Divergencies in Academic Performance among Spanish Students: Evidence from PISA 2018

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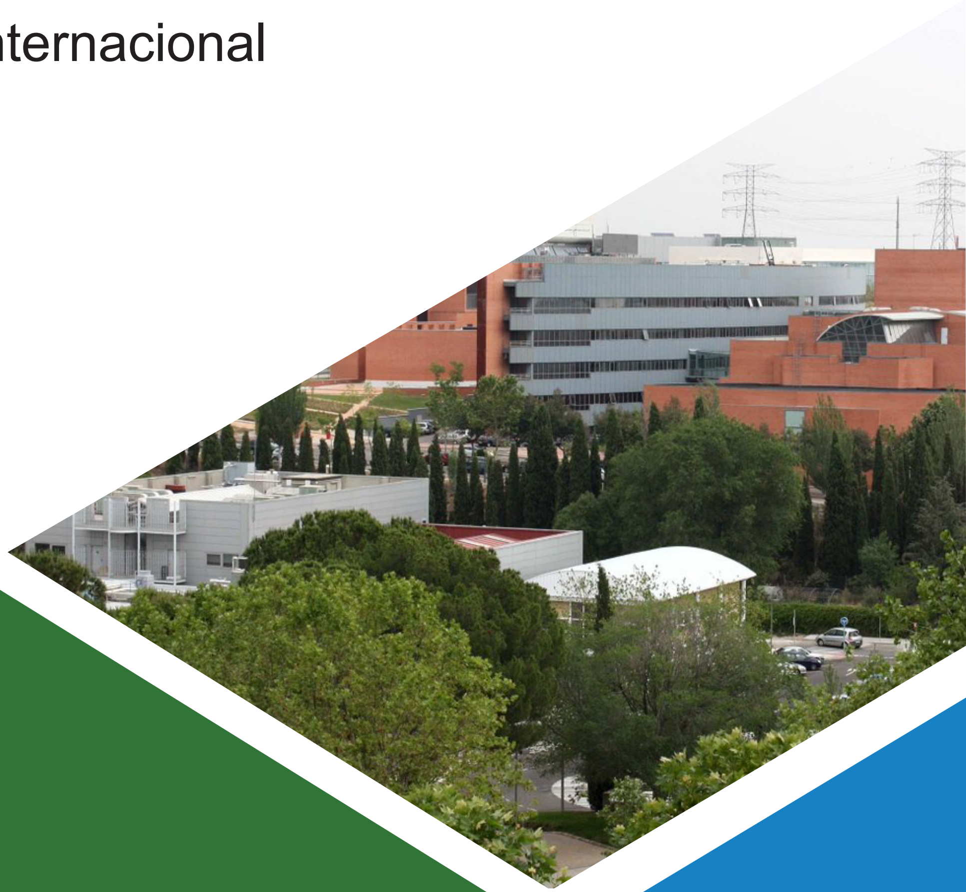

MÁSTERES DE LA UAM

2019 - 2020

Facultad de Ciencias Económicas y Empresariales

Universidad Autónoma de Madrid

Master in International Economics
2019-2020

Final Thesis

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Madrid, 2020

ABSTRACT

This paper analyses differences in the school performance of Spanish students between public and private schools, as well as regional divergencies in their academic performance. For this purpose, we use data from PISA 2018 for Spain from two subjects: Mathematics and Science. The Oaxaca-Blinder approach is adopted in order to estimate the potential score gap between public and private schools and between the high-performing (scoring above the mean) and low-performing (scoring below the mean) students. Results show that students enrolled in private schools in Spain achieve a significantly higher score than students from public schools even when controlling for socioeconomic characteristics. Furthermore, we find evidence supporting that the tests' score of high-performing students is not affected by the type of school (private or public) they attend. In contrast, the achievement of low-performing students is significantly reduced when they attend a public school. Along with these results, we find evidence of strong regional disparities in the academic performance of Spanish students.

Keywords: academic performance, type of school, regions, Oaxaca-Blinder.
JEL: I21, I24, R11

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1. INTRODUCTION

The results of the 2018 OECD Programme for International Student Assessment (PISA) have recently been published. The low performance of Spanish students is quite alarming, specially taking into account that these last results are much worse than the ones obtained just three years before in PISA 2015. According to OECD publications (see Figure 1 and Figure 2 Annexes), the average score of Spain in the Science test has been 481 in 2018 while in 2015 it was 493. Similar results are obtained for the Mathematics test in which the average score has decreased from 486 to 481. It is also important to emphasize that countries such as Estonia or Poland have scored more than 510 points in both tests while Spain has scored less than 490 points in both Science and Mathematics. Usually, these differences in results, are associated to the socioeconomic background and the inequality of opportunities. In fact, it is believed that, the quality of education in private schools is higher than in public schools (Javaid et al, 2012; Thapa, 2012). In this sense, families from a favourable background, enrol their children to private schools which might improve their chances of success. However, students from poorer families, are sent to public schools which could increase the score gap between both types of students. Although this hypothesis is plausible, evidence on this matter is not so straightforward and attending a private school not always improves academic performance.

Moreover, it is also quite striking to notice the dispersion in the results between regions. In fact, some regions, such as Navarra or Castile and Leon have achieved a mean score over 500 points in the Mathematics test while others such as Andalusia or Canary Islands have obtained a mean score of less than 470 (Figure 3 of the Annexes). These differences are also present in the Science test (Figure 4 of the Annexes), with a gap of 30 points. This huge spread in scores between regions has been long present. One of the main reasons for such gap is usually attributed to the decentralized educational system of Spain (Crespo-Cebada et al, 2014) in which each region has control over the education policy. Moreover, there are important differences between regions related to labour market conditions, income or immigration rate among many others (Tirado et al, 2016).

The purpose of this paper is to shed some light on these issues. In particular, the objective is twofold. First, we will analyse the role of the school ownership in the academic performance of Spanish students. Second, we will examine whether there are regional differences in the impact that school ownership exerts on students' achievements.

The contribution of this study is threefold. First, we will apply the Oaxaca-Blinder decomposition in order to study to what extent there exists differences in academic scores among Spanish students depending on the type of school: public or private. With this econometric approach, we aim at contributing to previous studies for Spain in which the relevance of school ownership in academic performance is still not clear. So far, many methodologies have been used for Spain to analyze the determinants of students' achievements such as a Data Envelopment Analysis (Calero and Escardíbul, 2007), a Multilevel analysis (Mancebón and Muñiz, 2008) or a Propensity Score Matching (Crespo-Cebada et al., 2004) analysis and have reached different conclusions. The interesting point of applying the Oaxaca-Blinder methodology is that we would be contributing to this issue through another perspective that allows us to study if there exists a significant score gap between private and public education in Spain. Moreover, we will account for regional differences. Second, we will attempt to go one step further and examine whether the school ownership is able to explain the score gap between the students achieving the higher scores and the students achieving the lower ones. This means that, after analyzing if there is a statically significant difference in scores between both types of education, we would study to what extent these differences are able to explain divergencies in scores between the high-performing and the low-performing students. Moreover, we would account for regional differences, so that we would examine whether there are significant advantages or disadvantages of attending education in some regions with respect to others. Finally, we will account for mother's education level and professional occupation in order to capture more efficiently the effect of economic resources in students' academic performance. Although Mothers' occupation has been considered in some studies as an important determinant of the academic achievements of their kids (Giannelli and Rapallini, 2018; Anger and Heineck, 2009; Goksel, 2014), its effect has not yet been studied for Spain.

The rest of the paper is structured as follows. In Section 2, we briefly summarize the main literature. In Section 3, we present the methodology along with the description of the data and variables. In Section 4, we discuss the results for our two models. Finally, in Section 5, we point out the main conclusions of the study

2. LITERATURE REVIEW

Regional disparities in the education level in Spain, have largely been analysed from different perspectives. In the study carried out in Cordero et al. (2010), they apply an efficiency approach in order to explain divergences in academic performance across Spanish regions based on PISA 2006 results. Using a Tobit regression approach, they find that Galicia and La Rioja are the most efficient regions while Basque Country and Catalonia are proved to be the most inefficient ones[1]. The BBVA foundation has also published a descriptive report (Pérez et al., 2018) contrasting the academic performance of Spanish regions. The report contains information regarding aspects such as the efficient use of resources or the students' attainment rates of each region. There seems to be higher efficiency in regions such as Navarra compared to others such as Andalusia. Some authors have focused on comparing differences across regions in different countries. Agasisti et al. (2006) study divergencies in academic performance among regions between Spain and Italy. They find evidence supporting heterogeneity between regions as the main explanation to such disparities. In fact, using multilevel techniques, they find stronger divergences across regions in Spain, where each region has control over the education policy, than in Italy. Nonetheless, they also find quite important differences across regions in Italy in which education is regulated by the general government.

Furthermore, the impact of the ownership of schools on educational performance is still a questionable matter. Although several studies have focused on this issue, the conclusions are quite different not only between countries but also depending on the applied methodology. In this sense, some authors have found a clear advantage for students attending private schools in different countries. For instance, in a paper from Schultz and Mcdonald (2013) for the United States, in which they apply a descriptive approach, they find evidence supporting that religious private schools are associated to better academic performance of students. In this same line, for the case of the Netherlands, Levin (2002) finds, using an instrumental variable methodology, that attending a private school is associated with higher scores. The paper of Dearden et al. (2002), based on panel data, also finds that students in the United Kingdom attending a

[1] Efficiency is defined as the level of use students make of the available resources at school (teacher, class size, equipment, library, etc)

private school have more possibilities of reaching a higher education level and a higher income.
However, these results are not supported by many other investigations. In a study carried out by Calero and Ecardíbul (2007) for Spain, the results show a non-significant effect of the type of school in the academic performance of students. They apply a Data Envelopment Analysis (DEA) technique and find that what actually determines the better performance of students are the student's characteristics rather than the type of school. In this same line, also for Spain, Mancebón and Muñiz (2008) use a multilevel approach and find that the differences in results between students are determined by families and peers' characteristics. Finally, other authors have even found a negative effect of private schools on students' scores. For instance, the investigation of Donkers and Robert (2008), based on multilevel technique, finds that private schools show lower scores in mathematics test than public schools, once controlling for the students' individual characteristics, parents and social composition.

A more sophisticated analysis on this topic has been the one of Crespo-Cebada et al. (2014) for the case of Spain. In their investigation, they compare the efficiency of two types of schools in Spain: private government-dependent schools and public schools. They use a Propensity Score Matching (PSM) approach, that allows to remove selection bias in the school decision (families with higher income often chose private government-dependent schools) in order to compare efficiency between private and public school. Their results show that, private government-dependent schools are more productive than public schools and they find strong disparities in efficiency between regions. This paper is somehow in line with this research. However, two important differences should be highlighted. First, we are interested in comparing only private and public schools (this latest also include private government-dependent schools). Second, we do not attempt to analyze efficiency but to test whether there are differences between private and public schools across regions as regards students' academic performance.

As we have seen, many methodologies can be used in order to analyze what are the main factors explaining divergencies in academic performance between students and between regions. However, to the best of our knowledge, very few papers have focused on the famous Oaxaca-Blinder decomposition (Blinder 1973; Oaxaca 1973; Jann, 2008). This methodology, usually applied in the labour economics literature, is aimed to evaluate differences for a given variable between two groups of the sample. In particular, this approach has been used to examine the gender wage gap (Fortin et al., 2017 ; Nielsen, 2000; Mysíková, 2012; Scorzafave and Pazello, 2007) but also to examine immigrant wage gap (Lehmer and Ludsteck, 2018) or wage gap between urban residents and rural migrants (Quheng, 2017).

Although this methodology is traditionally used in this type of research, the Oaxaca-Blinder decomposition is becoming increasingly popular in the Education Economics literature focused on students' academic achievements. In fact, in a working paper carried out by the World Bank, Barrera-Osorio et al., (2011) apply this technique in order to explain the increase of scores in Indonesia in PISA results between 2003 to 2006. They find that a non-negligible part of the increase in students' scores is due to unobserved factors. The authors conclude that, this result reflects that Indonesia managed to improve efficiency between 2003 and 2006 regardless of the students' characteristics.
In the same line, the paper of Castro et al. (2017) applies the Oaxaca-Blinder decomposition in order to explain inequalities between public and private schools in Latin America countries for PISA results 2012. They compute the score gap between public and private schools in different countries. They find significant and strong divergencies between the two types of schools in all countries. However, the majority of these disparities is explained by observed factors. In fact, their results prove that Uruguay and Brazil have the highest score gap (95.77 and 83.813 points of difference respectively) and Colombia and Mexico have the lowest gap but still quite important (42.477 and 37.453 points of difference respectively).

The study of Nieto and Ramos (2014) from the Research Institute of Applied Economics (IREA), also applies the Oaxaca-Blinder methodology. The analysis focus on the role of teacher and school quality in the academic performance of students for 10 middle income countries from Arab States (Jordan and Tunisia), Central Asia (Azerbaijan and Thailand), Latin America (Brazil and Mexico) and Central and Eastern Europe (Russia and Turkey); and academic performance for 2 high income countries from Western Europe (the Netherlands and United Kingdom). They divide the sample in 2 groups according to their ESCS (Social and Cultural status). The analysis is carried out in 2 steps: first they estimate through the Oaxaca-Blinder decomposition the score gap in academic performance between students at the top and bottom quartile for each ESCS group, then in a second step, they estimate the probability of each of these 2 groups of ESCS to score above the PISA level 2[2]. The results show that the quality of teachers and schools is key in order to explain academic performance.

To the best of my knowledge, very few papers have used the Oaxaca-Blinder decomposition to explain differences in students' academic performance in Spain. One exception is the investigation driven by the European Commission (Hippe et al., 2018) that studies differences in PISA scores 2015 between regions in Spain and Italy. The research shows significant differences in scores between regions in Spain and Italy. They find evidence supporting that grade repetition and student truancy exert a negative and significant effect, while teacher-directed teaching and epistemological beliefs have a positive and significant effect on students' performance. The investigation of Zinovyeva et al. (2011) also uses the Oaxaca-Blinder technique to study differences in academic performance among immigrants in Spain. They find that the most part of the score gap is explained by individual and family characteristics and that the segregation of students across public and private schools explains the lower performance of immigrant students.

Finally, students' academic performance has also been explained by many other factors. In general, studies agree in the significant effect of a higher mother's education level (Pianta and Harbers, 1996; Milne and Plourde, 2006), the positive effect of having a computer (Casey et al, 2012), the importance of the student teacher ratio (Raychaudhuri et al, 2010), the effect of the teacher quality (Akinsolu, 2010) and the lower performance of immigrant students (Calero et al., 2009). There is also some evidence regarding difference in academic performance between male and female students (Halldórsson and Ólafsson, 2009; Campbell et al., 2000).

The purpose of our study is to analyze the differences for Spanish students' performance in PISA 2018 using the Oaxaca-Blinder decomposition. Based on the previous studies that we have mentioned above, we are interested in explaining differences in academic performance between students combining the effects of the type of school and the region.

[2] PISA results are reported in proficiency scales from the lower level 1b to the highest level 6 with a total of 8 levels. The intervals of scores in each level vary each year and for each subject. The PISA methodology establishes as score mean 500 points (around level 3).

We will divide our empirical analysis in two steps. First, we will examine whether there are significant differences between students' scores attending private or public schools. Moreover, we will account for differences across regions as regards the type of school. This part of our study is in line with the work of Castro et al. (2017) for Latin America countries. In a second step, we will be interested in testing whether school ownership is able to explain differences between students who score above the overall mean and students who score below the overall mean. We will be also controlling for regions in order to analyze the effects of both variables simultaneously (type of school and region). This second part will be based on the research carried out by Nieto and Ramos (2014) studying the gap differences between students at the top and bottom quartiles of the score distribution.

3. METHODOLOGY

3.1. Data

The sample used in this paper comes from the PISA 2018 study. To be precise, the sample comprises 34 396 Spanish students.

Starting in 2000, the PISA survey is carried out by the OECD every 3 years. Its aim is to study the academic level of students across different countries. More than 90 countries have participated in PISA's project since it was first elaborated.

PISA data provide very rich information that allows researchers to study academic performance of 15 years old students. It does not only provide information about student's academic level, but it also provides information about students' socioeconomic background. In fact, in each wave, the information about characteristics of students, families and schools gets enriched. The 2018 survey is mainly divided in 4 questionnaires: students, schools, teachers and families. In each of them, multiple questions are asked to each member regarding economic and social issues. Furthermore, cognitive skills are evaluated for 3 different domains: Reading, Science and Mathematics. Unfortunately, for the case of Spain in PISA 2018, the reading questionnaire showed some irregularities, so the OECD has not published the results of Spain for the reading part. Therefore, in this research only data for students' performance in Mathematics and Science is available.

The main advantage of using PISA data is the way in which cognitive skills are evaluated. Instead of using a simple single score for each student, it is based on a scaling of the raw data with an item response model. In this sense, the reporting scales are called *proficiency scales* with a total of 8 levels. The point of this methodology is to capture the general population-level of a country instead of the individual student level. However, the PISA report also provides 5 plausible values for each student result in each of the 3 domains (reading, science and mathematics). These are estimated scores of each participant.

Thus, for the purpose of this study, we are going to use as measure of the students' performance, the average of the 5 plausible values for each of the available domains (Mathematics and Science). This methodology is in line with previous studies that have used the PISA dataset (Cordero et al., 2010; Calo-Blanco and Villar, 2010; Castro et al., 2017; Crespo-Cebada et al., 2014).

3.2. Econometric technique

As we have previously explained, the purpose of the paper is to study the impact of private and public education on students' achievement through the Oaxaca-Blinder decomposition. This technique calculates the difference in results between two groups of the sample and decompose it into 3 parts: *endowments*, *coefficien*ts and *interaction effects*.

In a similar vein to Castro et al. (2014), we attempt to estimate the score gap between two groups of the sample. We are going to estimate 2 models:

i) *Model 1*: score gap between private (Group A) and public (Group B) schools

ii) *Model 2*: score gap between the *High-performing* (Group A) and *Low-performing* (Group B) students. The *High-performing* students are those scoring above or equal to the overall mean and the *Low-performing* students are those scoring below the overall mean.[3]

[3] The mean for Mathematics is 491.16 and the mean for Science is 469.71.

The outcome difference between Group A and Group B is denoted as follows:

$$R = E(Y_A) - E(Y_B)$$

where $E(Y_i)$ denotes the expected score for group i

The outcome difference is decomposed into three components:

$$R = E + C + I$$

First, E denotes *Endowments effect*, that is the part of the difference due to observed factors:

$$E = E(X_A) - E(X_B)\,'\,\beta_B$$

where vectors X_A and X_B contain the predictors for groups A and B respectively (in our model $X_A = X_B$) and β accounts for the slope for all parameters.

Second, C refers to the *Coefficients effect*, that is the part of the difference due to unobserved factors

$$C = E(X_B)'(\beta_A - \beta_B)$$

And finally, I denotes the *Interaction effect*, that is the percentage of the difference due to observed and unobserved factors simultaneously (this effect is included in the unobserved part)

$$I = [E(X_A) - E(X_B)]'(\beta_A - \beta_B)$$

3.3. Variables

3.3.1 Dependent variables

As it was explained previously in this section, the results obtained by students in the Mathematics and Science subjects are used as output indicators which is the mean of the 5 plausible values for each domain. It is worth mentioning that, cognitive skills questions have different levels of difficulty which might lead to measurement error problems. This means that, students achieving very high or very low scores, have higher measurement errors than those scoring around the overall mean. In order to avoid these problems, the PISA assignment make use of a technique based on the Rasch model (Rasch, 1960). Therefore, the plausible values cannot be interpreted as the mean of the student actual score but more as the scores reasonably assigned to each individual which are randomly drawn from a distribution function of test results (Nieto and Ramos, 2014; Cordero et al, 2010).[4]

3.3.2 Explanatory variables

Our main interest is on school ownership (private or public). In our sample 9,457 students are enrolled in private schools, while students in public schools amount to 24.273 (see Table 1 of the Annexes for more descriptive statistics).

The selection of the rest of input variables has been based on the evidence found in similar investigations. The detail description of each of them is reported in Table 2 of the Annexes. These control variables are the following ones:

- *i) Regions*
- *ii) Mother education level*
- *iii) Mother Occupation*
- *iv) Gender*
- *v) Immigrant*
- *vi) Student/Teacher ratio*
- *vii) Computer at home*
- *viii) Single room*
- *ix) Grade retention*

4. RESULTS

4.1 Private vs Public schools (Model 1)

In this first part of our study, we have attempted to answer the following question: is the school ownership determinant of the academic performance of Spanish students? We find evidence supporting that students from private schools are more advantaged than those from public schools independently of their individuals' characteristics (capacity, culture, personality, etc). We find also evidence supporting inequalities in academic performance

[4] For more detailed information on the computation of the plausible values see Wu and Adams (2002) and the PISA Technical Report 2018 (OECD, 2018).

among the different Spanish regions. For instance, our results suggest that in general, students from Navarra and Castile Leon perform better than those from Madrid, and students from Andalusia, Canary Islands, Extremadura and Valencia perform worse.

We first discuss the results of Mathematics tests. The Oaxaca-Blinder decomposition (Table 3) indicates that, private schools score on average 19.203 points more than public schools (third line in Column 1) of which 62.53% (12.007 points) is explained by the *endowments effect*. This means that, the most part of the score gap in Mathematics between students from private and public schools, is due to group differences in the predictors included in the regression. This gives the model a high explanatory power. The rest of the score gap is explained by the *coefficient effect* (31.33% or 6.018 points) indicating the weight in the score gap of the unobserved components. Finally, the *interaction effect* accounts for 6.17 %. Hence the total weight of the unobserved factors is less than 50% (*coefficient* and *interaction effect*).

We now turn onto the findings for Science scores. The results obtained from the Oaxaca-Blinder decomposition, show a similar pattern than those found for Mathematics but the score gap between public and private schools is lower. For instance, as it is reported in Table 3 Column 2, we find that students from private schools score on average 14.36 points more than those from public schools (in Mathematics the score gap was 19.203). From these 14.36 points, 55.43% is explained by the *endowments effect* and the rest is explained by the *coefficient effect*. This means that, as we find for Mathematics, differences in Science between students from public and private schools are mainly due to observed factors. However, the evidence for Science is more limited since the weight of the unobserved factors in explaining the score gap is stronger than for Mathematics (31% vs 45%).

The interpretation of these results is that, differences in students' achievements between students from public and private schools in Spain, is mainly due to differences in the students' endowments such as mothers' education level or occupation, the region of school attendance or the immigrant condition. Less than 50% of such differences are due to non-observed factors such as the student capacity, culture or personality. This finding shows that, students in Spain attending public schools are disadvantaged compared to those from private schools independently from their individual characteristics.

Our results thus provide evidence supporting the relevant role of the school ownership on the academic performance of Spanish students. These findings are opposed to those in Calero and Ecardíbul (2007) and Mancebón and Muñiz (2008) that do not find a significant effect of attending a private or public school in Spain. These differences with previous works might be partially explained by differences in the applied methodology. Thus, our results suggest that, the effect of the type of school on academic performance of Spanish students should not be underestimated. Besides, another possible explanation for the discrepancy between our results and previous researches, might be the different periods of time studied. Our estimations are based on data from 2018 while the previous studies that analyzed the role of school ownership in explaining students' achievement in Spain focused in earlier periods. This means that, divergencies between students from private and public school might have increased after The Great Recession.

Furthermore, in Table 4, we have reported the estimated performance for each type of student (from public and private school) for both Mathematics and Science.

We mainly focus on the effect of regions. There are quite striking divergencies in the performance of students. For instance, we find that students attending school in Andalusia achieve a significantly lower score than students from Madrid. It is worth mentioning that, the performance of these students is lower whether they attend a private or public school. However, our results show that students from Cantabria, Castile and Leon and Navarra perform significantly better than students from Madrid. We specially emphasize the case of Navarra, which students from private school score on average 25.224 points more than students from private school in Madrid. Another interesting finding is that, we observe not only divergencies in results between students from one region or another but also in the type of education across regions. This means that, attending a public school in some regions is detrimental for the performance of students but attending a private school in these regions does not affect their score. We mainly point out the case of Canary Islands, Extremadura and Valencia which students from public school score on average in Mathematics between 13 and 27 points less than students from public school in Madrid, and score on average in Science between 9 and 18 less points than those from Madrid. Al in all, our results are in line with those found by other studies. For instance, we find significant effects of attending school in one region or another, which supports the existence of divergencies across regions (Agasisti et al., 2006). Moreover, in the paper by Cordero et al. (2010), they find that Castile and Leon is one of the most efficient regions. In the data provided by the BBVA Foundation (Pérez et al., 2018), it is shown that, Andalusia is the lowest performing region, along with Canary Islands, and Navarra is the one with the greater academic performance. In extension to these previous studies, our findings provide additional evidence supporting divergencies in public education between regions specially for Canary Islands, Extremadura and Valencia

Finally, we briefly comment the results for the rest of our control variables.

In line with the literature, we find a strong and positive effect on student's achievement of having a mother with high education level (Pianta and Harbers, 1996; Milne and Plourde, 2006). Although we find a positive and significant effect for both group of students, the impact is stronger among students from private schools. Regarding the role of mothers' occupation level, we find a negative and significant effect of having a mother with a low qualified occupation related to Service and sales, Skilled agricultural, forestry and fishing, Craft and trades and with Elementary occupation. We find however, a positive and significant effect of having a mother with a high qualified job related to a Professional occupation and to a Technician and associate professional occupation. These results are supported by other studies that focus on the importance of the transmission of intergenerational cognitive skills (Anger and Heineck, 2009), the relevance of high-paid jobs that allow parents to afford extra classes for their children (Selamat et al., 2012) and that mothers with high qualified jobs are usually more involved in their children performance (Guryan et al., 2008). We also note that, our results suggest that having a social beneficiary mother (unemployed or inactive) has a negative effect on the child performance specially among students from public school. These findings are opposed to those found in the paper carried out by Öster (2006) for Swedish students but are in line with those found in Schmitt et al. (1999) for students in United States. In which concerns the role of having a housewife mother, we find that it affects negatively the performance of children, which was already proved by Goksel (2014).

The rest of our results are similar to those found in previous investigations. For instance, females achieve a lower performance in private and public schools as it was pointed out by Campbell et al. (2000) and Trusty et al. (2011). As in Gilleece and Eiver (2018) and in Casey et al (2012), having a computer at home strongly increases the average score.

The effect of grade retention seems to be non-significant which differs to findings carried by out McCoy and Reynolds (1999) but are in line with others like the work of Chen et al. (2010). Regarding immigrant students, we find that they achieve, on average, a lower score in both types of schools. The effect is, however, stronger in private schools. These results are also in line with previous literature (Calero et al., 2009; Rong and Brown, 2002). As opposed to previous investigations, such as in Mansour and Martin (2006) and Catan (2004), we find no evidence of a significant effect of having a single room at home. Regarding the student/teacher ratio, we find a significant and negative effect as it was already found in Hoxby (2000) and Krueger (2003).

4.2. High-performing vs Low-performing (Model 2)

In this second part, we attempt to go one step further. We have found evidence supporting that, attending a private school increases the academic performance. Now, we address the question whether attending a private or public school is determinant of being amongst the high-performing students (above mean) or the low-performing students (below mean).

The results for the Oaxaca-Blinder decompositions are reported in Table 5. If we look at the results for Mathematics (Column 1), we find that the score gap between both groups of students is extremely high and strongly significant. For instance, the high- performing students score on average, 125.971 points more than the low-performing students. In this case, we observe that only 6.5 % (8.259 points) of this gap is due to the *endowments effect*, while more than 90% is explained by the *coefficients effect*. In Column 2 we find the results for the Science test. The score gap is even higher since students in the high-performing group score on average 132.013 more points than the low-performing students. Moreover, our results show that the *endowments effect* only explains 3.84% of the score gap while more than 95% is due to the *coefficients effect.* The main conclusion from these finding is that, differences between the high- and low- performing students in Spain are mainly due to non-observed characteristics (capacity, personality, culture). Our predictors explain less than 10% of the total gap. These results, however, were awaited and are in line with the rest of our findings.

We now turn the discussion onto the effects of the type of school for both group of students (high- and low- performing). The results are reported in Table 6. As we can see, among the students scoring above the mean, attending a public school is not statistically significant. However, among those below the mean, attending a public school decreases the score, on average, by 4.744 points in the Mathematics test and by 4.433 in the Science test. The interpretation for such results might be that, attending a private or public school is determinant for students' academic performance (Model 1). Nonetheless, while for high-performing students attending a private or public school is irrelevant, for the low-performing ones attending a public school is detrimental for their educational achievements (Model 2). According to what we found in the Oaxaca-Blinder decomposition, the majority of the gap between students scoring above and below the mean, is due to non-observed factors. Hence, we can assert that, these two groups of students achieve a different score due to some unobserved characteristics not included in our model. All in all, we can conclude that, for those students who are *more advantaged*, attending a public school is not determinant of their performance. In contrast, for those students who are *less advantaged*, attending a public school affects negatively their academic performance. In this sense, there is evidence supporting that students from the group below the mean, start at a more unfavourable position due to non-observed factors (personality or capacity) and additionally, their situation becomes more disadvantaged if they attend a public school.

Regarding the effects for regions, we find also quite interesting results. First, our findings suggest that attending a school in Andalusia and Canary significantly decreases the score in Mathematics and Science whether students are among the high-performing (above mean) or among the low-performing (below the mean) groups, compared to students in Madrid. Furthermore, we find evidence that high- and low-performing students in Navarra perform better in Mathematics than students in Madrid (7.209 more points among the high-performing and 7.749 more points among the low-performing). Similarly, attending school in Asturias beneficiate students in both groups for the Science test compared to those attending school in Madrid.

It is also worth mentioning the differences found for each group of students. It appears that, among the low-performing students, attending school in Cantabria is beneficial for their performance compared to low-performing students in Madrid (score 8.244 more points in Mathematics and 4.739 more points in Science). Among the high-performing ones, we find that attending school in Castile and Leon or Galicia, significantly increases the score compared to this same group in Madrid. However, attending school in Balearic Islands, Extremadura or Valencia, is detrimental for their performance.

The rest of results of our control variables are similar results to those in Model 1. For instance, having a mother with an Elementary occupation, unemployed or inactive and working as a housewife has a negative effect on the academic performance, whether the student is among the high- or low-performing group. Furthermore, being immigrant decreases the score, having a computer at home increases performance and having been retained in grade has a non-significant effect. We point out, however, three main differences compared to the results in Model 1. First, females perform worst in Science whether they are among the high-or low-performing students but for the Mathematics test, females in the low-performing group do not significantly perform different than males. This result suggesting a non-significant difference in the academic performance between females and males is supported in the investigations driven by Ebenuwa-Okoh (2010), Joseph et al. (2015) and Goni et al. (2015). Second, the evidence regarding the effect of having a mother with secondary education is not as straightforward as it was found previously. As a matter of fact, we find that among the high-performing students, having a mother with secondary education is not significant. In what concerns students with high-educated mothers (tertiary education), we still find a strong and positive effect for both group of students. Finally, as opposed to our findings in Model 1, we find non-significant effect of the student/teacher ratio which is line with previous studies (Raychaudhuri et al., 2010; Rivkin and Schiman, 2015).

5. CONCLUSIONS

Using data from PISA 2018, this paper has aimed to shed more light on two issues that have been the focus of study in the literature. First, we analyse the effect of the type of school on the academic performance of Spanish students. Second, we investigate whether attending a public or private school might be a determinant to be scoring among the high- or low-performing students.

The results of this investigation show a significant score gap between students from private and public schools, which is mostly explained by observed factors. Thus, the role of unobserved individual characteristics, such as personality or ability, seem to be negligible in explaining such disparities. We find evidence supporting that students from public schools in Spain perform much worse than students from private schools. Furthermore, our findings suggest that belonging to high-performing group of students is not determined by socioeconomic characteristics, but it is actually conditioned by unobserved factors related to capacity, personality or culture. The main novelty that we introduce in this paper, is that we find evidence supporting that low-performing students tend to be in a more unfavourable academic position (unrelated to socioeconomic factors) that is worsen if they attend a public school. However, high-performing students are not affected by the type of education they receive. This means that, they are able to achieve a higher score than the average whether they attend a public or private school.

These findings should serve as warning to policy makers in order to reduce the score gap between Spanish students from public and private schools. Moreover, authorities should not underestimate regional disparities in the educational attainment of students. They should specially be concerned by the cases of Andalusia, Canary Islands and Extremadura which students perform significantly lower than the rest of Spain. Thus, we would first recommend improving public education in Spain through new approaches to motivate teachers and students, more efficient use of resources and by increasing parents' involvement in their children's school activities. Second, policy makers should consider the possibility of a centralised educational system in order to coordinate academic programs between regions and induce to a convergence in the academic level of students.

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ANNEXES

Figure 1. PISA 2018 Results in Mathematics (EU countries)

Estonia	523
Netherlands	519
Poland	516
Denmark	509
Slovenia	509
Belgium	508
Finland	507
Sweden	502
United Kingdom	502
Norway	501
Ireland	500
Germany	500
Austria	499
Czech Republic	499
Latvia	496
France	495
Portugal	492
Italy	487
Slovak Republic	486
Luxembourg	483
Hungary	481
Lithuania	481
Spain	481
Malta	472
Cyprus	451
Greece	451
Bulgaria	436
Romania	430

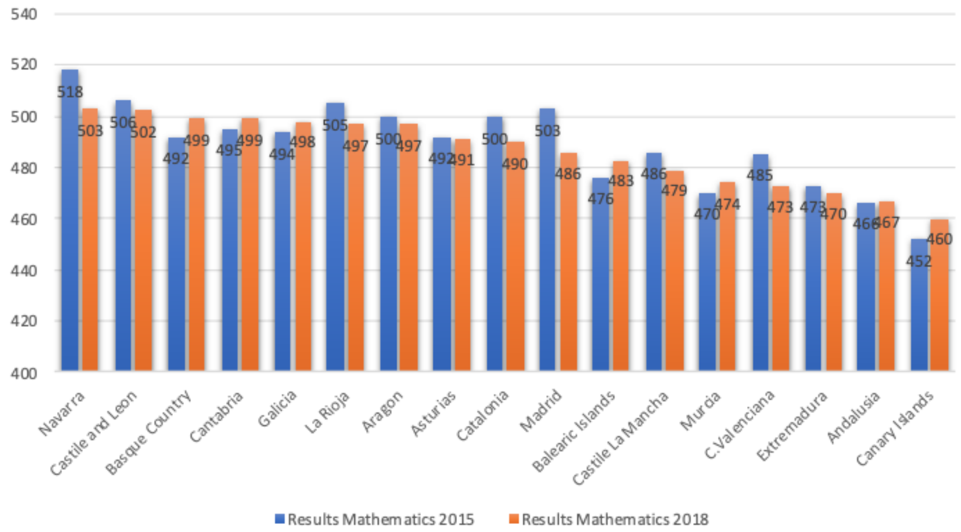
Source: OECD (Own Elaboration)

Figure 2. PISA 2018 Results in Science (EU countries)

Estonia	530
Finland	522
Poland	511
Slovenia	507
United Kingdom	505
Germany	503
Netherlands	503
Sweden	499
Belgium	499
Czech Republic	497
Ireland	496
France	493
Denmark	493
Portugal	492
Austria	490
Norway	490
Latvia	487
Spain	483
Lithuania	482
Hungary	481
Luxembourg	477
Italy	468
Slovak Republic	464
Malta	457
Greece	452
Cyprus	439
Romania	426
Bulgaria	424

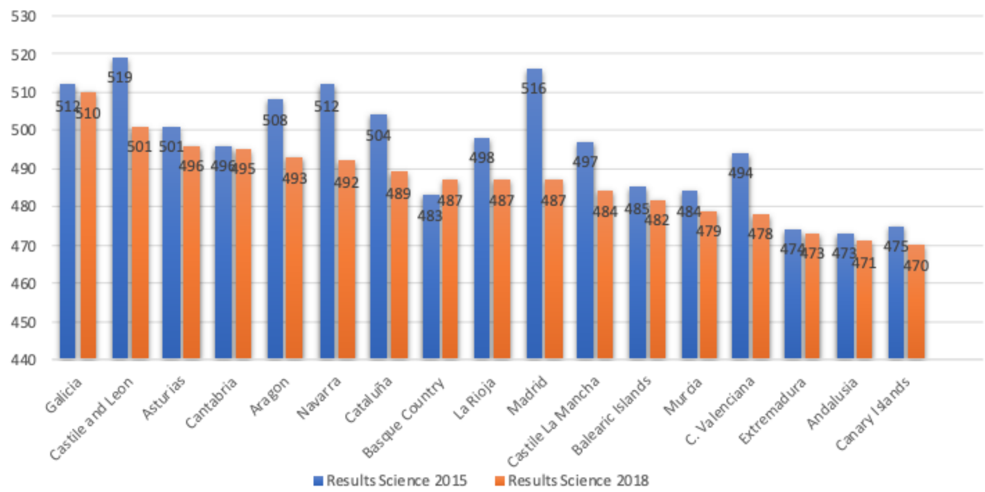
Source: OECD (Own Elaboration)

Figure 3. PISA Results in Mathematics for Spain (by Region)



Source: OECD (Own Elaboration)

Figure 4. PISA Results in Science for Spain (by Region)



Source: OECD (Own Elaboration)

Table 1. Descriptive Statistics

Variables	Observations	Standard Deviation
Regions	**35 276**	
Andalusia	1 766	0.218
Aragon	1 797	0.219
Asturias	1 896	0.225
Balearic Islands	1 723	0.215
Basque Country	3 605	0.302
Canary Islands	1 790	0.219
Cantabria	1 880	0.224
Castile and Leon	1 876	0.221
Castile La Mancha	1 832	0.229
Catalonia	1 690	0.227
Extremadura	1 816	0.201
Galicia	1 934	0.213
La Rioja	1 494	0.215
Madrid	5 014	0.349
Murcia	1 682	0.213
Navarra	1 728	0.215
Valencia	1 753	0.217
Type of School	**33 730**	
Public	24 273	0.449
Private	9 457	0.442
Mother Occupation	**32 046**	
Managers	1 621	0.219
Professional	6 694	0.406
Technicians and associate professionals	4 776	0.356
Clerical support workers	1 974	0.240
Service and sales workers	7 027	0.413
Skilled agricultural, forestry and fishery workers	232	0.084
Craft and related trades workers	1 265	0.194
Plant and machine operators, and assemblers	260	0.089
Elementary occupations	4 001	0.330
Social Beneficiary	690	0.145
Housewife	3 475	0.31
Mother Education	**33 841**	
Primary	2 904	0.280
Secondary	12 622	0.483
Tertiary	18 315	0.498
Females	17 612	0.500
Males	17 664	0.500

Source: OECD (Own Elaboration)

Table 2. Variables Description

Variable	Type of Variable	Description
Regions	**Categorical**	
Madrid	Reference	17 regions (excluding Ceuta and Melilla)
Mother Occupation*	**Categorical**	
Managers	Reference	Chiefs executives, senior officials and legislators; administrative and commercial; hospitality, retails and others
Professional		Science and engeneering; Health; Teaching; Business; information and communications; legal, social and cultural
Technicians and associate professionals		Science and engeneering; Health; Teaching; Business; information and communications; legal, social and cultural
Clerical support workers		General and keyboard; customer services; numerical and material recording; others
Service and sales workers		Personal service; sales; personal care; protective services
Skilled agricultural, forestry and fishery workers		Market-oriented; subsistence farmers, fishers, hunters and gatherers
Craft and related trades workers		Building; metal, machinery; electrical and electronic; food processing, wood working, garment and others
Plant and machine operators, and assemblers		Stationary plant and machine; drivers and mobile plant
Elementary occupations		Cleaners and helpers; agricultural, forestry and fishery labourers; food preparation; street workers; housewife; social beneficiary
Armed forces occupations		Excluded
Mother Education level	**Categorical**	
Primary	Reference	Primary or less
Secondary		Secondary or Upper secondary
Tertiary		post-secondary
Female	**Dummy**	takes value 1 if the student is female and 0 otherwise
Immigrant	**Dummy**	takes value 1 if the student is immigrant and 0 otherwise
Computer	**Dummy**	takes value 1 if the student has a computer at home and 0 otherwise
Single room	**Dummy**	takes value 1 if the student has a single bedroom and 0 otherwise
Grade retention	**Dummy**	takes value 1 if the student has ever been retained in grade and 0 otherwise
Student/Teacher ratio	**Continuous**	average number of students per teacher in school

Source: PISA (Own elaboration)

*We follow the International Standard Classification of Occupations (ISCO).

We note 2 specifications:

-There are only 32 observations for the Armed forces group. We have then excluded them and our total sample constitutes then 35 276 students.

-We have separated from the Elementary occupations group the observations corresponding to housewife and social beneficiary. Thus, we have created 2 new categories: housewife and social beneficiary. We have then a total of 11 occupation categories.

Table 3. Oaxaca-Blinder decomposition for public and private schools (Model 1)

	Math Score		Science Score	
	Coefficient	**P-value**	**Coefficient**	**P-value**
Private	510.176*** (0.796)	0.000	506.579*** (0.817)	0.000
Public	490.972*** (0.535)	0.000	492.213*** (0.549)	0.000
Difference	19.203*** (0.960)	0.000	14.366*** (0.985)	0.000
Decomposition				
Endowments	11.827*** (0.550)	0.000	7.961*** (0.537)	0.000
Coefficients	6.217*** (1.040)	0.000	6.359*** (1.097)	0.000
Interaction	1.158* (0.685)	0.091	0.044 (0.721)	0.95

Note: *p<0.10; **p<0.05; ***p<0.01

Table 4. Public vs Private school (Model 1)

	(1)		(2)		(3)		(4)	
	Group 1: Private School		Group 2: Public School		Group 1: Private School		Group 2: Public School	
Dependent Variable	Math Score				Science Score			
Independent Variables	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Mother Education level								
Ref .Var: Primary								
Secondary	18.558***	0.000	4.628***	0.008	14.790***	0.001	1.279	0.483
	(4.042)		(1.732)		(4.260)		(1.793)	
Tertiary	40.530***	0.000	26.448***	0.000	33.887***	0.000	20.004***	0.000
	(4.057)		(1.810)		(4.266)		(1.907)	
Mother Occupation								
Var. Ref: Manager								
Professional	11.759***	0.000	12.107***	0.000	13.188***	0.000	13.488***	0.000
	(3.218)		(2.607)		(3.396)		(2.745)	
Technicians and associate professional	7.661***	0.022	3.487	0.196	10.326***	0.004	7.217**	0.011
	(3.354)		(2.694)		(3.540)		(2.838)	
Clerical support worker	7.888*	0.052	-0.165	0.957	10.174**	0.017	2.832	0.382
	(4.053)		(3.076)		(4.278)		(3.239)	
Service and sales worker	-14.224***	0.000	-19.771***	0.000	-10.303***	0.004	-15.691***	0.000
	(3.347)		(2.587)		(3.533)		(2.729)	
Skilled agricultural, forestry and fishery worker	-18.537	0.194	-23.939***	0.000	-25.446*	0.091	-22.635***	0.000
	(14.255)		(5.604)		(15.046)		(5.902)	
Craft and related trades worker	-10.126**	0.048	-15.783***	0.000	-5.006	0.355	-12.055***	0.001
	(5.122)		(3.352)		(5.406)		(3.531)	
Plant and machine operator, and assembler	-22.282**	0.022	-14.416**	0.012	-11.711	0.252	-8.810	0.143
	(9.692)		(5.712)		(10.230)		(6.016)	
Elementary occupation	-24.268***	0.000	-27.005***	0.000	-15.620***	0.000	-23.369***	0.000
	(3.912)		(2.795)		(4.130)		(2.873)	
Social Beneficiary	-16.306**	0.011	-34.473***	0.000	-7.679	0.257	-31.742***	0.000
	(6.420)		(4.003)		(6.706)		(4.217)	
Housewife	-12.267***	0.002	-27.005***	0.000	-11.322***	0.007	-24.655***	0.000
	(3.966)		(2.795)		(4.186)		(2.944)	
Regions								
Var. Ref: Madrid								
Andalusia	-14.690***	0.002	-15.798***	0.000	-12.111***	0.014	-11.249***	0.000
	(4.678)		(2.401)		(4.938)		(2.529)	
Aragon	7.254**	0.043	5.444**	0.028	4.704	0.266	2.845	0.275
	(3.992)		(2.475)		(4.226)		(2.607)	
Asturias	6.065	0.137	-1.615	0.508	10.594***	0.009	5.027*	0.051
	(3.822)		(2.441)		(4.035)		(2.572)	
Balearic Islands	-3.085	0.726	-7.823***	0.002	-3.736	0.421	-8.651***	0.001
	(4.365)		(2.466)		(4.642)		(2.598)	
Basque Country	12.346***	0.000	-7.407***	0.002	-0.885	0.769	-14.998***	0.000
	(2.846)		(2.430)		(3.012)		(2.560)	
Canary Islands	1.593	0.771	-26.410***	0.000	12.480**	0.031	-18.003***	0.000
	(5.478)		(2.370)		(5.781)		(2.497)	
Cantabria	13.926***	0.001	9.684***	0.000	5.102	0.219	7.871***	0.003
	(3.936)		(2.471)		(4.154)		(2.604)	
Castile and Leon	11.471***	0.003	13.099***	0.000	7.714*	0.055	13.734***	0.000
	(3.812)		(2.464)		(4.023)		(2.595)	
Castile La Mancha	6.032	0.24	-4.610**	0.048	7.562	0.163	1.465	0.551
	(5.138)		(2.330)		(5.423)		(2.455)	
Catalonia	-4.895	0.218	-1.560	0.540	-8.507**	0.042	0.195	0.942
	(3.969)		(2.546)		(4.189)		(2.682)	
Extremadura	-7.162	0.112	-16.779**	0.000	-4.146	0.383	-11.719***	0.000
	(4.500)		(2.427)		(4.750)		(2.557)	
Galicia	0.34	0.938	10.329***	0.000	5.670	0.216	25.749***	0.000
	(4.346)		(2.363)		(4.750)		(2.489)	
La Rioja	3.531	0.338	14.743***	0.000	-9.485**	0.015	4.558	0.160
	(3.684)		(2.401)		(3.888)		(3.242)	
Murcia	10.035**	0.012	-4.759*	0.062	12.519***	0.003	2.168	0.420
	(3.977)		(2.554)		(4.198)		(2.691)	
Navarra	25.224***	0.000	6.057**	0.028	9.472***	0.012	-2.577	0.374
	(3.551)		(2.754)		(3.748)		(2.902)	
Valencia	-4.152	0.308	-13.234***	0.000	-2.648	0.538	-9.124***	0.001
	(4.071)		(2.500)		(4.297)		(2.634)	
female	-7.786***	0.000	-11.1311***	0.000	-3.712***	0.018	-6.978***	0.000
	(1.480)		(0.975)		(1.562)		(1.027)	
computer	26.075***	0.000	35.287***	0.000	29.065***	0.000	35.507***	0.000
	(3.129)		(1.566)		(3.356)		(1.926)	
single room	0.489	0.835	3.665**	0.019	-2.857	0.249	-0.548	0.740
	(2.348)		(1.566)		(2.478)		(1.649)	
grade retention	-1.245	0.599	-1.835	0.243	-1.494	0.55	-0.684	0.679
	(2.367)		(1.571)		(2.498)		(1.655)	
immigrant	-41.257***	0.000	-36.971***	0.000	-28.681***	0.000	-27.741***	0.000
	(3.061)		(1.662)		(3.231)		(1.751)	
Student/Teacher Ratio	-0.007***	0.005	-0.005***	0.005	-0.009***	0.001	-0.003	0.124
	(0.002)		(0.001)		(0.002)		(0.001)	
Observations	8 444		21 250		8 444		21 250	
R^2	0.1459		0.1754		0.0968		0.1313	

Note: Column (1) and Column (2) present the results for Mathematics
Column (3) and Column (4) present the results for Science
*p<0.10; **p<0.05; ***p<0.01

Table 5. Oaxaca-Blinder decomposition for High-performing and Low-performing students (Model 2)

	Math Score		Science Score	
	Coefficient	P-value	Coefficient	P-value
Above mean	553.217*** (0.330)	0.000	544.371*** (0.356)	0.000
Below mean	427.245*** (0.416)	0.000	412.413*** (0.413)	0.000
Difference	125.971*** (0.531)	0.000	132.013*** (0.545)	0.000
Decomposition				
Endowments	8.259*** (0.316)	0.000	5.071*** (0.264)	0.000
Coefficients	118.351*** (0.577)	0.000	125.499*** (0.584)	0.000
Interaction	-0.638 (0.393)	0.104	1.443*** (0.478)	0.000

Note: *p<0.10; **p<0.05; ***p<0.01

Table 6. High-performance and Low-performance students (Model 2)

	(1)		(2)		(3)		(4)	
	Group 1: Above mean		Group 2: Below mean		Group 1: Above mean		Group 2: Below mean	
Dependent Variable	**Math Score**				**Science Score**			
Independent Variables	**Coefficient**	**P-value**	**Coefficient**	**P-value**	**Coefficient**	**P-value**	**Coefficient**	**P-value**
School ownership								
Ref. Var: Private								
Public	-1.100 (0.722)	0.127	-4.744*** (0.978)	0.000	-1.281 (0.790)	0.105	-4.433*** (1.117)	0.000
Mother Education level								
Ref . Var: Primary								
Secondary	-0.309 (1.523)	0.839	5.371*** (1.312)	0.000	-2.703* (1.536)	0.079	3.062** (1.324)	0.021
Tertiary	7.287*** (1.535)	0.000	13.640*** (1.399)	0.000	5.593*** (1.560)	0.000	9.752*** (1.414)	0.000
Mother Occupation								
Var. Ref: Manager								
Professional	5.084*** (1.474)	0.001	2.446 (1.246)	0.283	7.630*** (1.642)	0.000	3.916* (2.275)	0.085
Technicians and associate professional	0.893 (1.540)	0.562	1.697 (2.315)	0.464	2.718 (1.915)	0.111	5.207** (2.335)	0.016
Clerical support worker	-0.474 (1.790)	0.657	1.889 (2.689)	0.482	0.876 (1.985)	0.659	5.213* (2.709)	0.054
Service and sales worker	-8.326*** (1.554)	0.000	-5.800** (2.765)	0.007	-7.534*** (1.700)	0.000	-2.030 (2.159)	0.347
Skilled agricultural, forestry and fishery worker	-8.719* (4.672)	0.062	-4.254 (4.456)	0.340	-8.745* (4.920)	0.076	3.770 (4.400)	0.392
Craft and related trades worker	-8.396** (2.185)	0.000	-3.800 (2.765)	0.169	-6.604*** (2.358)	0.005	0.204 (2.798)	0.942
Plant and machine operator, and assembler	-6.57 (4.054)	0.105	-3.239 (4.583)	0.480	3.713 (4.275)	0.385	1.231 (4.681)	0.792
Elementary occupation	-10.444*** (1.760)	0.000	-9.568*** (2.237)	0.000	-9.267*** (1.891)	0.000	1.231 (4.681)	0.167
Social Beneficiary	-5.941** (2.913)	0.041	-15.216*** (3.124)	0.000	-3.759 (3.120)	0.228	-3.108** (2.250)	0.010
Housewife	-7.669*** (1.779)	0.000	-8.916*** (2.298)	0.000	-6.080*** (1.933)	0.002	-7.991* (3.092)	0.058
Regions								
Var. Ref: Madrid								
Andalusia	-6.971*** (1.777)	0.000	-6.510*** (1.983)	0.001	-3.460* (1.893)	0.068	-3.769* (1.994)	0.059
Aragon	4.036** (1.592)	0.011	1.990 (2.167)	0.358	1.975 (1.743)	0.257	-1.647 (2.191)	0.452
Asturias	1.961 (1.588)	0.217	1.189 (2.062)	0.567	4.930*** (1.703)	0.004	2.584** (2.143)	0.228
Balearic Islands	-6.463*** (1.691)	0.000	0.914 (2.101)	0.663	-4.610** (1.851)	0.013	1.797 (2.086)	0.389
Basque Country	0.188 (1.341)	0.888	0.667 (1.828)	0.715	-5.547*** (1.495)	0.000	-1.562 (1.782)	0.381
Canary Islands	-8.273*** (1.911)	0.000	-5.961*** (1.931)	0.002	-6.300*** (1.937)	0.001	-2.587 (1.990)	0.194
Cantabria	1.858 (1.561)	0.234	8.244*** (2.192)	0.000	1.808 (1.724)	0.294	4.739*** (2.188)	0.030
Castile and Leon	5.807*** (1.529)	0.000	2.136 (2.213)	0.335	5.956*** (1.686)	0.000	2.671 (2.23)	0.232
Castile La Mancha	-1.890 (1.664)	0.256	-2.354 (2.048)	0.250	1.571 (1.790)	0.380	1.721 (2.080)	0.408
Catalonia	0.307 (1.665)	0.853	0.535 (2.130)	0.802	2.471 (1.815)	0.173	-0.135 (2.142)	0.950
Extremadura	-5.642*** (1.809)	0.031	-1.825 (1.962)	0.352	-4.294** (1.898)	0.024	1.225** (1.992)	0.538
Galicia	3.377** (1.566)	0.002	3.691* (2.141)	0.085	12.410*** (1.669)	0.000	4.691 (2.318)	0.043
La Rioja	5.338*** (1.749)	0.677	-2.093 (2.441)	0.391	0.533 (1.981)	0.788	-2.098 (2.326)	0.367
Murcia	0.711 (1.707)	0.000	-1.377 (2.085)	0.509	3.819** (1.818)	0.036	-0.694 (2.151)	0.747
Navarra	7.209*** (1.602)	0.000	5.749** (2.286)	0.012	1.999 (1.800)	0.267	1.665 (2.205)	0.450
Valencia	-5.086*** (1.773)	0.004	2.423 (1.991)	0.224	-5.421*** (1.849)	0.003	1.727 (2.055)	0.401
female	-9.857*** (0.640)	0.000	0.538 (0.804)	0.504	-7.699*** (0.694)	0.000	1.803** (0.810)	0.026
computer	9.340*** (1.607)	0.000	14.960*** (1.288)	0.000	11.976*** (1.637)	0.000	12.256*** (1.272)	0.000
single room	-0.749 (1.061)	0.480	3.826*** (1.234)	0.002	-2.095* (1.317)	0.065	-0.722 (1.246)	0.663
grade retention	-0.474 (1.033)	0.646	-0.173 (1.288)	0.892	-1.410 (1.115)	0.206	0.827 (1.301)	0.525
immigrant	-10.446*** (1.440)	0.000	-17.174*** (1.208)	0.000	-10.043*** (1.425)	0.000	-10.353*** (1.222)	0.000
Student/Teacher Ratio	-0.002* (0.001)	0.073	-0.0007 (0.001)	0.960	-0.003*** (0.001)	0.009	0.001 (0.001)	0.289
Observations	13 385		13 798		18 881		10 813	
R^2	0.077		0.0853		0.0559		0.0500	

Note: Column (1) and Column (2) present the results for Mathematics
Column (3) and Column (4) present the results for Science
*p<0.10; **p<0.05; ***p<0.01