Effectiveness of State Funded Private Schools Versus Public Schools: A Comparative Analysis in Portugal

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This study compares the effects of private versus public school administration on student performance in Portugal, which benefits from the existence of state funded private schools. We have constructed two measures of students' achievements in order to compare the effectiveness of each type of school. Firstly, a Logit is used to estimate the probability of completing Lower Secondary School (7th to 9th grade) in three years. Secondly, we employ a Value-Added approach by OLS, to compare national exam scores at 9th grade. Our findings suggest that, on average, students attending a state funded private class from 7th grade to 9th grade, when compared to those attending a public school class, are more likely to complete lower secondary cchool with zero retentions by approximately 1.7 percentage points. With respect to the 9th grade national exams, there is evidence that attending a state funded private class increases national exam scores by 0.07 s.d. in Mathematics and 0.04 s.d. in Portuguese, when compared to attending a public school class. We also used an instrument to tackle endogeneity arising from the self-selection of students into private schools, althought this proved not to be the case.
Keywords: state funded private schools; effectiveness; value-added; national exams

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INTRODUCTION

Despite the motivation for the existence of public-private partnerships in school systems being the improvement of learning outcomes of students (Flaker, 2014), in Portugal the so-called "***C**ontratos de **A**ssociação*" were implemented due to the lack of public school provision in some specific geographic areas, which meant that not all students were given the opportunity to benefit from public government-financed education. Accordingly, instead of creating new infrastructures that would require more time and money, the Portuguese Ministry of Education came up with the following solution: the funding of education in certain private schools to ensure education was available to everyone who had enrolled in the public-school network. However, more recently the Portuguese government has been conducting educational reforms, by reducing the number of classes under these contracts[1], thus reallocating students to regular public schools[2]. Are students in state funded private schools getting worse results? If so, is this caused by the different property management schemes? These are some of the questions we will address during this study.

The fundamental advantage, for a researcher, of the coexistence of state funded private schools, regular public schools and strictly private schools in Portugal, as mentioned by Rosado and Seabra (2015), is that we have two groups of students - from state funded private schools and regular public schools - that are more homogeneous with respect to family income when compared to a third group of students from strictly private schools, who tend to come from wealthier families[3]. Strictly private schools and state funded private schools have more freedom in terms of staff hiring decisions, while regular public schools are obliged to follow centralized state decisions. Therefore, a comparison between regular public school and state funded private school students may be the best way to isolate the impact of property management schemes on students' educational outcomes. Hence, this will be the primary goal and focus of this research as both public and state funded private schools constitute two freely available educational alternatives. Thus, we will add our contribution to the somewhat scarce literature currently available in Portugal regarding the effectiveness of state funded private schools. For simplicity, henceforth we will refer to state funded private classes as classes in which students are fully exempted from tuitions fees, within the Portuguese context.

This study extends the work of Rosado and Seabra (2015) by using a richer dataset. We use cross-sectional data but instead of using the cohort of students at the 9th grade in the academic year 2009/10, we resort to five different cohorts of students at the 6th grade, from the academic year 2008/09 to the academic year 2012/13. Each cohort is established to capture the first observation of a given student at 6th grade, i.e. the academic year in which the student enters the 6th grade for the first time. Therefore, our dataset contain students that

[1] See Figure 1 in Section 4.1 and Tables A.4. and A.5. in Appendix

[2] *"Contratos de Associação"* are pluriannual contracts signed between the government and private schools at the beginning of each school cycle, meaning that a new class established in the 7th grade in 2009/10 in a state funded private school will be financed for at least three years, until the 9th grade, even though the government may choose not to finance new 7th grade classes in 2010/11 in that state funded private school

[3] In this study we use subsidies awarded to families based on aggregate income and family composition as a proxy for family income

enter the 6th grade between the academic year 2008/09 and the academic year 2012/13. Moreover, we observe the students' academic achievement both in terms of the time required to finish lower secondary school (7th to 9th grade) and the Mathematics and Portuguese language standardized test scores obtained in the 9th grade. We then use a Logit Model to estimate the probability of completing lower secondary school without retentions in opposition to being retained once. We also implement a Value-Added approach for the exam scores obtained at the 9th grade, using 6th grade national exams as the baseline. This second approach is quite often used in Economics of Education to account for the cumulative effects of prior education inputs on current achievement level (Sass, 2006).

In the robustness section, we model the school type choice using an instrumental variable since we suspect that enrolling a student in a private school is an endogenous decision. There might be unobservable factors that affect both the student's performance and the decision to enroll a student in a private school. In addition to the classic two stage least squares (2SLS) estimation, we use the instrument to implement a simultaneous equations model to account for the possible nonlinear nature of the school type choice decision. Furthermore, we implement propensity score matching to estimate the average treatment effect (ATE) of studying in a state funded private class as opposed to studying in a public school class. Lastly, we regress each achievement measure by cohort in an attempt to capture differences between the students' cohorts.

After constructing an instrument that takes the difference in the distance (in minutes) between the student's nearest state funded private school and the nearest public school, we do not find evidence that the school choice is endogenous. Therefore, the results obtained are the following: there is evidence that a student attending a state funded private school from 7th grade to 9th grade, on average, is 1.7 percentage points (p.p.) more likely to finish lower secondary school in three years when compared to a student attending a public school from 7th grade to 9th grade. However, this positive effect of private school administration on students' graduation is not visible in all the cohorts.

With respect to students' performance in national exams at 9th grade, we corroborate the findings of Rosado and Seabra (2015) with regard to the positive impact of attending a state funded private class compared to public school class. On average, studying in a state funded private class during lower secondary school, *ceteris paribus*, increases 9th grade national exam score by 0.07 standard deviations and 0.04 standard deviations in Mathematics and Portuguese, respectively, compared to a student enrolled in a public school class. Nevertheless, likewise the results obtained for the **Probability of Graduation on Time**, the positive effect from private school administration on 9th grade national exam scores is not present in all the cohorts, as the coefficient becomes not statistically different from zero.

The structure of this research is organized in the following manner: Section 2 is devoted to Literature Review; Section 3 presents some facts about the Portuguese Education System and the nature of ***C**ontratos de **A**ssosiação* (CA); Section 4 describes the data, the variables used throughout the study and the group decomposition of each type of school; Section 5 reports the methodology used; Section 6 is devoted to results obtained; Section 7 we perform robustness checks; and finally the last Section 8 is dedicated to our conclusion and policy implications.

LITERATURE REVIEW

The debate around educational funding and school administration is quite extensive and comprises decades of research, mainly fostered by attempts to identify whether there are significant differences in the public and private school system management. The challenge of measuring school quality differences under private and public administrations however, lies in separating students' achievement from differences in students' background (Hanushek *et al.*, 2007).

There is a widespread consensus that students who attend strictly private schools tend to come from more privileged socioeconomic backgrounds, since the high tuition fees encountered in these schools impose a financial barrier to many families (Mancebón *et al.*, 2010; Flaker, 2014), thereby generating a self-selection problem that may bias the results of private school attendees. In general, the direction of the selection bias is in favor of private school students. As Hanushek *et al.* (2015) stated, differences in early experiences in childhood (pre-school), which are closely linked to family background, may explain differences in students' achievement at school. Students who are given opportunities and incentives to develop cognitive and non-cognitive skills earlier in life tend to come from wealthier families. Their parents are also generally more educated and tend to enroll their children in private schools, and thus the direction of the bias will be in favor of private schools.

However, it might be the case that the bias from self-selection into some types of private schools is downwards. Noell (2012) in a reanalysis of the '*Public and Private'* by Coleman et al., corrected self-selection into Catholic schools using an Instrumental Variable of students' religious identification as Catholic. Noell reports a negative bias of the impact of Catholic school attendance on sophomore reading score tests implemented in different states of USA, caused by unmeasured factors which affect both school choice and students' achievement.

Given Noell's findings, it is possible that, despite the extensive controls used for students' backgrounds, there may exist other unmeasured factors in self-selection into the private sector that are correlated with higher achievement (Coleman, Kilgore and Hoffer, 1982), in particular the factor of students' ability**.** This in fact, sparked many different reactions against the apparent superiority of private school system administration.

Epple and Romano (2002) provide evidence that private schools practice cream-skimming by accepting students based on income and ability stratification, i.e. to retain the most able students and encourage transfer or even drop-out - of low performing students, thus implying that private school results are upwardly biased.

Jimenez, Lockheed and Paqueo, (1991), advocate that since private schools must compete for students to remain financially viable, and given their autonomy and freedom to adjust to the needs of students and parents, the right incentives are in place to manage resources and staff in the most effective and efficient way. Hence, the free market competition promotes efficiency and forces private schools to attain high standards of excellence (Mancebón *et al.*, 2010).

Focusing now on the empirical findings regarding effectiveness of state funded private schools, Rosado and Seabra (2015) evaluate the relative performance of public versus private schools in

Portugal, using state funded private schools to isolate the impact of background from the property and management school schemes. Employing cross-section data to compare students at the 9th grade in 2010, they find a positive effect of private ownership in students' performance in national exams. After controlling for students' individual characteristics e.g. age and gender, and background (the latter mainly district controls), belonging to a state funded private school increases the probability of passing the 9th grade national exam by 2.34% for Mathematics and by 2.06% for Portuguese subject, when compared to a public school. However, when considering the impact of school administration on students' consistency over academic years, being in a state funded private school decreases by 0.79% the probability of reaching 9th grade without any retention; increases by 0.68% the probability of being retained once; and increases by 0.11% the probability of being retained more than once when compared to public schools. The advantage of the current study is that we have a richer dataset, since it is possible to observe students in different periods, thus controlling for past historical education inputs (prior achievement scores). Nevertheless, the overall results are similar.

Mancebón *et al.* (2010), conduct a non-parametric efficiency analysis (Data Envelopment Analysis) in the context of public schools and state funded private schools in Spain, using microdata from PISA 2006 on science competencies. After controlling for students' background and school resources, and after removing individual management inefficiencies, they find that public schools are more efficient than state funded private schools, i.e. students in public schools have better results than state funded private schools in science PISA scores, while the former use equal or fewer resources than the latter.

Some countries have Charter schools, another type of school choice program that differs mainly in school administration, given that they can be either privately or publicly owned and managed. Charter schools are state funded and foster student learning by promoting educational innovation while allowing more autonomy and freedom with regards to school governance (Robert Bifulco, 2006). Flaker (2014) using data from students in the 8th grade in Massachusetts, reports that Charter schools outperform traditional public schools in schoolwide proficiency scores in both math and reading, whilst being more efficient in doing so, i.e. spending less money per student. Note, however, that even though Flacker disaggregated data by community type to control for variation between urban and non-urban systems, this was an observational study and thus the author did not consider different student characteristics, prior ability nor family background, raising concerns about the results obtained due to selection bias.

Similarly to what Mancebón *et al.* (2010) did in Spain**,** Grosskopf, Hayes and Taylor (2009) employ a non-parametric approach (DEA) to compare efficiency of Charter schools relative to traditional public schools in Texas, for students in elementary grades at metropolitan or micropolitan areas during the 2001/02 academic year. They find that Charter schools are more technically efficient than traditional public schools, i.e. Charter schools produce better outcomes - such as net improvements in math and reading standardized tests - using the same or fewer resources than traditional public schools.

PORTUGUESE EDUCATION SYSTEM & *CONTRATOS DE ASSOCIAÇÃO*

In Portugal, since 2009[4], education is mandatory until the 12th grade and is divided in two different stages: *Ensino Básico* and *Ensino Secundário.* The former comprises three school cycles: *1º Ciclo* – 1st to 4th grade; *2º Ciclo* – 5th and 6th grade; *3º Ciclo* – 7th to 9th grade. *Ensino Secundário* comprises 10th to 12th grade and corresponds to the last school cycle before higher education, which is not compulsory. For this study, we use national exams for Portuguese and Mathematics subjects at the 9th grade in order to compare scores between students in different types of school between the academic year 2011/12 and 2016/17. We also use national exams for Portuguese and Mathematics subjects at the 6th grade as our past achievement control between the academic year 2008/09 and 2012/13. However, during the scope period of this research, from 2008/09 until 2010/11, the 6th grade national exams were not compulsory thus not affecting the final grade of the subject. From the academic year 2011/12 until 2014/15, the 6th grade national exams were compulsory and scores would affect the 6th grade final evaluation of the student.

Regarding ***C**ontratos de **A**ssociação*, these are pluriannual contracts established by the government with private schools to guarantee public education, free of tuition fees, in areas in which the provision of public schools is scarce (or non-existent)[5]. This point is extremely important since there are districts in which there are no state funded private schools. Hence, it might be the case that students whose parents cannot afford tuitions in private schools, do not have feasible alternatives, i.e. they will be bound to a public school in his or her municipality[6].The first law providing the basis for these contracts dates back to 1980[7], when Portugal experienced a change in the law which extended mandatory schooling until the 9th grade[8], and established public funding at the individual level which was consistent with the amount spent in public schools with the same level and equivalent degree of education. From 2015/16, the government decided to publicly fund private schools at the class level, allocating 80.500€ per class and per academic year.

Students who enroll in private schools are subject to the criteria defined by private agents, whilst in both public schools and state funded private schools, students who apply to benefit from public education are assigned based on their residential area and - subject to the maximum school capacity - are able to rank their school choice preferences[9].

With regard to teachers' hiring and allocation, private schools and state funded private schools have freedom to hire teachers in accordance with their own criteria. In public schools the school principal does not exert that function, it being the responsibility of the Ministry of Education's to allocate teachers based on their preferences, experience and grades upon graduation (Ferreira, 2015).

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4 Portuguese Law nr.85/2009 of 27th August (Article nr.1 and nr.2)

5 In Portugal there are other types of contracts between private schools and the government that are not addressed in this study, namely *Contratos Simples*, *Contratos de Patrocínio*, *Contratos de Desenvolvimento*

6 This topic will be reviewed in section 4.1.

7 Portuguese Decree-Law nr.553/80 of 21th November (Article nr.14-16)

8 Portuguese Law nr.45/86 of 14th October (Article nr.6)

9 Interestingly, students who apply to a certain school and whose sibling(s) are already studying there have priority; a possible explanation could be to facilitate transportation among the household

DATA, VARIABLES & GROUP DECOMPOSITION

The data used in this study belongs to the DGEEC[10] (Direção-Geral de Estatísticas da Educação e Ciência) from the Portuguese Ministry of Science and Education (MEC). From MISI dataset, which contains the entire population in Portugal from the 1st grade up to the 12th grade in public schools and state funded private schools, with respect to students and teachers, we collected information distributed among two distinguishable groups of variables, which we will refer to as 'vector regressors' in the Analytical Framework section.

The first group of variables concerns students' individual characteristics including gender and age. Additionally, we built a proxy for family income, *Child_Support*, which is a dummy variable that takes the value 1 if the student's family received social support from the Portuguese Social Security. Regarding the validity of this proxy, we argue that it is closely linked with socio-economic status since social support is awarded on the basis of family aggregate income, family composition (i.e. number of children), and the student's current employment status. Nevertheless, it may not, by itself, be sufficient to control for family background. Hence, we also include a dummy variable of Parent's Education, separately, for father and mother, that takes the value 1 if the student's father or mother has an education degree equal or higher than Bachelors, and 0 otherwise[11]. Finally, there are two additional controls, also dummy variables, if the student has home access to Computer or Internet.

The second group of variables include a set of school characteristics, such as school district, municipality and type of school or class. We separate school from class, since it is possible that one school is not fully financed by the contracts (***C**ontratos de **A**ssociação*), meaning that there will be a mix of state funded private classes and regular private classes[12]. Either public school or state funded private school are dummy variables and will measure the impact of attending a certain type of school. The description of the variables is summarized in **Table A.1** in the Appendix.

Additionally, we use data of Portuguese and Mathematics national exams scores at 6th and 9th grades from JNE[13] (Júri Nacional de Exames) to construct the measure of students' achievement with the **Value-Added** approach, with 9th grade exam being the output variable, and 6th grade exam the baseline of the student[14].

The dataset starts at the academic year 2006/07 and continues until the academic year 2016/17. However, because data of state funded private schools only starts at the academic year 2008/09, we restrict the population and take the cohort of students at the 6th grade who

[10] DGGEC is the entity responsible for collecting, monitoring, treating, producing and releasing statistics with regards to the Portuguese education system

[11] In order to keep students whose values for Parent's Education were missing, we created another category for the students with missing values

[12] However, since we do not consider students from private schools in this research, state funded private schools or state funded private classes are exactly the same

[13] JNE is integrated into the DGE (Direção-Geral da Educação) and is responsible for coordinating, planning and executting final cycle exams, national final examinations and school-level examinations equivalent to national tests

[14] Notice that there are two phases of national exam scores in the same academic year, and the data collected corresponds to the 1st exam phase taken by the student

performed both Portuguese and Mathematics national exams between the academic year 2008/09 and 2012/13 for the first time. The baseline scores of 6th grade national exams are reported on a scale from 1 to 5. However, the 9th grade national exam scores which we use to compare the effectiveness of each school type, are reported on a scale from 0 to 100. In addition, we standardize both 6th and 9th grade national exam scores at the population level.

In the analysis, only students from the Portuguese mainland in the regular academic track were considered. Besides, it was necessary to observe the students in the three grades of lower secondary school (7th, 8th, and 9th) to record the time required for graduation. Moreover, for the **Value-Added** approach**,** we required that each student had both Portuguese and Mathematics national exam at 9th grade. In summary, the measures of the **Probability of Graduation on Time** and the **Value-Added** will reflect the impact of attending the same school type throughout the three grades, e.g. studying the impact of attending 7th, 8th and 9th grade in a state funded private class compared to a public school class.

Descriptive Statistics

In this subsection, we compare students from different types of school. According to DGEEC's reports **(Table A.2 and A.3)**, the percentage of students enrolled in public schools is by far the largest among the three available alternatives, as expected. The proportion of students attending state-dependent private schools[15] is stable between the academic year 2008/09 and 2016/17 with the exception for the 5th grade and the 7th grade. In these school grades the Ministry of Education decides whether or not they will finance new classes of state funded private schools throughout the Portuguese's school cycles (*2º and 3º Ciclo*). In 2016/17, we can observe both an absolute and relative reduction of students enrolled in state-dependent private schools, in line with the goals established by the Ministry of Education, elected in late 2015.

Regarding the distribution of schools within mainland Portugal, it is possible to identify some factors that may affect the comparison between schools, specifically schools' territorial distribution. **Figure 1**[16] below, displays the percentage of students attending a state funded private class, in each district, relative to students attending a public school class, at the 7th grade in the academic year 2015/16 (left-side) and in the academic year 2016/2017 (right-side), for the students reported on the MISI dataset[17]. It is possible to verify that there are four districts of mainland Portugal in which there are actually no state funded private classes[18]. Also notice that the number of students in state funded private classes in the 7th grade was reduced from 7 258 students in the academic year 2015/16 to 4 287 students in the academic year 2016/17 (41% reduction), according to the data retrieved from MISI. In addition, **Figure 1** provides evidence

[15] Including state funded private classes i.e. the students are exempted from tuitions fees

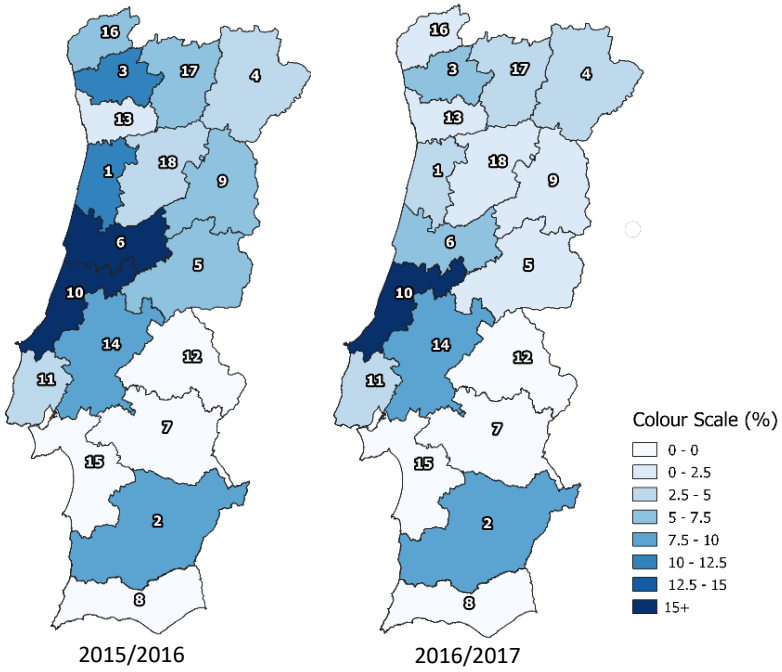
[16] District labels are reported on Table A.4. or Table A.5. in Appendix

[17] See Table A.4. and Table A.5. in Appendix the corresponding data; note that the number of students reported on the MISI dataset exceeds those reported by DGEEC's report. This is due to the fact that the MISI dataset is an administrative dataset which might contain some minor percentage of duplicates and errors, thus there are more students than in the official reports

[18] This issue it tackled by imposing that the maximum allowed distance, in minutes, between the student's nearest state funded private school and the nearest public school is 35 minutes

that the reduction in absolute terms was followed by a reduction in relative terms to students attending public schools. The reduction in relative terms occurred mostly in the center/north of mainland Portugal, from the academic year 2015/16 to the academic year 2016/17, in particular at the district of Coimbra (number 6). Thus, combining both the data from DGEEC's annual reports of students 'enrollment and the data from the MISI database of students territorial distribution by type of school, it is possible to verify the government efforts to reallocate students to public school classes, and reduce the expenditure attributed to private parties.

Figure 1: Percentage of students (per district) in state-funded private class, 7th grade



Our sample consists of 336 078 individuals that we can follow from 6th grade until 9th grade and performed national exams of Mathematics and Portuguese in both school grades. Of this sample, we only used 240 249 on the robustness tests due to the presence of an important variable that was created based on the students' postal code. At this point, it is important to point out that in order to have cohorts with a similar timeline, the students observed either completed lower secondary school in three or four years. Hence, we ended up with five different cohorts of students that differ in the first observation at the 6th grade and the 9th grade [19]. In addition, the national exam scores either collected in the 6th grade or in the 9th grade correspond to the first time the student performed the exams.

From **Table 1 (**Section B) below we confirm Rosado and Seabra's (2015) statement that students from public schools, i.e. those studying in public school classes, are closer to their peers in state funded private classes, in Portugal, with respect to family income, - as measured by our proxy *Child Support*. In all the three grades of lower secondary school, the percentage of students receiving child support is quite similar and stable. The maximum relative difference between

[19] See Table A.6. in Appendix the cohorts composition explained

both types of class is verified in the 8th grade, where students in public school classes receive 6.95 percentage points more child support than students in state funded private classes.

Table 1. Sample Group Decomposition by type of school

TYPE OF SCHOOL	State Funded Private Schools	Public Schools	TOTAL
N	22 038	314 040	336 078
% of Students	6,56%	93,44%	100,00%
SECTION A: National Exam Scores			
Score9thMAT (mean)	0.29 (0.96)	0.04 (0.97)	0.05 (0.97)
Score9thPT (mean)	0.20 (0.98)	0.03 (0.97)	0.05 (0.97)
Score6thMAT (mean)	0.42 (0.91)	0.24 (0.91)	0.25 (0.91)
Score6thPT (mean)	0.37 (0.92)	0.24 (0.91)	0.25 (0.91)
RAW_Score9thMAT (mean)	55.87 (24.19)	49.49 (24.43)	49.90 (24.46)
RAW_Score9thPT (mean)	57.58 (15.90)	54.89 (15.69)	55.07 (15.72)
RAW_Score6thMAT (mean)	3.36 (0.91)	3.19 (0.92)	3.20 (0.92)
RAW_Score6thPT (mean)	3.43 (0.76)	3.33 (0.76)	3.33 (0.76)
SECTION B: Student Characteristics			
Gender(MALE=1)			
% of Males	48,84%	47,52%	47,61%
Child Support(Receives=1)			
7TH GRADE: % of Receivers	38,88%	45,81%	45,35%
8TH GRADE: % of Receivers	36,72%	43,67%	43,21%
9TH GRADE: % of Receivers	33,51%	40,36%	39,91%
Move School (YES=1)			
between 6th and 7th grade			
% of Movers	8,26%	27,59%	26,32%
Mother Higher Educ. (YES=1)			
% of YES (1's)	11,82%	17,45%	17,08%
Mother Less than Higher Educ. (YES=1)			
% of YES (1's)	52,37%	69,81%	68,67%
Mother Educ. Missing (YES=1)			
% of missings	35,81%	12,74%	14,25%
Computer at home (YES=1)			
% of students with computer	78,20%	62,60%	77,18%
Internet at home (YES=1)			
% of students with internet	71,01%	56,38%	70,05%

(Standard deviations in parentheses)

Looking at mother's education, the first thing to notice is that the percentage of missing observations for students in state funded private classes is much higher when compared to students in public school classes. Unfortunately, it happened because MISI dataset only contains information of parent's education for public schools. Nevertheless, we were able to collect information regarding parent's education for some of the students in state funded private classes that had studied in public schools prior or after lower secondary school, i.e. studied in public schools between 1st and 6th grade or 10th and 12th grade. As a result of the missing observations, when comparing students from state funded private classes and

students from public school classes, one could expect lower percentage of student's whose mothers have either an education degree in higher education or less than higher education. In our sample, there are 17.45% of mothers whose student's attend a public school with an education degree in Higher Education, whereas there are only 11,82% of mothers whose student's attend a state funded private class with an equivalent education degree.

Regarding pupils' gender, the distribution of students is evenly distributed among male students and female students. There are 47.01% of male students in the sample, and the difference between students in state funded private classes and students in public schools is not large (1.32 p.p.).

With regard to students' mobility between 6th and 7th grade, one can observe some differences between the two types of class. Students from state funded private classes tend to remain in the same school; only 8.26% moved to a different school. On the other hand, students from public school classes are more prone to move between the 6th and 7th grade, with a percentage of 27.59 % from the sample moving school[20]. This may happen due to the fact that students that attend a state funded private class during 5th grade and 6th grade (*2º Ciclo* in the Portuguese context) are more likely to remain in the same school when moving to Lower Secondary School (from 7th grade to 9th grade), especially if they have completed 5th grade and 6th grade without retentions.

Finally, when looking at the percentage of students with home access to computer or to internet, students from public schools seem to have easiness accessing such resources compared to students from state funded private schools.

ANALYTICAL FRAMEWORK

Probability of Graduation on Time

The first measure was constructed to estimate the probability of students completing Lower Secondary School - from the 7th to 9th grade, in three years, and thus to evaluate the student's consistency over an extended period, rather than at a single point in time, i.e. when they take an exam.

Consider:

$$C_i = \beta_0 + \alpha \boldsymbol{X_i} + \delta \boldsymbol{F_i} + \gamma \boldsymbol{M} + \theta \boldsymbol{A_i^6} + \beta \boldsymbol{T_i} + \varepsilon_i \qquad \textbf{(1)}$$

$$i = 1, \dots, \overline{N}\ ;$$

Where C_i is a dummy variable that takes the value one (1) if the student *i* completes Lower Secondary School (7th to 9th grade) in three years (0 if more than three years). $\boldsymbol{X_i}$ is a vector of student *i* time-invariant individual characteristics, $\boldsymbol{F_i}$ is a vector of family background time-invariant variables, including our proxy for family income *Child_Support* in the three grades of

[20] Changing school is actually moving to another school, not to a different type of school or class, although this may occur

the Lower Secondary School, as well as Parent's Education. $\boldsymbol{M}$ is a vector of municipality dummies, or Municipalities Fixed Effects. The baseline achievement measure $\boldsymbol{A_i^6}$ is a vector of student's *i* national exam scores at 6th grade at Mathematics and Portuguese subjects, that will account for the cumulative effects of prior education inputs (Sass, 2006).

Our variable of interest $\boldsymbol{T_i}$, is a dummy variable, that takes the value 1 if student *i* belongs to a state funded private class and 0 if the student is listed in a public school. The $\boldsymbol{\beta}$ coefficient will measure the impact of attending a state funded private class in the probability of graduating Lower Secondary School without retentions, *ceteris paribus*, relative to a student attending a public school class. β_0 is a constant term and ε_i is the composite error. $\overline{N}$ is the number of students in the sample.

Achievement Value-Added Measure

Following Todd and Wolpin (2003), who constructed a conceptual framework of children's achievement as a cumulative process of knowledge acquisition, we construct an **Achievement Value-Added** measure of students' performance that uses a baseline achievement measure to allow for unobserved input history as well as unobserved initial ability.

The focus of this model is the standardized exam scores obtained at 9th grade:

$$A_{ij}^9 = \beta_0 + \boldsymbol{\alpha X_i} + \boldsymbol{\delta F_i} + \boldsymbol{\gamma M} + \theta \boldsymbol{A_i^6} + \beta \boldsymbol{T_i} + \varepsilon_i \qquad \textbf{(2)}$$

$$i = 1, \dots, \overline{N}\,; j = 1, \dots, \overline{M}$$

Where A_{ij}^9 is the 9th grade national exam score of the student *i* in subject *j* and the other explanatory variables were already defined. $\overline{M}$ is the total number of subjects, in this case two, Portuguese and Mathematics.

Similarly, $\boldsymbol{T_i}$ is a dummy variable that assumes the value 1 if student *i* belongs to a state funded private class and 0 if the student is listed in a public school class. The $\boldsymbol{\beta}$ coefficient will measure the impact of attending a state funded private class in the 9th grade national exams, *ceteris paribus*, relative to a student attending a public school class.

RESULTS

Probability of Graduation on Time

With the Probability of Graduation on Time, we are trying to measure the achievement of the student in terms of consistency i.e. over the years, in this case during lower secondary school. **Table 2,** displays the average marginal effects after estimating **Equation 1** by Logit. We use robust standard errors clustered at school level to account for correlation between students in the same school (Cameron and Miller, 2015).

Table 2. Average Marginal Effects of the Probability of Graduation on Time

VARIABLES	(1) Logit	(2) Logit
STATE_FUNDED_PS	0.0172** (0.00683)	0.0164** (0.00708)
SCORE6thMAT	0.0930*** (0.00100)	0.0913*** (0.00118)
SCORE6thPT	0.0649*** (0.000925)	0.0634*** (0.00106)
COMPUTER	0.0151*** (0.00254)	0.0168*** (0.00303)
INTERNET	0.000221 (0.00210)	-0.000543 (0.00256)
MOTHER_HEDUC	0.0680*** (0.00271)	0.0652*** (0.00308)
MOTHER_HEDUC_MISS	-0.00656*** (0.00193)	-0.00575** (0.00227)
CHILD_SUPPORT7th	-0.0206*** (0.00194)	-0.0181*** (0.00218)
CHILD_SUPPORT8th	-0.00740*** (0.00215)	-0.00922*** (0.00243)
CHILD_SUPPORT9th	0.000486 (0.00194)	0.000643 (0.00230)
MALE	-0.0384*** (0.00121)	-0.0378*** (0.00140)
AGE6th	-0.0214*** (0.00121)	-0.0213*** (0.00139)
MOVESCHOOL6thTO7th	0.00513** (0.00255)	0.00515* (0.00286)
Cohort2(=1)	-0.0253*** (0.00254)	-0.0222*** (0.00291)
Cohort3(=1)	-0.00589** (0.00261)	-0.00700** (0.00292)
Cohort4(=1)	0.0334*** (0.00239)	0.0342*** (0.00267)
Cohort5(=1)	0.0412*** (0.00247)	0.0433*** (0.00273)
Observations	336,078	240,222
Municipalities FE	YES	YES
Exam Year FE	NO	NO
School Clusters	1140	1002

Robust clustered standard errors in parentheses *** p<0.01 ** p<0.05 * p<0.1

After the Logit estimation of **Equation 1**, the effect of school administration on student's achievement, measured by the years required to complete lower secondary school (from 7th grade to 9th grade) is positive in favor of state funded private schools and statistically significant at 5% level. On average, *ceteris paribus*, we find evidence that a student attending a state funded private class is 1.72 percentage points more likely to complete lower secondary school in three years when compared to a student attending a public school class (Column 1 of **Table 2**).

The effects of the control variables are as expected. Looking at the impact of family background, receiving child support at the 7th grade and at the 8th grade, i.e. belonging to a less wealthy family, on average, *ceteris paribus*, decreases the probability of reaching 10th grade without retentions. Mother's education, i.e. a mother with an education degree in higher

education, affects positively the outcome variable. This effect is as strong as the student's previous test scores at the 6th grade in Portuguese and Mathematics national exams.

To conclude, age at 6th grade or being male has a negative impact on the probability of completing lower secondary school in three years.

Achievement Value-Added Measure

The **Achievement Value-Added** measure was estimated by OLS and the results are shown in **Table 3**. Columns 1 and 2 displays the estimation results for the 9th grade Mathematics national exam scores; whereas Columns 3 and 4 reports the estimation results for the 9th grade Portuguese national exam scores. Grades are standardized at the population level by school year and subject[21]. We use robust standard errors clustered at school level.

From **Table 3**, there is statistical evidence that students from state funded private classes outperform students in public school classes in both subjects. In particular, on average, belonging to a state funded private class during lower secondary school, *ceteris paribus*, increases Mathematics and Portuguese 9th grade national exam scores by approximately 0.07 standard deviations (s.d.), and 0.04 s.d., respectively in Column 1 and Column 3. Hence, it seems that the effect of private administration on student's achievement is higher for Mathematics than for Portuguese, *ceteris paribus*, even though both coefficients' magnitudes are not very large. In addition, one can argue that the 10% significance level of the state funded private class in the case of the Portuguese 9th grade national exam is not sufficiently strong to find evidence of differences between the students due to the high number of observations.

As with the results obtained for the first measure of students' achievement **Probability of Graduation on Time**, we find that the better the results in prior achievement test scores, the better the results in national exams at 9th grade. Moreover, prior achievement test score in the same subject, not surprisingly, is the most determinant of student's achievement in 9th grade national exam score, since they represent the highest coefficient in each estimation i.e. *SCORE6thMAT* in Column 1 and *SCORE6thPT* in Column 3.

Table 3. Achievement Value-Added estimation results

VARIABLES	(1) OLS - Mathematics	(2) OLS - Mathematics	(3) OLS - Portuguese	(4) OLS - Portuguese
STATE_FUNDED_PS	0.0659*** (0.0237)	0.0651*** (0.0242)	0.0415* (0.0214)	0.0372* (0.0223)
SCORE6thMAT	0.546*** (0.00206)	0.548*** (0.00245)	0.318*** (0.00220)	0.318*** (0.00253)
SCORE6thPT	0.165*** (0.00196)	0.166*** (0.00230)	0.410*** (0.00205)	0.408*** (0.00239)
COMPUTER	-2.00e-05 (0.00756)	0.00219 (0.00901)	-0.00200 (0.00712)	0.00214 (0.00848)
INTERNET	0.0427*** (0.00534)	0.0401*** (0.00630)	0.0347*** (0.00556)	0.0341*** (0.00666)

[21] See, in Appendix, the summary statistics of the 9th grade and 6th grade national exam scores standardized at the popoluation level by school year and subject (Table A.1)

VARIABLES	(1) OLS - Mathematics	(2) OLS - Mathematics	(3) OLS - Portuguese	(4) OLS - Portuguese
MOTHER_HEDUC	0.245*** (0.00432)	0.246*** (0.00500)	0.171*** (0.00465)	0.173*** (0.00539)
MOTHER_HEDUC_MISS	-0.00227 (0.00627)	-0.00441 (0.00662)	0.00983* (0.00544)	0.0148** (0.00596)
CHILD_SUPPORT7th	-0.0499*** (0.00493)	-0.0494*** (0.00565)	-0.0354*** (0.00511)	-0.0396*** (0.00603)
CHILD_SUPPORT8th	-0.0393*** (0.00535)	-0.0395*** (0.00616)	-0.0178*** (0.00554)	-0.0166*** (0.00630)
CHILD_SUPPORT9th	-0.0616*** (0.00472)	-0.0626*** (0.00554)	-0.0240*** (0.00495)	-0.0227*** (0.00570)
MALE	-0.0456*** (0.00295)	-0.0477*** (0.00344)	-0.255*** (0.00313)	-0.256*** (0.00369)
AGE6th	-0.146*** (0.00313)	-0.146*** (0.00362)	-0.140*** (0.00352)	-0.139*** (0.00398)
MOVESCHOOL6thTO7th	-0.00888 (0.00911)	-0.00891 (0.00989)	-0.0102 (0.00767)	-0.0103 (0.00850)
Cohort2(=1)	0.233*** (0.0110)	0.234*** (0.0134)	0.130*** (0.0115)	0.134*** (0.0140)
Cohort3(=1)	0.472*** (0.0167)	0.475*** (0.0200)	0.197*** (0.0159)	0.201*** (0.0190)
Cohort4(=1)	0.774*** (0.0202)	0.782*** (0.0247)	0.283*** (0.0199)	0.287*** (0.0241)
Cohort5(=1)	1.007*** (0.0231)	1.019*** (0.0284)	0.281*** (0.0226)	0.282*** (0.0274)
Constant	1.668*** (0.0488)	1.670*** (0.0551)	1.643*** (0.0629)	1.637*** (0.0676)
Observations	336,078	240,249	336,078	240,249
Adjusted R-squared	0.523	0.526	0.455	0.457
Municipalities FE	YES	YES	YES	YES
Exam Year FE	YES	YES	YES	YES
School Clusters	1140	1007	1140	1007

Robust clustered standard errors in parentheses *** p<0.01 ** p<0.05 * p<0.1

Child support in all the school grades of lower secondary school contributes negatively to the outcome variable in both subjects. Additionally, being older at 6th grade or being male also has a negative effect upon 9th grade national exam scores. In particular, on average, *ceteris paribus*, being male decreases the Portuguese 9th grade national exam score by approximately 0.26 standard deviations (s.d.).

Regarding student's home resources, having access to a computer does not seem to have an impact on students' achievement, however internet does. As for mother's education, there is evidence that student's whose mothers are more educated seem to perform better. On average, *ceteris paribus*, a mother with an education degree in higher education increases his child's 9th grade national exam score by approximately 0.25 s.d. and 0.17 s.d., for Mathematics and Portuguese, respectively in Column 1 and Column 3, when compared to a mother with an education degree less than higher education i.e. primary, and or secondary education.

Finally, regarding the dummy variables that control for the cohorts, there is statistical evidence that all the cohorts performed better, on average, than the first cohort (left outside). Interestingly, as we move further to the present, students are performing better in the 9th grade Mathematics national exams, as the coefficients from the second cohort up to the fifth cohort are increasing, relative to the first cohort of students.

ROBUSTNESS TESTS

In this section, we start by employing the method of instrumental variables, since we suspect that the choice of enrolling a student into a state funded private school is not exogenous, thus in the presence of an endogenous covariate OLS is generally inconsistent and the estimators are biased (Wooldridge, 2012). Moreover, we extend the IV to a simultaneous equations model to account for the possible nonlinear nature of the school choice type. We also use propensity score matching to estimate the average treatment effect (ATE) of attending a state funded private school compared to studying in a public school. Lastly, we regress the **Probability of Graduation on Time** measure and the **Value-Added** measure to each of the cohorts in an attempt to identify differences between the cohorts[22].

Following Wooldridge's (2012) simplest approach to the endogeneity problem, consider:

$$y = \beta_0 + \beta_1 x + u$$

where *x* is endogenous if $Cov(x, u) \neq 0$.

In the presence of an endogenous covariate, it is possible to get consistent estimators of β_0 and β_1 by finding an instrument (z) that is uncorrelated with the error term (u) but strongly correlated with the variable which we suspect to be endogenous (x).

In our case, the choice of enrolling a student into a private school may not be exogenous given that parents may perceive private schools as being more attractive and capable of providing better learning conditions to their children. Thus, there might be unobserved factors that affect both the choice of enrolling a student into a private school and the performance of the student, leading the variable *STATE_FUNDED_PS* to be correlated with the error term of each of the achievement measures. Hence, students who attend state funded private classes could have been self-selected to this type of school.

To solve this problem, we use students' postcode as well as schools' postcode to build an instrument that takes the difference of the distance between the student's nearest state funded private school and the student's nearest public school. Note that the school that is nearest to the student's home residence, either public or private, is not necessarily the school that the student actually attends. The distance is measured in minutes and was calculated using the OpenStreetMap's algorithm[23]. Moreover, we use simultaneous equations models to take into account the fact that the potential endogenous variable is binary, and thus in the presence of nonlinear models we do not incur in the forbidden regression[24]. In addition, we assumed that the maximum allowed difference in the distance between a student's nearest

[22] Note that regressing the achievement measures to each of the cohorts is different from regressing all the students and using dummies to control for the 9th grade exam years

[23] The key assumption is that the route was calculated based on the distance (in minutes) from the student's residence to the nearest state funded private school or the nearest public school, using car as the means transport

[24] In the simultaneous equations model, we model the choice of attending a state funded private school as a nonlinear function of the covariates already presented in the achievement's measures plus the instrument, to avoid falling in the case of a forbidden regression (Angrist J. D. and J. S. Pischke, 2008) i.e. assuming OLS in the 2SLS when in the presence of nonlinear models

state funded private school and a student's nearest public school to be of thirty-five (35) minutes, given the presence of right-hand side outliers[25].

The instrument has proved to be strongly correlated with the decision of choosing a state funded private school, as reported by the coefficients of the instrument *TIME_DIF* in **Table A.9.** (Appendix) of the equation that models the school choice, from the simultaneous equations model estimated by Probit. Column 1 displays the coefficient from *TIME_DIF* of the equation that models the school choice in the Value Added measure (Mathematics and Portuguese 9th grade national exam scores). Column 2 reports the coefficient from *TIME_DIF* of the equation that models the school choice in the Probability of Graduation on Time measure. Despite the coefficients and standard errors from Column 1 and Column 2 are equal, the equation that models the school choice in the two columns differs in the 9th grade exam years fixed effects. The result obtained has the expected sign and can be interpreted in the following manner: a minute increase between the student's nearest state funded private school relative to the student's nearest public school (public school is closer than a state funded private school), decreases the probability that a student chooses a state funded private school.

With regards to the correlation between the instrument and the error term from the achievement measures, we argue that it is true that the closest a student is to the school he attends, the more time the student will have to study. This could invalidate the instrument, under the assumption that students who would have more time to study could have better results in national exams. However, the instrument is the difference in the distance between the nearest state funded private school and the nearest public school, thus it is not expected to influence student's achievement success, either measured by time required to complete lower secondary school or measured by 9th grade national exam scores. In addition, as mentioned earlier, the nearest school that enters into the instrument is not necessarily the school the student attends in the 9th grade. Nevertheless, we estimated both student's achievement measures introducing the instrument *TIME_DIF* as an explanatory variable and the coefficients proved to be not statistically different from zero[26].

Robustness of the Probability of Graduation on time

In **Table A.11.** (Appendix), find the results obtained for the Robustness Estimation of the **Probability of Graduation on Time** measure. Column 1 is estimated by Linear Probability Model. Column 2 it is exhibited the estimation output from which the average marginal effects from the Logit estimation of **Equation 1** in **Table 2** were derived. In Columns 3, 4 and 5 we use the instrumental variable *TIME_DIF* and estimate **Equation 1** by IV[27], ERM (Extended Regressions Model) or simultaneous equations model, and propensity score matching (ATE). In Columns 3 and 4 of **Table A.11.**, we also provide the Wald Test for endogeneity and the correlation between the error from **Equation 1** and the error from the equation that models the school choice. Since in both cases we do not find evidence that the variable

[25] See the histogram of the instrument *TIME_DIF* in **Table A.8.** Appendix

[26] See **Table A.10.** in Appendix

[27] IV Probit due to the binary nature of the dependent variable

STATE_FUNDED_PS is endogenous[28], we can still estimate **Equation 1** by Logit. Hence, the results obtained in **Section 6.1.** are robust to endogeneity.

In **Table A.12.**, we present the average marginal effects of the **Probability of Graduation on Time** measure of the complete sample of individuals (already shown in Column 1 of **Table 2**) and for each of the cohorts (Columns 2 to 6 of **Table A.12.)**. We include the higher sample of individuals since we have found no evidence that the school choice type was endogenous. The results suggest that there is still a positive effect of private school administration, i.e. less retentions of students in state funded private classes relative to students in public school classes, although this effect is not observed in all the cohorts. Nonetheless, these results are robust in the sense we do not find opposite directions of the effect of private school administration on the students' **Probability of Graduation on Time** measure.

Robustness of the Achievement Value-Added Measure

In **Table A.13**. and **Table A.14.,** Columns 1 and 2, in Appendix, we present the usual OLS coefficients of the variable of interest, *STATE_FPS*, in the achievement measure of the 9th grade national exam scores for Mathematics and Portuguese, respectively[29]. In Columns 3, 4 and 5 of **Table A.13.** and **Table A.14.** in Appendix, we estimated **Equation 2** using the instrumental variable *TIME_DIF* and present the results for the IV estimation, the simultaneous equations model (ERM - Probit) and the propensity score matching (ATE). Recall that the goal of these alternative estimation methods was to tackle endogeneity with regard to the variable of interest, attending a state funded private school. In both achievement **Value Added** measures, considering the robust regression-based tests for the IV estimation and the correlation between the errors of the simultaneous equations model, there is no evidence that the decision to enroll a student in a state funded private school is endogenous. Therefore, the results from the OLS (Columns 1 of **Table A.13.** and **Table A.14.**) are robust and should be considered.

As in the case of the **Probability of Graduation on Time**, we are also interested in separating the regressions by cohort and see if there are differences between the students. Thus, **Table A.15.** and **Table A.16.** in Appendix, we display the estimation results (OLS) of the complete sample of individuals and per cohort. The effect of private school administration relative to public school administration is not visible in all the cohorts. In the first, second and fifth cohort, the coefficient from *STATE_FPS* is not statistically different from zero, suggesting, on average, that there is no difference between a student studying in a state funded private school compared to a student attending a public school. However, in the third and fourth cohorts, the effect of private school administration is largely amplified, in both subjects. Similarly to the achievement measure of the **Probability of Graduation on Time**, we do not have opposite effects of private school administration compared to public school administration on students' achievement. Therefore, we can confidently suggest that this effect, if existent, will be in favor of private school administration, thus positive.

[28] The p-value from the Wald Test is very high (0.85) and the correlation is not statistically different from zero

[29] These coefficients are equivalent to those of Columns 1 through 4 of **Table 3**.

CONCLUSIONS AND POLICY IMPLICATIONS

The goal of this research was to compare the effectiveness of private schools, relative to public schools, at class level, in Portugal, with particular interest in studying state funded private schools. Thus, it is an important study for public policy evaluation in Portugal, since the government has been conducting several education reforms over the past years. In particular, from 2015/16 to 2016/17, the government reduced in approximately 41%, the number of newly government-financed classes in private schools at the 7th grade, i.e. in the beginning of lower secondary school.

In order to measure the effectiviness of schools in general, we constructed two achievement measures: the first is a measure of graduation, **Probability of Graduation on Time**, where we use the time required of the student to finish lower secondary school (7th to 9th grade); the second is a **Value Added** approach of the 9th grade national at Mathematics and Portuguese subjects, using 6th grade national exam scores as the baseline of the student.

We extended the work of Rosado and Seabra (2015) which studied the effectiviness of private schools[30] versus public schools by introducing controls at the student level as well as increasing the number of cohorts observed. Whereas in their study, the probability of being retained at least once is higher in state funded private schools than in public schools, in our study we find the opposite effect, i.e. a student in a state private school is more likely to complete lower secondary school without retentions than a student in a public school. By separating the sample by cohorts, the positive effect of private school administration over public school administration in the probability of completing lower secondary school without retentions is not statistically significant in all the cohorts. This result is robust since it does not invalidate that if the type of school administration is to play a role in student's probability of graduation, it will be in favor of private school administration. An explanation for the difference in our results may be the different set of controls that we employ, namely municipalities fixed effects, mother's education, home access to computer and internet. In addition, we control for the baseline scores (6th grade).

Regarding students' performance in national exams at 9th grade, we corroborate their findings of the positive impact of attending a state funded private class compared to public class. We used an instrumental variable for the difference in the distance between the student's nearest state funded private school and the nearest public school and estimated both achievement measures using IV, simultaneous equations model (ERM) and propensity score matching (ATE), and showed that the school choice is not endogenous. Thus, resorting to the OLS estimations, on average, studying in a state funded private class during lower secondary school, *ceteris paribus*, increases 9th grade national exam score by 0.07 standard deviations and 0.04 standard deviations in Mathematics and Portuguese, respectively, compared to a student enrolled in a public school class. Nevertheless, likewise the results obtained for the **Probability of Graduation on Time**, we find that the positive effect of state funded private school attendance compared to public school attendance is not observed in all the cohorts of students. However,

[30] Both strictly private schools and state funded private schools

in those cohorts in which there is statistical evidence of differences between a student attending a state funded private school relative to a student attending a public school, the effect is largely amplified as the coefficients almost duplicate in magnitude. The coefficient that captures type of school administration differences, reaches the maximum value of 0.13 s.d. and 0.08 s.d. for Mathematics and Portuguese, respectively.

An interesting result that we get from combining both students' achievement measures is that students from state funded private schools, on average, were less likely to be retained once during lower secondary school than students from public schools. Thus, one could argue that private schools could be facilitating the graduation of students along their academic journey. If this was true, we would be seeing students from state funded private schools, on average, having worse performance in national exams compared to students from public schools as less achieving students were being able to graduate more easily. However, mixing the results from the **Probability of Graduation on Time** and the **Value Added** measure, we exclude this argument since we have evidence that students from state funded private schools, on average, have better results in 9th grade national exams than students from public schools, in particular at Mathematics.

Despite the results obtained for Portugal, in order to determine whether the school choice outcome should be state funded private schools in preference to public schools, one must also consider efficiency, i.e. the costs involved. Hence, we want to look at the annual average cost of financing a student at the different types of schools. The report from *Tribunal de Contas*[31], carried out in 2012, calculates the annual average student cost throughout 5th to 9th grade in both state funded private schools and public schools for the academic year 2009/10 and shows that financing students in state funded private schools is cheaper than in public schools. In values, they estimate the annual average cost of a student in a state funded private school to be 4.522€, compared to 4.648€ in a public school. However, this estimate suffers from several limitations due to the lack of available data and the methodologies used. Therefore, we do not infer that the government should choose either to increase or to decrease the investment in state funded private schools. Nevertheless, more studies are required, in particular to estimate the costs of financing a student in each type of school.

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APPENDIX

Table A.1. General Descriptive Statistics for the sample

VARIABLE	DESCRIPTION	OBS	MIN	MAX	MEAN	STD.DEV
SECTION A: ACHIEVEMENT MEASURES						
RAW_SCORE9THMATH	9th grade national exam scores (Mathematics)	336 078	0	100	49.90	24.46
RAW_SCORE9THPT	9th grade national exam scores (Portuguese)	336 078	0	100	55.07	15.72
SCORE9THMATH	9th grade standardized national exam scores (Mathematics)	336 078	-2,22	2,37	0,053	0,971
SCORE9THPT	9th grade standardized national exam scores (Portuguese)	336 078	-3.86	3.11	0,045	0,974
COMPLETEIN3YEARS	If the student completed lower secondary school in three years	336 078	0	1	0.87	0.34
SECTION B: INDEPENDENT VARIABLES						
RAW_SCORE6THMATH	6th grade national exam scores (Mathematics)	336 078	1	5	3.20	0.912
RAW_SCORE6THPT	6th grade national exam scores (Portuguese)	336 078	1	5	3.33	0.76
SCORE6THMATH	6th grade standardized national exam scores (Mathematics)	336 078	-2,46	2,20	0,251	0,914
SCORE6THPT	6th grade standardized national exam scores (Portuguese)	336 078	-3,11	2,78	0,250	0,912
CHILD_SUPPORT7TH	If student's family received social support in 7th grade	336 078	0	1	0,45	0,50
CHILD_SUPPORT8TH	If student's family received social support in 8th grade	336 078	0	1	0,43	0,50
CHILD_SUPPORT9TH	If student's family received social support in 9th grade	336 078	0	1	0,40	0,49
PUBSCHOOL	If the student attends a public school class between 7th and 9th grade	336 078	0	1	0.93	0.25
STATE_FUNDED_PS	If the student attends a state funded private class between 7th and 9th grade	336 078	0	1	0.07	0.25
MALE	If the student is male	336 078	0	1	0,48	0,50
AGE6TH	Age of the student at the 6th grade	336 078	9.04	16.15	11.31	0.42
MOVESCHOOL6TO7TH	If the student moved school from 6th to the 7th grade	336 078	0	1	0.26	0.44
M.HEDUC	If the student's mother has an education degree in higher education	336 078	0	1	0.17	0.38
M.LESS_HEDUC	If the student's mother has an education degree less than higher education	336 078	0	1	0.69	0.46
M.EDUC_MISSING	If the student's mother education is missing	336 078	0	1	0.14	0.35
F.HEDUC	If the student's father has an education degree in higher education	336 078	0	1	0.11	0.32
F.LESS_HEDUC	If the student's father has an education degree less than higher education	336 078	0	1	0.71	0.45
F.EDUC_ MISSING	If the student's father education is missing	336 078	0	1	0.17	0.38
COMPUTER	If the student has home access to computer	336 078	0	1	0,77	0,42
INTERNET	If the student has home access to Internet	336 078	0	1	0,70	0,46
SECTION C: VARIABLES FOR THE ROBUSTNESS TESTS						
TIME_DIF	Tine difference between the student's neareast state funded private school and the nearest public school (minutes)	280 891	-27.560	135.9	22.40	22.89
NEAREST_PUBSCHOOL	Student's nearest public school (in minutes)	280 891	0	53.55	4.25	3.87
NEAREST_STATE_FUNDED_PS	Student's nearest state funded private school (in minutes)	280 891	0	139.77	26.64	22.71

Table A.2. Students enrolled in Portugal Mainland by school grade, academic year and type of school

SCHOOL GRADE	ACADEMIC YEAR	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
5TH GRADE	Public Schools	105 309	105 239	106 164	100 307	99 023	96 823	90 482	88 833	88 348
	SFPS	8 428	8 576	8 230	7 527	7 323	7 418	7 394	7 216	4 764
	Private Schools	7 003	7 126	7 322	7 020	7 135	7 222	7 422	7 932	7 867
	Total	120 740	120 941	121 716	114 854	113 481	111 463	105 298	103 981	100 979
6TH GRADE	Public Schools	104 814	104 402	104 760	104 410	102 252	100 306	94 990	89 060	88 531
	SFPS	8 114	8 432	8 432	8 323	7 583	7 551	7 484	7 288	6 969
	Private Schools	6 677	6 871	7 061	7 025	7 020	6 937	7 217	7 623	7 987
	Total	119 605	119 705	120 253	119 758	116 855	114 794	109 691	103 971	103 487
7TH GRADE	Public Schools	104 346	106 417	106 247	106 907	105 202	97 726	98 037	95 522	95 261
	SFPS	8 805	8 747	8 746	8 856	8 523	7 844	8 114	7 911	5 660
	Private Schools	5 635	5 638	5 817	5 776	5 731	6 000	6 103	6 767	6 810
	Total	118 786	120 802	120 810	121 539	119 456	111 570	112 254	110 200	107 731
8TH GRADE	Public Schools	88 833	89 816	92 710	92 509	95 188	94 335	87 548	86 811	87 926
	SFPS	8 041	8 148	8 020	8 181	8 138	8 158	7 446	7 555	7 285
	Private Schools	5 090	5 332	5 356	5 471	5 590	5 581	5 793	6 155	6 722
	Total	101 964	103 296	106 086	106 161	108 916	108 074	100 787	100 521	101 933
9TH GRADE	Public Schools	84 113	83 249	84 008	86 416	89 280	90 285	89 350	83 741	84 634
	SFPS	7 632	7 631	7 466	7 684	7 674	7 923	7 861	6 993	7 137
	Private Schools	5 234	5 167	5 473	5 318	5 621	5 692	5 698	6 011	6 360
	Total	96 979	96 047	96 947	99 418	102 575	103 900	102 909	96 745	98 131

Source: DGEEC's annual reports

Table A.3. Percentage of students enrolled in Portugal Mainland by school grade, academic year and type of school

SCHOOL GRADE	ACADEMIC YEAR	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
5TH GRADE	Public Schools	87,22	87,02	87,22	87,33	87,26	86,87	85,93	85,43	87,49
	SFPS	6,98	7,09	6,76	6,55	6,45	6,66	7,02	6,94	4,72
	Private Schools	5,80	5,89	6,02	6,11	6,29	6,48	7,05	7,63	7,79
	Total	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00
6TH GRADE	Public Schools	87,63	87,22	87,12	87,18	87,50	87,38	86,60	85,66	85,55
	SFPS	6,78	7,04	7,01	6,95	6,49	6,58	6,82	7,01	6,73
	Private Schools	5,58	5,74	5,87	5,87	6,01	6,04	6,58	7,33	7,72
	Total	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00
7TH GRADE	Public Schools	87,84	88,09	87,95	87,96	88,07	87,59	87,33	86,68	88,42
	SFPS	7,41	7,24	7,24	7,29	7,13	7,03	7,23	7,18	5,25
	Private Schools	4,74	4,67	4,81	4,75	4,80	5,38	5,44	6,14	6,32
	Total	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00
8TH GRADE	Public Schools	87,12	86,95	87,39	87,14	87,40	87,29	86,86	86,36	86,26
	SFPS	7,89	7,89	7,56	7,71	7,47	7,55	7,39	7,52	7,15
	Private Schools	4,99	5,16	5,05	5,15	5,13	5,16	5,75	6,12	6,59
	Total	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00
9TH GRADE	Public Schools	86,73	86,68	86,65	86,92	87,04	86,90	86,82	86,56	86,25
	SFPS	7,87	7,95	7,70	7,73	7,48	7,63	7,64	7,23	7,27
	Private Schools	5,40	5,38	5,65	5,35	5,48	5,48	5,54	6,21	6,48
	Total	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00

Source: DGEEC's annual reports

Table A.4. Percentage of students in State Funded Private Schools (SFPS) and in Public Schools (PUBS) per district – 7th grade 2015/2016

DISTRICT	TOTAL SFPS DIST	TOTAL PUBS DIST	TOTAL DISTRICT	% OF SFPS DISTRICT	% OF PUBS DISTRICT
1 - AVEIRO	886	6934	7820	11,33	88,67
2- BEJA	130	1339	1469	8,85	91,15
3 - BRAGA	1127	8099	9226	12,22	87,78
4 - BRAGANÇA	59	986	1045	5,65	94,35
5 - CASTELO BRANCO	75	1514	1589	4,72	95,28
6 - COIMBRA	809	3185	3994	20,26	79,74
7 - ÉVORA	0	1582	1582	0,00	100,00
8 - FARO	0	5064	5064	0,00	100,00
9 - GUARDA	142	1235	1377	10,31	89,69
10 - LEIRIA	1369	3790	5159	26,54	73,46
11 - LISBOA	1282	21401	22683	5,65	94,35
12 - PORTALEGRE	0	1120	1120	0,00	100,00
13 - PORTO	426	18768	19194	2,22	97,78
14 - SANTARÉM	477	4212	4689	10,17	89,83
15 - SETÚBAL	0	9666	9666	0,00	100,00
16 - VIANA DO CASTELO	57	2045	2102	2,71	97,29
17 - VILA REAL	142	1912	2054	6,91	93,09
18 - VISEU	277	3557	3834	7,22	92,78
TOTAL	7258	96409	103667		

Source: Constructed by the authors based on the MISI dataset

Table A.5. Percentage of students in State Funded Private Schools (SFPS) and in Public Schools (PUBS) per district – 7th grade 2016/2017

DISTRICT	TOTAL SFPS DIST	TOTAL PUBS DIST	TOTAL DISTRICT	% OF SFPS DISTRICT	% OF PUBS DISTRICT
1 - AVEIRO	346	6870	7216	4,79	95,21
2- BEJA	138	1334	1472	9,38	90,63
3 - BRAGA	650	8219	8869	7,33	92,67
4 - BRAGANÇA	28	956	984	2,85	97,15
5 - CASTELO BRANCO	25	1571	1596	1,57	98,43
6 - COIMBRA	194	3302	3496	5,55	94,45
7 - ÉVORA	0	1568	1568	0,00	100,00
8 - FARO	0	4978	4978	0,00	100,00
9 - GUARDA	30	1272	1302	2,30	97,70
10 - LEIRIA	1044	3964	5008	20,85	79,15
11 - LISBOA	1019	21439	22458	4,54	95,46
12 - PORTALEGRE	0	1064	1064	0,00	100,00
13 - PORTO	150	18378	18528	0,81	99,19
14 - SANTARÉM	447	4309	4756	9,40	90,60
15 - SETÚBAL	0	9504	9504	0,00	100,00
16 - VIANA DO CASTELO	40	2229	2269	1,76	98,24
17 - VILA REAL	67	1880	1947	3,44	96,56
18 - VISEU	109	3576	3685	2,96	97,04
TOTAL	4287	96413	100700		

Source: Constructed by the authors based on the MISI dataset

Table A.6. Cohorts explained: first observation in the 6th and 9th grade

		ACADEMIC YEAR								
COHORT NR.	School Grade	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Cohort 1	6th grade	●								
Obs: 65 697	9th grade				●	●				
Cohort 2	6th grade		●							
Obs: 67 234	9th grade					●	●			
Cohort 3	6th grade			●						
Obs: 66 323	9th grade						●	●		
Cohort 4	6th grade				●					
Obs: 69 678	9th grade							●	●	
Cohort 5	6th grade					●				
Obs: 67 146	9th grade								●	●

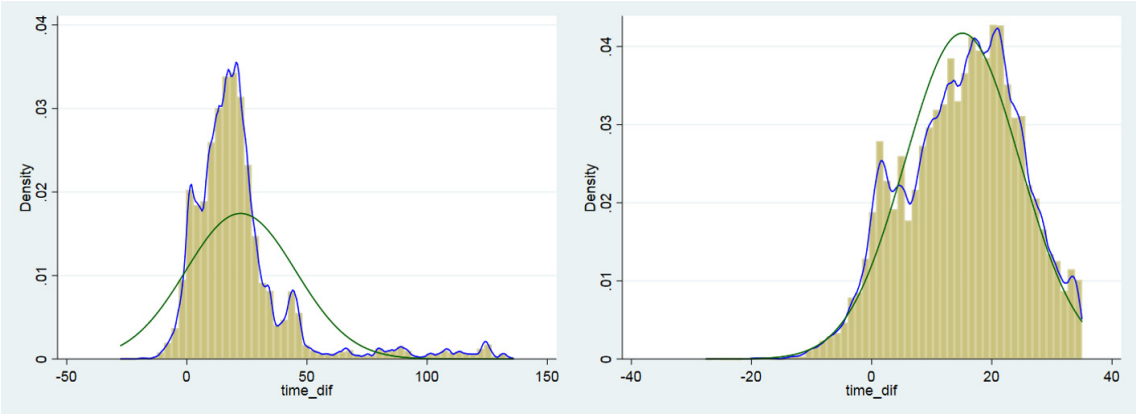
Source: Constructed by the authors based on the MISI dataset

Table A.7. Number of schools – per district and type of school

SCHOOL DISTRICT	STATE FUNDED PRIVATE SCHOOLS	PUBLIC SCHOOLS	TOTAL NR. OF SCHOOLS
1 - AVEIRO	8	82	90
2- BEJA	2	28	30
3 - BRAGA	7	86	93
4 - BRAGANÇA	2	18	20
5 – CASTELO BRANCO	2	27	29
6 - COIMBRA	11	50	61
7 - ÉVORA	0	25	25
8 - FARO	0	57	57
9 - GUARDA	4	25	29
10 - LEIRIA	16	43	59
11 - LISBOA	5	183	188
12 - PORTALEGRE	0	12	23
13 - PORTO	2	172	174
14 - SANTARÉM	4	53	57
15 - SETÚBAL	0	89	89
16 - VIANA DO CASTELO	1	27	28
17 - VILA REAL	2	30	32
18 - VISEU	3	53	56
TOTAL NR. OF SCHOOLS	69	1071	1140

Source: Constructed by the authors based on the MISI dataset

Table A.8. Instrumental Variable (*TIME_DIF*) - Histogram



Before assumption | After assumption

Source: Constructed by the authors based on the MISI dataset

Table A.9. Simultaneous equations model – School choice (Independent Variable – *STATE_FUNDED_PS*)

VARIABLES	(1) VALUE ADDED	(2) GRADUATION ON TIME
TIME_DIF	-0.137*** (0.00679)	-0.137*** (0.00679)
Observations	240,249	240,249
Municipalities FE	YES	YES
Exam Year FE	YES	NO
School Clusters	1007	1007

Robust clustered standard errors in parentheses *** p<0.01 ** p<0.05 * p<0.1

Table A.10. Instrument coefficient from the Achievement Measures – Value Added (VA) and Probability of Graduation on Time

VARIABLES	(1) OLS – VA MATH	(2) OLS – VA PT	(3) Logit – Graduation on Time
TIME_DIF	-0.000302 (0.000733)	-1.56e-05 (0.000627)	-0.000385 (0.00248)
Observations	240,249	240,249	240,222
Adjusted R-squared	0.526	0.457	-
Municipalities FE	YES	YES	YES
Exam Year FE	YES	YES	NO
School Clusters	1007	1007	1002

Robust clustered standard errors in parentheses *** p<0.01 ** p<0.05 * p<0.1

Table A.11. Probability of Graduation on Time - Estimation Outputs

VARIABLES	(1) LPM	(2) Logit	(3) IV Probit	(4) EProbit	(5) ATE
STATE_FPS	0.0172*** (0.00596)	0.180** (0.0778)	0.115 (0.0829)	0.0792 (0.0600)	0.00944 (0.00596)
Observations	240,249	240,222	240,222	240,249	76,941
Adjusted R-squared	0.138	-	-	-	-
Endogenous Var. [STATE_FPS]	NO	NO	NO	NO	NO
School Clusters	1007	1002	1002	1007	1007
Wald test statistic	-	-	0.0375	-	-
Wald test p-value	-	-	0.847	-	-
corr[e.STATE_FPS e.COMPLETEIN3YEARS]	- -	- -	- -	0.01924 (0.03285)	- -

Robust clustered standard errors in parentheses *** p<0.01 ** p<0.05 * p<0.1

Table A.12. Average Marginal Effects (AME) of the Probability of Graduation on time – total and by cohort

VARIABLES	(1) AME - ALL	(2) AME - C1	(3) AME - C2	(4) AME - C3	(5) AME - C4	(6) AME - C5
STATE_FPS	0.0172**	-0.00796	0.0162	0.0296***	0.0318***	0.0116
	(0.00683)	(0.00985)	(0.0108)	(0.00996)	(0.0109)	(0.00838)
Observations	336,078	65,630	67,182	66,305	69,592	66,950
School Clusters	1140	1119	1110	1077	1062	1051

Robust clustered standard errors in parentheses *** p<0.01 ** p<0.05 * p<0.1

Table A.13. Achievement Value Added Measure – 9th grade Mathematics National Exam Scores – Estimation Output

VARIABLES	(1) OLS	(2) OLS	(3) IV	(4) ERM - PROBIT	(5) ATE
STATE_FPS	0.0659***	0.0651***	0.0816*	0.0684**	0.0819***
	(0.0237)	(0.0242)	(0.0460)	(0.0324)	(0.0302)
Observations	336,078	240,249	240,249	240,249	76,941
Adjusted R-squared	0.523	0.526	0.526	-	-
Municipalities FE	YES	YES	YES	YES	YES
Exam Year FE	YES	YES	YES	YES	YES
Endogenous Var. [STATE_FPS]	NO	NO	NO	NO	NO
School Clusters	1140	1007	1007	1007	1007
Endogeneity F-test	-	-	0.170	-	-
Endogeneity p-value test	-	-	0.680	-	-
corr(e.STATE_FPS,	-	-	-	-0.004335	-
e.SCORE9THMAT)	-	-	-	(0.0220496)	-

Robust clustered standard errors in parentheses *** p<0.01 ** p<0.05 * p<0.1

Table A.14. Achievement Value Added Measure – 9th grade Portuguese National Exam Scores – Estimation Output

VARIABLES	(1) OLS	(2) OLS	(3) IV	(4) ERM - PROBIT	(5) ATE
STATE_FPS	0.0415*	0.0372*	0.0380	0.0419	0.0427
	(0.0214)	(0.0223)	(0.0418)	(0.0309)	(0.0288)
Observations	336,078	240,249	240,249	240,249	76,941
Adjusted R-squared	0.455	0.457	0.457	-	-
Municipalities FE	YES	YES	YES	YES	YES
Exam Year FE	YES	YES	YES	YES	YES
Endogenous Var. [STATE_FPS]	NO	NO	NO	NO	NO
School Clusters	1140	1007	1007	1007	1007
Endogeneity F-test	-	-	0.000622	-	-
Endogeneity p-value test	-	-	0.980	-	-
corr(e.STATE_FPS,e.SCORE9THMAT)	-	-	-	-0.0058275	-
	-	-	-	(0.01999)	-

Robust clustered standard errors in parentheses *** p<0.01 ** p<0.05 * p<0.1

Table A.15. Achievement Value Added Measure by cohort – 9th grade Mathematics National Exam Scores – Estimation Output

VARIABLES	(1) OLS - ALL	(2) OLS - C1	(3) OLS - C2	(4) OLS - C3	(5) OLS - C4	(6) OLS - C5
STATE_FPS	0.0659***	0.0234	0.0144	0.0821***	0.127***	0.0542*
	(0.0237)	(0.0334)	(0.0282)	(0.0306)	(0.0281)	(0.0305)
Observations	336,078	65,697	67,234	66,323	69,678	67,146
Adjusted R-squared	0.523	0.481	0.504	0.502	0.583	0.572
Municipalities FE	YES	YES	YES	YES	YES	YES
Exam Year FE	YES	YES	YES	YES	YES	YES
School Clusters	1140	1124	1112	1081	1067	1061

Robust clustered standard errors in parentheses *** p<0.01 ** p<0.05 * p<0.1

Table A.16. Achievement Value Added Measure by cohort – 9th grade Portuguese National Exam Scores – Estimation Output

VARIABLES	(1) OLS - ALL	(2) OLS - C1	(3) OLS - C2	(4) OLS - C3	(5) OLS - C4	(6) OLS - C5
STATE_FPS	0.0415*	0.0390	-0.0243	0.0775***	0.0660**	0.0445
	(0.0214)	(0.0313)	(0.0335)	(0.0229)	(0.0273)	(0.0323)
Observations	336,078	65,697	67,234	66,323	69,678	67,146
Adjusted R-squared	0.455	0.450	0.478	0.466	0.458	0.462
Municipalities FE	YES	YES	YES	YES	YES	YES
Exam Year FE	YES	YES	YES	YES	YES	YES
School Clusters	1140	1124	1112	1081	1067	1061

Robust clustered standard errors in parentheses *** p<0.01 ** p<0.05 * p<0.1