.056 | 0.039 | 0.061 |
| Residual Std. Error (df = 65160) | 0.772 | 0.706 | 1.293 |
| F Statistic (df = 1; 65160) | $3,856.487^{***}$ | $2,643.050^{***}$ | $4,245.598^{***}$ |

*Note:* $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01
Beta coefficients and standard errors (in parenthesis). Reference category is Non full-day schooling.

### 4.1.2. OLS with controls

To refine these models, Table 4 includes results for OLS regressions with controls corresponding to characteristics of the school (school sector, average socioeconomic status of students, school area, and quality) and of students (gender, socioeconomic status, and education level of each parent). Model 4 corresponds to the effects of a full-length day on the mathematics test, Model 5 on the language test, and Model 6 on the pooled test results. As was to be expected, there is a substantial drop in the estimators of the effect of the length of the school day on test scores compared to the ones in Models 1-3. Holding the mentioned school and individual characteristics constant, having a full-length school day increases the mathematics scores by 0.132 points, compared to children who attend only partial school days. This is more than twice the effect full-day schooling has on language scores (0.062). Both results are significant at the 0.01 level. These disparities between the language and mathematics scores will appear throughout the models and will be commented on further in the discussion section.

Compared to those attending private schools, children in public schools perform better in the mathematics test. The results for the language test are negative, very small, and not statistically significant.

Estimators for all socioeconomic status levels of the school are positive and significant, for tests in both subjects considered. Children in schools with higher average socioeconomic status perform better than their counterparts in more disadvantaged contexts. In all socio-economic levels, the results indicate larger effects in the language tests, compared to the mathematics test.

The location of the school in an urban area also has a positive and significant effect on test results, compared to observations that correspond to children in rural schools. The effect is slightly bigger for the language scores. Coefficients for the different levels of school quality indicate a significant and positive effect on test scores of increases in school quality. These effects are consistently greater for the mathematics scores.

On the controls that correspond to individual characteristics of students, girls perform worse than boys in the mathematics test, with a significant coefficient of -0.176. The coefficient or the language score is also negative, but not significant and very small. Socio-economic status at the individual level has comparable effects as at the school level: more affluent children perform better than their less wealthy counterparts. All of these coefficients are significant and markedly bigger for the mathematics tests than for the language ones.

Regarding the variables that account for the level of parental education, the results are very surprising. In Model 4, mathematics scores of children with mothers who have completed primary, secondary, technical, professional, and master's degrees decrease compared to the reference category of having no education. Coefficients are positive, although not always statistically significant at the 0.01 level, for all non-completed education levels. For the language scores considered in Model 5, all education levels after primary education have a positive coefficient and most of them are significant at the 0.01 level.

In the case of the education of the fathers, all coefficient for the mathematics scores are negative and most of them are significant at the 0.01 level. All statistically significant coefficients for the language scores show improvements in the test scores of children with parents more educated than the base category.

Including these controls in these models has increased the R2 considerably compared to the naïve model, with values now ranging from 0.26 to 0.18. However, we are still failing to capture a major portion of the variation of our outcome variable.

**Table 4. OLS - Effects of full schoool days on test scores with controls**

| | *Dependent variable:* | | |
|---|---|---|---|
| | Test scores Mathematics | Test scores Language | Test scores Pooled performance |
| | (1) | (2) | (3) |
| Full-day school | 0.129*** | 0.060*** | 0.189*** |
| | (0.007) | (0.007) | (0.012) |
| Public school | 0.028*** | -0.016** | 0.012 |
| | (0.009) | (0.008) | (0.015) |
| Urban school | 0.110*** | 0.127*** | 0.236*** |
| | (0.011) | (0.010) | (0.018) |
| School - SES 2 | 0.113*** | 0.178*** | 0.291*** |
| | (0.027) | (0.025) | (0.045) |
| School - SES 3 | 0.212*** | 0.320*** | 0.533*** |
| | (0.028) | (0.026) | (0.046) |
| School - SES 4 | 0.360*** | 0.453*** | 0.813*** |
| | (0.031) | (0.029) | (0.051) |
| Medium quality school | 0.085*** | 0.075*** | 0.160*** |
| | (0.007) | (0.007) | (0.012) |
| High quality school | 0.388*** | 0.313*** | 0.701*** |
| | (0.009) | (0.008) | (0.014) |
| Girl | -0.175*** | -0.005 | -0.180*** |
| | (0.006) | (0.005) | (0.009) |
| Student - SES 2 | 0.124*** | 0.083*** | 0.207*** |
| | (0.011) | (0.010) | (0.018) |
| Student - SES 3 | 0.350*** | 0.167*** | 0.517*** |
| | (0.012) | (0.011) | (0.020) |
| Student - SES 4 | 0.650*** | 0.309*** | 0.959*** |
| | (0.017) | (0.016) | (0.028) |
| Mother - full primary education | -0.181*** | -0.011 | -0.192*** |
| | (0.016) | (0.015) | (0.027) |
| Mother - some secondary education | 0.033** | 0.037** | 0.070** |
| | (0.017) | (0.016) | (0.028) |
| Mother - full secondary education | -0.164*** | 0.021 | -0.143*** |
| | (0.015) | (0.014) | (0.024) |
| Mother - some technical education | 0.049** | 0.100*** | 0.150*** |
| | (0.024) | (0.023) | (0.040) |
| Mother - full technical education | -0.096*** | 0.113*** | 0.017 |
| | (0.016) | (0.015) | (0.027) |
| Mother - some professional education | 0.101*** | 0.195*** | 0.296*** |
| | (0.027) | (0.025) | (0.045) |

| | | | |
|---|---|---|---|
| Mother - full professional education | -0.153*** | 0.065*** | -0.088*** |
| | (0.017) | (0.016) | (0.029) |
| Mother - masters or more | -0.271*** | 0.035* | -0.236*** |
| | (0.019) | (0.018) | (0.032) |
| Father - full primary education | -0.256*** | -0.010 | -0.266*** |
| | (0.014) | (0.013) | (0.023) |
| Father - some secondary education | -0.025* | 0.012 | -0.013 |
| | (0.015) | (0.014) | (0.024) |
| Father - full secondary education | -0.277*** | -0.010 | -0.287*** |
| | (0.012) | (0.012) | (0.021) |
| Father - some technical education | -0.019 | 0.095*** | 0.076* |
| | (0.025) | (0.024) | (0.042) |
| Father - full technical education | -0.230*** | 0.072*** | -0.159*** |
| | (0.014) | (0.014) | (0.024) |
| Father - some professional education | -0.021 | 0.113*** | 0.093** |
| | (0.026) | (0.025) | (0.044) |
| Father - full professional education | -0.237*** | 0.048*** | -0.189*** |
| | (0.016) | (0.015) | (0.026) |
| Father - masters or more | -0.346*** | 0.047*** | -0.298*** |
| | (0.018) | (0.017) | (0.030) |
| Constant | 2.086*** | 2.071*** | 4.157*** |
| | (0.030) | (0.028) | (0.050) |
| Observations | 65,162 | 65,162 | 65,162 |
| $R^2$ | 0.240 | 0.180 | 0.257 |
| Adjusted $R^2$ | 0.240 | 0.180 | 0.256 |
| Residual Std. Error (df = 65133) | 0.693 | 0.652 | 1.151 |
| F Statistic (df = 28; 65133) | 733.982*** | 512.284*** | 802.956*** |

*Note:* *p**p***p<0.01

Beta coefficients and standard errors (in parenthesis). Reference categories are Non-full day school, Private school, Rural School, School - SES 1, Low quality school, Boy, Student - SES 1, Mother - some primary education, Father - some primary education.

**Table 5. OLS - Effects of full school days on test scores with controls and interaction of school day length and quality**

| | *Dependent variable:* | | |
|---|---|---|---|
| | Test scores Mathematics | Test scores Language | Test scores Pooled performance |
| Non-full day school - Low quality school | -0.562*** | -0.395*** | -0.958*** |
| | (0.012) | (0.011) | (0.020) |
| Full day school - Low quality school | -0.502*** | -0.345*** | -0.846*** |
| | (0.016) | (0.015) | (0.027) |
| Non-full day school - Medium quality school | -0.481*** | -0.316*** | -0.797*** |
| | (0.011) | (0.010) | (0.018) |
| Full day school - Medium quality school | -0.427*** | -0.307*** | -0.734*** |
| | (0.016) | (0.015) | (0.027) |
| Non-full day school - High quality school | -0.210*** | -0.094*** | -0.304*** |
| | (0.011) | (0.010) | (0.018) |
| Full day school - High quality school | | | |
| Constant | 2.649*** | 2.463*** | 5.112*** |
| | (0.031) | (0.029) | (0.051) |
| Observations | 65,162 | 65,162 | 65,162 |
| $R^2$ | 0.241 | 0.181 | 0.258 |
| Adjusted $R^2$ | 0.241 | 0.180 | 0.257 |
| Residual Std. Error (df = 65131) | 0.692 | 0.652 | 1.150 |
| F Statistic (df = 30; 65131) | 689.973*** | 479.229*** | 753.195*** |
| *Note:* | *p**p***p<0.01 | | |

Only the coefficients for the interaction are shown. Beta coefficients and standard errors (in parenthesis). Reference categories are Private school, Rural School, School - SES 1, Boy, Student - SES 1, Mother - some primary education, Father - some primary education.

### 4.1.3. OLS: quality and length of school day interaction

As a final refinement of the OLS models, Table 5 shows results with a model with an interaction between the length of the school day and the school quality variables. The reasoning behind this is simple: school quality might be a factor in how much the length of the school day affects students' achievement. The results, however, are somewhat unexpected. Predictably, children in schools of higher quality perform better than their counterparts in medium and low-quality schools, both when they are offered full-length and partial school days. Coefficients here range from -0.6 to -0.2 in the mathematics scores, and between -0.4 and -0.1 in the language scores. All of them are significant at the $p < 0.01$ level.

However, the difference between the interaction coefficients of school day length and school quality is larger for low-quality schools (-1.074 for partial school days and -0.808 for full school days in the pooled tests results), than for medium quality schools (-0.843 for partial school days and -0.791 for full school days in the pooled tests results). I interpret this to mean that the difference more time in school makes in the student's test performance is greater for low-quality schools, than for schools rated of medium quality. This is true both for the mathematics and the language tests, despite the fact that Models 7 and 8 again show a disparity between the effects of additional school time between subjects, with effects being consistently larger for the mathematics scores.

#### 4.1.4. Fixed effects

As noted above, a substantial part of the variation of our variable of interest seems to be coming from variables we were not able to include and have not controlled for. With a fixed-effects model, however, we can account for time constant heterogeneity and get estimations for the effect of the length of the school day within each individual. As was mentioned in the section about the method of analysis, these results are driven by the observations that correspond to children who changed from a school that offered partial school days to one that has a full-length school day in the time covered by our sample. There are 4292 such observations, which amounts to 13.17% of the full sample.

Before presenting the results for the fixed effects models, Table 6 offers comprehensive descriptive statistics of the sub-sample of these *changers*. For the most part, the composition of this sub-sample is similar to the one of the full sample. That is to say, no strong patterns appear here that suggest that *changers* are systematically different from children who had the same length of school days throughout the considered period. A few minor differences are worth pointing out, nonetheless. Amongst children who went from a partial to a full-length school day, a somewhat larger proportion of them attend public schools and rural schools than in the full sample. It is interesting to note that children attending schools at both ends of the quality spectrum represent a larger proportion of those who changed from partial to full-day schooling. Conversely, they are a smaller proportion of the students in medium quality schools.

Having said that and given that the sub-sample of children who are driving the fixed effects models is both large enough to have statistical value and to be a considerable portion of the full sample, the fixed effects models that I present below are the most credible, i.e., less likely to be affected by omitted variable bias.

Table 6. Sample statistics for observations of children who changed from partial to full day schooling

| | | | | | (N=8584) |
|---|---|---|---|---|---|
| School level variables | **School sector** | | Individual level variables | **Gender** | |
| | 0 - Private | 1338 (15.6%) | | 0 - Boy | 3665 (42.7%) |
| | 1 - Public | 7246 (84.4%) | | 1 - Girl | 4919 (57.3%) |
| | **School area** | | | **Student SES** | |
| | 0 - Rural | 1302 (15.2%) | | 1 | 618 (7.2%) |
| | 1 - Urban | 7282 (84.8%) | | 2 | 3226 (37.6%) |
| | **School SES** | | | 3 | 3903 (45.5%) |
| | 1 | 97 (1.1%) | | 4 | 837 (9.8%) |
| | 2 | 2680 (31.2%) | | **Education of the Mother** | |
| | 3 | 5211 (60.7%) | | Some primary | 350 (4.1%) |
| | 4 | 596 (6.9%) | | Full primary | 850 (9.9%) |
| | 5 | 0 (0%) | | Some secondary | 608 (7.1%) |
| | **School Quality** | | | Full secondary | 3424 (39.9%) |
| | Low | 2748 (32.0%) | | Some technical | 201 (2.3%) |
| | Medium | 1995 (23.2%) | | Full technical | 1423 (16.6%) |
| | High | 3841 (44.7%) | | Some professional | 133 (1.5%) |
| | | | | Full professional | 1037 (12.1%) |
| | | | | Masters or more | 558 (6.5%) |
| | | | | **Education of the Father** | |
| | | | | Some primary | 565 (6.6%) |
| | | | | Full primary | 1148 (13.4%) |
| | | | | Some secondary | 675 (7.9%) |
| | | | | Full secondary | 3426 (39.9%) |
| | | | | Some technical | 131 (1.5%) |
| | | | | Full technical | 1138 (13.3%) |
| | | | | Some professional | 126 (1.5%) |
| | | | | Full professional | 832 (9.7%) |
| | | | | Masters or more | 543 (6.3%) |

Own calculations with data from ICFES

Table 7 shows the results for a standard fixed effects model without any controls. All coefficients of this model are significant at a $p < 0.01$ level and show a positive effect of 0.36 points in the mathematics tests of children attending a full-length school day, and one of 0.06 points for the language tests. Rather surprisingly -because coefficients for fixed-effects models tend to be smaller than the ones for OLS regressions on the same data- these coefficients are larger than the ones reported in Tables 1 and 2, but they follow the same trends: there is a positive effect on having longer instruction time in both the mathematics and language tests, and this effect is larger in the former. In this model, however, the difference between the effects on the two subjects' tests is much larger than in the previous ones. It must be noted that this model does not control for shocks that affected all or most units across the examined period.

**Table 7. FE - Effects of a full day of schooling on test scores (without controls)**

| | *Dependent variable:* | | |
|---|---|---|---|
| | Test scores Mathematics | Test scores Language | Test scores Pooled |
| Full-day schooling | 0.355*** | 0.059*** | 0.414*** |
| | (0.013) | (0.010) | (0.018) |
| Observations | 65,162 | 65,162 | 65,162 |
| $R^2$ | 0.021 | 0.001 | 0.016 |
| Adjusted $R^2$ | -0.958 | -0.998 | -0.968 |
| F Statistic (df = 1; 32580) | 696.421*** | 36.103*** | 533.316*** |
| *Note:* | *p<0.1; **p<0.05; ***p<0.01 | | |
| | Beta coefficients and standard errors (in parenthesis). Reference category is Non full-day schooling. | | |

This model has the lowest R2 values so far and they again vary significantly between both subjects. These values suggest that despite the panel data set up and the possibility it offers us of automatically controlling for all variation between individuals, we are failing to capture the variation of our variable of interest. To better understand the data at hand, I ran additional models as follows. First, I ran a fixed-effects model controlling for the 'wave' variable, which stands for the time periods observations were gathered. As there are only two-time observations, this model is equivalent to a first difference model[5], which allows us to control for all common time shocks. The coefficients here correspond, thus, to changes exclusively within units. As can be seen in Table 8, in this set-up the wave dummy has a large effect, which implies that there was a

[5] Appendix 3 shows the results for a first difference model for comparison. As can be seen there, the coefficients are the same as for the fixed effects model that controls for the wave variable. The first difference model, however, drops half the observations in the sample and has an R2 of 0.

common increase in the dependent variable value across observations in the period examined. The coefficients for the full day variable here are not statistically significant, very small, and even negative for the language test. This indicates that the variation in test scores that cannot be attributed to a common shock, the changes exclusively within units, is minimal. Given that the data offers observations only for two years, this is not very surprising. Changes in school performance do not happen overnight and individual children are likely to perform similarly to how they were performing in previous years. The effects the lengthening of the school day was intended to have are more likely to show up over time and as an aggregate effect, than as a jump in individual performance. The discussion in the following section will therefore rest primarily on the initial fixed effects model.

**Table 8. FE - Effects of a full day of schooling on test scores (controlling for wave)**

| | *Dependent variable:* | | |
|---|---|---|---|
| | Test scores Mathematics | Test scores Language | Test scores Pooled |
| Full-day school | 0.001 | -0.011 | -0.010 |
| | (0.011) | (0.010) | (0.015) |
| Second Wave | $0.570^{***}$ | $0.113^{***}$ | $0.684^{***}$ |
| | (0.004) | (0.004) | (0.005) |
| Observations | 65,162 | 65,162 | 65,162 |
| $R^2$ | 0.411 | 0.031 | 0.333 |
| Adjusted $R^2$ | -0.178 | -0.939 | -0.334 |
| F Statistic (df = 2; 32579) | $11,358.000^{***}$ | $514.872^{***}$ | $8,140.250^{***}$ |

*Note:* $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$
Beta coefficients and standard errors (in parenthesis). Reference categories are Non full-day school and First wave.

### 4.1.5. Effect heterogeneity in fixed effects models as robustness tests

Then I ran a series of additional models that were intended to capture effect heterogeneity amongst groups with common time constant characteristics that the fixed effects models are unable to capture. As these variables are time constant including them as controls in the model was not possible. They are intended as robustness checks for the results presented before and largely confirm the previous findings. I ran models for groups restricted by school area, sector, quality level, and average socio-economic level of its students, as well as for the individual socio-economic level of each student. The full results can be found in Appendix 4, but general tendencies are as follows.

The discrepancy between subjects we have already noted appears for all subgroups examined. Additional instruction time has larger effects on the mathematics tests than the language ones.

Having the additional instruction time that a full-length school day offers makes a bigger difference in rural schools than in urban ones. The data and scope of this paper do not allow for further investigation here, but this difference could stem from the lower availability of opportunities to study and continue the learning process outside the classroom in rural areas. If access to an adequate environment to do homework is limited, for example by lower availability of public libraries, time spent in school might make a bigger difference in educational attainment than it does for students who can continue learning outside the classroom. The same logic could be applied to explain why the lengthening of the school day has a bigger impact on schools and students with lower socioeconomic levels, which the data also shows. Additional time in school makes the most difference in the cases where resources outside the classroom are more limited. The reversal that argument of that argument would explain why these additional instruction hours make a bigger difference for private schools -typically better funded and with access to more resources-, than for public ones.

The models for sub-groups divided by the three quality levels my data accounts for are somewhat surprising. The disparities of the effects of having a full school day on the two different subjects persist, but in both cases, additional instruction time makes a bigger difference in the lowest and highest quality scores and is reduced in schools of medium quality.

## 4.2. Discussion: what these results tell us about full-day schooling

### 4.2.1. Two remarks about effect interpretation

Before diving into a deeper discussion of the main findings of my models, two small remarks about these results and how to interpret them are in order. As was mentioned above, the dependent variables I use across all models are ordinal and have four categories. Although there is no strict mathematical reason for it, convention dictates that ordinal data be treated as continuous only if the variable has five categories or more (see for example Rhemtulla et al., 2012). In order to validate my results, I ran both a naïve regression and one with all controls as an ordered probit model. Detailed results for both of them can be found in the Appendix 2. Results for the ordered probit models are all consistent with what I find taking my dependent variables as continuous, i.e., they follow the same patterns and have the same levels of significance. However, the effects for the ordered probit are all unvaryingly bigger than the ones of the linear regressions. I chose to focus on the linear regression results for two reasons. First, they seem more distinctly comparable to the results in the fixed effects models, which given the panel data setting I had the opportunity of using are likely to be the less biased ones and constitute my main focus. Second, interpreting effect sizes is not always straightforward. As Matthew Kraft notes, "this is particularly true in fields such as education where common outcomes like academic achievement are measured using arbitrary scales" (2019, p. 2). In that sense, I prefer to base my analysis on the trends that appear in the results and the comparisons between coefficients, rather than strict interpretations of them. Hence, if preferred, the coefficients from the ordered probit models would only support a more extreme version of the same conclusions I draw from the linear regressions.

That being said, the question about what constitutes a big or small effect is still consequential. Various approaches are used across disciplines to gauge and communicate the magnitude of effects revealed by statistical analysis. Often researchers will "convert unintuitive and disparate measures onto the same scale using a simple statistic: the standardized effect size" (Kraft, 2019, p. 2) and combine this with a set of benchmarks against which results are compared. In research about education outcomes, the benchmarks proposed by Jacob Cohen are a common reference. However, "recent meta-analyses of well-designed field experiments find that education interventions often result in no effects or effects that would be characterized as small by Cohen's standards" (Kraft, 2019, p. 2), but that under more careful consideration are both substantial and bigger than other interventions available. On the basis of the distribution of 1942 effect sizes from 747 randomized controlled trials that evaluate interventions in the field of education, specifically concerning standardized test outcomes, Kraft proposes new benchmarks to evaluate effect sizes: less than 0.05 standard deviations is a small effect, 0.05 to less than 0.20 standard deviations is a medium one, and 0.20 standard deviations or greater is a large one (2019, p. 20). Kraft offers the following illustration of what these benchmarks might translate into, for anyone skeptical of calling an effect of 0.20 standard deviations large:

> "by 5th grade, student achievement improves about 0.40 SD or less over the course of an academic year (Bloom et al., 2008), and schools only account for around 40 percent of these achievement gains (Konstantopolus

& Hedges, 2008; Chingos, Whitehurst, & Gallaher, 2015; Luyten, Merrell & Tymms, 2017). Formal schooling, our society's defining education intervention, is delivered over more than 1,000 hours a year, costs over $10,000 per student, and barely qualifies as producing large effects in middle and high school. Additionally, consider this: raising student achievement by 0.20 SD results in a 2 percent increase in annual lifetime earnings on average (Chetty, Friedman, & Rockoff, 2014)" (2019, p. 21).

As I said before, my analysis of the results will be based on the general trends in the coefficients and comparisons between them, but Kraft's benchmarks are useful as a reference. For my sample, one standard deviation of performance in the mathematics test corresponds to 0.79 points, and to 0.72 for the language test. As such, all the results of my analysis fall either under medium or large effects according to Kraft's standards.

#### 4.2.2. The somewhat predictable

First, a couple of words about the results that confirm what previous literature (or some educated guesses) might have anticipated. Somewhat unsurprisingly, across all models, more instruction time led to better test scores in pooled outcomes for mathematics and languages. Although somewhat unclimactic, it is nonetheless reassuring to see that the school system is making some difference in the ability of students to answer academically designed questions in an academic setting. While this does not tell us if these children are learning what they are learning by virtue of the pedagogical talents of their teachers, or by interacting with their peers, or simply because they are not getting recruited by armed groups, it is still an indication that schools should be appreciated and supported. Also, this is a first confirmation of my main hypothesis.

Another outcome that was foreseeable, at least to some extent, and that this data confirms is that there are considerable differences in the effects a longer school day has, depending on what type of school and which students one is referring to. As results for all models show, an increase in the time children get to spend in school has bigger effects for rural and public schools, compared to urban and private ones. It also makes a bigger difference in schools with a lower average socioeconomic status, and for individual students of less advantaged backgrounds. This confirms my first two supporting hypothesis.

The key finding in this regard is that more time of instruction makes more of a difference wherever other resources are more limited. If the chances a child has of devoting time to reading or homework are limited to the time they spend in school, and if their living conditions make it less likely for them to engage in after school activities that might contribute to their learning, then how much they get out of schooling crucially depends on how long they get to be there every day. Moreover, since a larger proportion of such schools and such children are enrolled in two-shift schooling, this policy is clearly widening the gap between children in different contexts, instead of contributing to leveling the playing field.

#### 4.2.3. The surprising

And now to the results that were harder to anticipate. First, although some of the literature had found differences in the effect of full-day schooling in different subjects, because most research is done with the pooled results of test scores, these differences are underexplored and rather anecdotal. In this case, however, contrasts between the students' performance in language and mathematics is substantial and present across all main models. It also consistently appears in all the models that were intended as robustness checks for my results, i.e., for subgroups of schools and students of different characteristics. The results indicate that lengthening the school day has a considerably larger impact on the mathematics test scores, then the language ones. Comparing the difference between the coefficient for each subject for the full-day school variable that result from the OLS regression with controls (Table 4) with the ones that the fixed effects model shows (Table 7), one goes from a doubling of the effect to a six-time increase. The results are largest in the most reliable model, which is also indicative.

There are a couple of possible explanations for this disparity. First, as Diana Hincapie points out, time in school might impact math scores more than language ones, because schools tend to play a larger role in teaching mathematics, while language skills are more likely to also be developed in the home (2016). I would add to this, that the specific language skills that are tested in standardized testing, which concentrates on reading comprehension, are the ones more likely to be learned outside of specific language classes. There is no testing on writing skills, for example, which children are less likely to pick up outside of school.

Alternatively, these disparities could come from how the additional time is spent in school. Since the extension of the school hours gives schools no indication on how to invest this additional instruction time, schools could be prioritizing some subjects over others. Proponents of two-shift schooling make the case that "extending the length of the school day could have no impact on student achievement if the content of the extra hours in the school is irrelevant for math and language learning. For example, additional time devoted to sports, or more playing time may have desirable effects on other skills, such as discipline, team work, persistence, etc., which are valued in the labor market but many not affect math and language test scores" (Hincapie, 2016, p. 2). The results of this analysis show that additional instruction time is in fact having a positive impact on test scores. So rather than dismiss the potential effects on performance that the development of a variety of skills could have on the intellectual preparation of students, I believe research should focus on it. It would be important to better understand how much of the performance in one specific subject comes from instruction time devoted to it specifically, and how much other skills that children are picking up in their other classes are transferable between subjects.

Additionally, Hincapie's 2016 study does find larger effects of a full day of school on the mathematics tests, compared to the language ones. In her study, both the effects and the difference between subjects are reported to be bigger for children in the $9^{th}$ grade, than for children in the $5^{th}$ grade. Although comparing coefficients across studies does not always offer an accurate picture, the difference between subjects in her findings is somewhat smaller than in mine. Hincapie suggests that this might be the result of older children who are not in school being more likely to spend their free time in 'unproductive' activities that do not contribute to their learning. More intensive schooling would therefore have a bigger impact on them, than their younger counterparts.

Although more research would have to be conducted to test this, I think an important part of the explanation for this has to do with how differences in instruction time have a cumulative effect over time. Also, results from studies in other countries point to differences in how we test in different subjects across the academic life. Kraft offers reason to think so when he mentions that "effects in reading are driven exclusively by the considerably large effects on standardized tests of early-literacy skills in pre-kindergarten through 3rd grade. […] In math, the distribution of effect sizes is relatively stable across grade levels, despite students making much larger learning gains in early childhood than during adolescence" (2019, p. 22). Perhaps, the magnitude of the effects across grade levels has to do with how much expectations vary across grade levels. If the difficulty of what we test for does not reflect the increased complexity of what we teach -think, for example, of how advanced language classes are often centered on developing writing skills that standardized test do not evaluate-, it gets hard to assess how much of a difference additional instruction time is making for our students.

Finally, the results related to the impact of differences in school quality deserve attention. Initially, I had anticipated that the impact of additional instruction time would increase as school quality increased, thinking that better schools would be in a better place to translate the extra hours with their students into better test scores. But this turned out to only be partially true. While in high-quality schools the effect of full-day schooling on performance was significant and considerable (for example the coefficients for the fixed effects model by school quality reported in Appendix 4e would be considered large in mathematics test and medium in the language test according to Kraft's benchmarks), and even though they are substantially larger than the effects for medium-quality schools, they are smaller than the coefficients for low-quality schools. This is surprising and has big implication for the hypothesis I had put forth in the beginning about how school quality might factor into this discussion. In the first place, the results do not follow the pattern the explanation I had offered would anticipate. The relationship between a school's quality and its ability to transform instruction time into good grades is not linear, because additional time in school seems to be doing the most difference at both ends of the quality spectrum and dipping for medium quality schools. Secondly, it is the schools that are comparably worse the ones where spending additional time at is making the largest difference, which is puzzling.

More research should be done to explain these results, but a couple of things can be said already. First, since the relationship between a school's quality and its ability to transform instruction time into good grades is not linear, improving the quality of a school does not immediately lead to additional time there to be used successfully. Here again, although all students benefit from having full-school days, some features of the schools they attend mean that some benefit more than others. Despite the intuitive idea that good schools will put time to good use -which might be true regardless-, the somewhat less intuitive notion that in schools of lesser quality, that might be very inefficient, every extra moment in class helps seems to be supported by the data. This is important because it is further evidence that the chance to attend full-day schooling is most important for children who are all-around less favored, those attending poorer quality schools included. Moreover, it points to the fact that simply striving to improve the quality of schools, while allowing some of them to offer less time than others, is not sufficient. Once more, if the school system is going to contribute to offering all children equal opportunities in life, measures such as two-shift schooling should be brought to an end.

## 5. So, is additional time in school a waste of time?

Luckily for teachers and enthusiast of the school system -such as myself! -, the answer is no, spending more time in school does make a difference in a variety of outcomes, performance in standardized testing included. These effects are apparent across subjects, and for different types of schools as well as children with different backgrounds. But as we have seen, they are not uniform, and these differences are important.

More attention needs to be devoted in further research to explaining why full-length school days have a bigger impact in mathematics test, than they do in language ones. Regardless of whether the answer points to variations in how additional instruction time is spent in each school, or how we test across subjects, or how much students learn outside the classroom, we need to understand how the time spent with their teachers relates to what children learn.

The relationship between the effects of longer school days and the quality of the school students go to also needs to be explored further. It is key to better our understanding of the ways schools translate time in the classroom into performance in tests.

Finally, these results offer consistent indications that schools make the most difference where other resources are less available. Be that in underfunded public schools, in underserved rural areas, or for underprivileged children, schools are an essential part of the development and flourishing of kids who are otherwise dealt a rough hand. And yes, some educational arrangements contribute to the perpetuation of inequalities. But they don’t have to. And offering every child the opportunity to have a full day in school every day is a first step towards turning the education system into a tool for closing the enormous social gaps that are still present in Colombia.

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# Appendixes

Appendix 1. Sample statistics and distribution of independent variables among the different school day lengths

| | | | Afternoon | Full Day | Morning | Night | Saturday | Total |
|---|---|---|---|---|---|---|---|---|
| **School level variables** | **School Sector** | **Private** | 9,26 | 57,55 | 16,08 | 3,64 | 18,97 | **24,17** |
| | | **Public** | 90,74 | 42,45 | 83,92 | 96,36 | 81,03 | **75,83** |
| | **School Area** | **Rural** | 4,67 | 6,75 | 11,18 | 8,36 | 15,52 | **8,66** |
| | | **Urban** | 95,33 | 93,25 | 88,82 | 91,64 | 84,48 | **91,34** |
| | **School SES** | **1** | 0,70 | 0,50 | 1,67 | 1,45 | 0,00 | **1,17** |
| | | **2** | 36,79 | 15,94 | 39,59 | 70,55 | 84,48 | **33,64** |
| | | **3** | 59,21 | 48,83 | 54,01 | 28,00 | 15,52 | **53,80** |
| | | **4** | 3,30 | 34,73 | 4,73 | 0,00 | 0,00 | **11,39** |
| | | **5** | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| | **School Quality** | **Low** | 26,37 | 18,44 | 33,17 | 41,82 | 39,66 | **28,23** |
| | | **Medium** | 52,53 | 18,00 | 43,07 | 48,73 | 42,24 | **39,39** |
| | | **High** | 21,11 | 63,56 | 23,75 | 9,45 | 18,10 | **32,38** |

| | | | Afternoon | Full Day | Morning | Night | Saturday | Total |
|---|---|---|---|---|---|---|---|---|
| **Individual level variables** | **Gender** | **Man** | 43,95 | 47,41 | 44,23 | 52,73 | 52,59 | **44,96** |
| | | **Woman** | 56,05 | 52,59 | 55,77 | 47,27 | 47,41 | **55,04** |
| | **Student SES** | **1** | 10,56 | 3,98 | 10,30 | 12,73 | 18,97 | **8,91** |
| | | **2** | 47,41 | 24,08 | 41,16 | 45,45 | 43,97 | **38,61** |
| | | **3** | 37,91 | 43,10 | 41,06 | 41,82 | 34,48 | **40,81** |
| | | **4** | 4,12 | 28,84 | 7,48 | 0,00 | 2,59 | **11,67** |
| | **Mother's Education** | **Some primary** | 5,38 | 3,44 | 4,82 | 20,73 | 18,97 | **4,72** |
| | | **Full primary** | 14,57 | 6,29 | 12,68 | 7,64 | 12,93 | **11,60** |
| | | **Some secondary** | 8,37 | 6,08 | 7,42 | 17,45 | 17,24 | **7,38** |
| | | **Full secondary** | 43,91 | 28,85 | 41,28 | 32,73 | 32,76 | **38,92** |
| | | **Some technical** | 1,88 | 2,28 | 1,99 | 3,64 | 2,59 | **2,04** |
| | | **Full technical** | 13,48 | 14,84 | 14,86 | 9,82 | 9,48 | **14,51** |
| | | **Some professional** | 1,03 | 2,52 | 1,22 | 2,18 | 1,72 | **1,49** |
| | | **Full professional** | 7,41 | 20,29 | 9,65 | 5,82 | 4,31 | **11,60** |
| | | **Masters or more** | 3,97 | 15,41 | 6,07 | 0,00 | 0,00 | **7,74** |
| | **Father's Education** | **Some primary** | 7,52 | 5,46 | 7,25 | 22,18 | 31,90 | **7,00** |
| | | **Full primary** | 17,04 | 8,18 | 15,75 | 8,36 | 6,90 | **14,23** |
| | | **Some secondary** | 8,77 | 7,34 | 7,89 | 18,91 | 18,10 | **8,03** |
| | | **Full secondary** | 42,21 | 29,57 | 40,28 | 34,55 | 26,72 | **38,17** |
| | | **Some technical** | 1,32 | 1,98 | 1,47 | 2,18 | 0,86 | **1,56** |
| | | **Full technical** | 11,65 | 12,45 | 12,18 | 6,91 | 5,17 | **12,09** |
| | | **Some professional** | 0,96 | 2,27 | 1,21 | 2,55 | 0,00 | **1,40** |
| | | **Full professional** | 6,67 | 17,45 | 8,41 | 4,36 | 9,48 | **10,11** |
| | | **Masters or more** | 3,86 | 15,29 | 5,56 | 0,00 | 0,86 | **7,42** |

*Colum percentages by variable
Own calculations with data from ICFES and the Ministry of Education

## Appendix 2a. Ordered probit - Effects of full school days on test scores (naïve estimators)

| | *Dependent variable:* | |
|---|---|---|
| | Test scores Mathematics | Test scores Language |
| Full-day schooling | 1.087*** | 0.941*** |
| | (0.018) | (0.019) |
| Observations | 65,162 | 65,162 |
| *Note:* | *p**p***p<0.01 | |
| | Beta coefficients and standard errors (in parenthesis). Reference category is Non full-day schooling. | |

## Appendix 2b. Ordered Probit - Effects of full school days on test scores with controls

| | *Dependent variable:* | | |
|---|---|---|---|
| | Test scores Mathematics | Test scores Language | Test scores Pooled performance |
| | (1) | (2) | (3) |
| Full-day school | 0.370*** | 0.179*** | 0.303*** |
| | (0.021) | (0.021) | (0.019) |
| Public school | 0.078*** | -0.061** | 0.015 |
| | (0.025) | (0.025) | (0.023) |
| Urban school | 0.305*** | 0.365*** | 0.375*** |
| | (0.030) | (0.030) | (0.028) |
| School - SES 2 | 0.291*** | 0.525*** | 0.462*** |
| | (0.074) | (0.077) | (0.071) |
| School - SES 3 | 0.553*** | 0.938*** | 0.826*** |
| | (0.076) | (0.079) | (0.073) |
| School - SES 4 | 1.029*** | 1.370*** | 1.322*** |
| | (0.084) | (0.087) | (0.080) |

| | | | |
|---|---|---|---|
| Medium quality school | 0.233*** | 0.210*** | 0.243*** |
| | (0.019) | (0.020) | (0.018) |
| High quality school | 1.038*** | 0.942*** | 1.059*** |
| | (0.024) | (0.025) | (0.023) |
| Girl | -0.485*** | -0.019 | -0.286*** |
| | (0.015) | (0.016) | (0.014) |
| Student - SES 2 | 0.342*** | 0.232*** | 0.324*** |
| | (0.030) | (0.030) | (0.028) |
| Student - SES 3 | 0.980*** | 0.476*** | 0.811*** |
| | (0.033) | (0.033) | (0.031) |
| Student - SES 4 | 1.875*** | 0.933*** | 1.551*** |
| | (0.048) | (0.048) | (0.045) |
| Mother - full primary education | -0.517*** | -0.028 | -0.312*** |
| | (0.044) | (0.044) | (0.041) |
| Mother - some secondary education | 0.084* | 0.108** | 0.106** |
| | (0.046) | (0.047) | (0.043) |
| Mother - full secondary education | -0.467*** | 0.067 | -0.234*** |
| | (0.040) | (0.041) | (0.038) |
| Mother - some technical education | 0.120* | 0.315*** | 0.224*** |
| | (0.066) | (0.068) | (0.062) |
| Mother - full technical education | -0.283*** | 0.346*** | 0.007 |
| | (0.045) | (0.045) | (0.042) |
| Mother - some professional education | 0.274*** | 0.627*** | 0.466*** |
| | (0.075) | (0.077) | (0.071) |
| Mother - full professional education | -0.448*** | 0.206*** | -0.156*** |

| | | | |
|---|---|---|---|
| | (0.048) | (0.049) | (0.045) |
| Mother - masters or more | -0.803$^{***}$ | 0.114$^{**}$ | -0.394$^{***}$ |
| | (0.054) | (0.054) | (0.051) |
| Father - full primary education | -0.710$^{***}$ | -0.020 | -0.417$^{***}$ |
| | (0.037) | (0.038) | (0.035) |
| Father - some secondary education | -0.073$^{*}$ | 0.026 | -0.034 |
| | (0.040) | (0.041) | (0.038) |
| Father - full secondary education | -0.774$^{***}$ | -0.030 | -0.460$^{***}$ |
| | (0.034) | (0.035) | (0.032) |
| Father - some technical education | -0.057 | 0.297$^{***}$ | 0.119$^{*}$ |
| | (0.069) | (0.072) | (0.064) |
| Father - full technical education | -0.649$^{***}$ | 0.215$^{***}$ | -0.265$^{***}$ |
| | (0.040) | (0.041) | (0.037) |
| Father - some professional education | -0.060 | 0.343$^{***}$ | 0.137$^{**}$ |
| | (0.073) | (0.075) | (0.068) |
| Father - full professional education | -0.661$^{***}$ | 0.156$^{***}$ | -0.301$^{***}$ |
| | (0.043) | (0.044) | (0.041) |
| Father - masters or more | -0.975$^{***}$ | 0.161$^{***}$ | -0.478$^{***}$ |
| | (0.050) | (0.050) | (0.047) |
| Observations | 65,162 | 65,162 | 65,162 |

*Note:* $^{*}$p$^{**}$p$^{***}$p<0.01

Beta coefficients and standard errors (in parenthesis). Reference categories are Non-full day school, Private school, Rural School, School - SES 1, Low quality school, Boy, Student - SES 1, Mother - some primary education, Father - some primary education.

## Appendix 3. FE - Effects of a full day of schooling on test scores (first difference)

| | *Dependent variable:* | | |
|---|---|---|---|
| | Test scores<br>Mathematics | Test scores<br>Language | Test scores<br>Pooled |
| Full-day school | 0.001 | -0.011 | -0.010 |
| | (0.011) | (0.010) | (0.015) |
| Constant | $0.570^{***}$ | $0.113^{***}$ | $0.684^{***}$ |
| | (0.004) | (0.004) | (0.005) |
| Observations | 32,581 | 32,581 | 32,581 |
| $R^2$ | 0.00000 | 0.00004 | 0.00001 |
| Adjusted $R^2$ | -0.00003 | 0.00001 | -0.00002 |
| F Statistic (df = 1; 32579) | 0.009 | 1.321 | 0.474 |
| *Note:* | $^{*}$p$^{**}$p$^{***}$p<0.01 | | |
| | Beta coefficients and standard errors (in parenthesis). Reference category is Non full-day school. | | |

## Appendix 4a. FE - Effects of a full day of schooling on test scores by school area

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | Test scores<br>Urban Schools - Mathematics | Test scores<br>Urban Schools - Language | Test scores<br>Rural Schools - Mathematics | Test scores<br>Rural Schools - Language |
| Full-day school | $0.332^{***}$ | $0.049^{***}$ | $0.474^{***}$ | $0.095^{***}$ |
| | (0.015) | (0.011) | (0.035) | (0.028) |
| Observations | 59,517 | 59,517 | 5,645 | 5,645 |
| $R^2$ | 0.017 | 0.001 | 0.065 | 0.005 |
| Adjusted $R^2$ | -0.983 | -1.015 | -1.049 | -1.182 |
| F Statistic | $507.601^{***}$ (df = 1; 29511) | $20.932^{***}$ (df = 1; 29511) | $179.967^{***}$ (df = 1; 2575) | $11.856^{***}$ (df = 1; 2575) |
| *Note:* | $^{*}$p$^{**}$p$^{***}$p<0.01 | | | |
| | Beta coefficients and standard errors (in parenthesis). Reference category is Non full-day school. | | | |

## Appendix 4b. FE - Effects of a full day of schooling on test scores by school sector

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | Test scores<br><br>Public Schools - Mathematics | Test scores<br><br>Public Schools - Language | Test scores<br><br>Private Schools - Mathematics | Test scores<br><br>Private Schools - Language |
| Full-day school | $0.348^{***}$ | $0.055^{***}$ | $0.437^{***}$ | $0.096^{***}$ |
| | (0.015) | (0.011) | (0.035) | (0.027) |
| Observations | 49,411 | 49,411 | 15,751 | 15,751 |
| $R^2$ | 0.021 | 0.001 | 0.020 | 0.002 |
| Adjusted $R^2$ | -0.984 | -1.025 | -1.046 | -1.085 |
| F Statistic | $531.184^{***}$ (df = 1; 24371) | $25.819^{***}$ (df = 1; 24371) | $155.928^{***}$ (df = 1; 7541) | $13.209^{***}$ (df = 1; 7541) |
| *Note:* | $^{*}$p$^{**}$p$^{***}$p<0.01 | | | |
| | Beta coefficients and standard errors (in parenthesis). Reference category is Non full-day school. | | | |

## Appendix 4c. FE - Effects of a full day of schooling on test scores by school SES

| | *Dependent variable:* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Test scores<br><br>SES 1 - Mathematics | Test scores<br><br>SES 1 - Language | Test scores<br><br>SES 2 - Mathematics | Test scores<br><br>SES 2 - Language | Test scores<br><br>SES 3 - Mathematics | Test scores<br><br>SES 3 - Language | Test scores<br><br>SES 4 - Mathematics | Test scores<br><br>SES 4 - Language |
| Full-day school | $0.688^{***}$ | $0.250^{**}$ | $0.451^{***}$ | $0.041^{*}$ | $0.265^{***}$ | $0.035^{**}$ | 0.136 | -0.136 |
| | (0.144) | (0.115) | (0.030) | (0.022) | (0.020) | (0.015) | (0.157) | (0.130) |
| Observations | 763 | 763 | 21,919 | 21,919 | 35,060 | 35,060 | 7,420 | 7,420 |
| $R^2$ | 0.102 | 0.023 | 0.025 | 0.0004 | 0.011 | 0.0004 | 0.0003 | 0.0004 |
| Adjusted $R^2$ | -2.389 | -2.686 | -1.387 | -1.447 | -1.345 | -1.371 | -1.658 | -1.658 |
| F Statistic | $22.822^{***}$ (df = 1; 202) | $4.753^{**}$ (df = 1; 202) | $226.857^{***}$ (df = 1; 8955) | $3.499^{*}$ (df = 1; 8955) | $168.739^{***}$ (df = 1; 14782) | $5.767^{**}$ (df = 1; 14782) | 0.755 (df = 1; 2790) | 1.097 (df = 1; 2790) |
| *Note:* | $^{*}$p$^{**}$p$^{***}$p<0.01 | | | | | | | |
| | Beta coefficients and standard errors (in parenthesis). Reference category is Non full-day school. | | | | | | | |

## Appendix 4d. FE - Effects of a full day of schooling on test scores by individual SES

| | *Dependent variable:* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Test scores | Test scores | Test scores | Test scores | Test scores | Test scores | Test scores | Test scores |
| | SES 1 - Mathematics | SES 1 - Language | SES 2 - Mathematics | SES 2 - Language | SES 3 - Mathematics | SES 3 - Language | SES 4 - Mathematics | SES 4 - Language |
| Full-day school | $0.522^{***}$ | 0.061 | $0.452^{***}$ | $0.053^{**}$ | $0.338^{***}$ | $0.058^{***}$ | $0.271^{***}$ | 0.022 |
| | (0.082) | (0.061) | (0.031) | (0.023) | (0.026) | (0.019) | (0.050) | (0.041) |
| Observations | 5,804 | 5,804 | 25,161 | 25,161 | 26,595 | 26,595 | 7,602 | 7,602 |
| $R^2$ | 0.034 | 0.001 | 0.031 | 0.001 | 0.022 | 0.001 | 0.012 | 0.0001 |
| Adjusted $R^2$ | -3.812 | -3.977 | -2.754 | -2.872 | -2.518 | -2.592 | -2.041 | -2.077 |
| F Statistic | $40.899^{***}$ (df = 1; 1165) | 0.990 (df = 1; 1165) | $209.899^{***}$ (df = 1; 6492) | $5.470^{**}$ (df = 1; 6492) | $164.916^{***}$ (df = 1; 7395) | $9.543^{***}$ (df = 1; 7395) | $29.338^{***}$ (df = 1; 2470) | 0.285 (df = 1; 2470) |

*Note:* $^{*}$p$^{**}$p$^{***}$p<0.01

Beta coefficients and standard errors (in parenthesis). Reference category is Non full-day school.

## Appendix 4e. FE - Effects of a full day of schooling on test scores by school quality

| | *Dependent variable:* | | | | | |
|---|---|---|---|---|---|---|
| | Test scores | Test scores | Test scores | Test scores | Test scores | Test scores |
| | High Quality Schools - Mathematics | High Quality Schools - Language | Medium Quality Schools - Mathematics | Medium Quality Schools - Language | Low Quality Schools - Mathematics | Low Quality Schools - Language |
| Full-day school | $0.354^{***}$ | $0.070^{***}$ | $0.291^{***}$ | 0.028 | $0.418^{***}$ | $0.069^{***}$ |
| | (0.019) | (0.015) | (0.032) | (0.022) | (0.026) | (0.019) |
| Observations | 21,099 | 21,099 | 25,665 | 25,665 | 18,398 | 18,398 |
| $R^2$ | 0.032 | 0.002 | 0.007 | 0.0001 | 0.029 | 0.002 |
| Adjusted $R^2$ | -1.002 | -1.064 | -1.092 | -1.106 | -1.069 | -1.128 |
| F Statistic | $340.101^{***}$ (df = 1; 10200) | $22.208^{***}$ (df = 1; 10200) | $83.668^{***}$ (df = 1; 12186) | 1.559 (df = 1; 12186) | $261.443^{***}$ (df = 1; 8630) | $13.594^{***}$ (df = 1; 8630) |

*Note:* $^{*}$p$^{**}$p$^{***}$p<0.01

Beta coefficients and standard errors (in parenthesis). Reference category is Non full-day school.

**Statement of Authorship**

I hereby confirm and certify that this master thesis is my own work. All ideas and language of others are acknowledged in the text. All references and verbatim extracts are properly quoted and all other sources of information are specifically and clearly designated. I confirm that the digital copy of the master thesis that I submitted on June 14, 2021, is identical to the printed version I submitted to the Examination Office on June 15, 2021.

DATE: June 14, 2021

NAME: Isabel de Brigard

SIGNATURE: