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CRITICAL ANALYSIS: PORTUGUESE 9TH GRADE EXAM RESULTS AND SOCIOECONOMIC FACTORS

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ABSTRACT

The typical indicator used to assess school performance is average test score results. Literature has pointed out serious weaknesses of this measure as a school performance indicator. The strongest criticism resides in the bias that may exist in socially disadvantaged schools. In fact, this measure does not take into account socioeconomic and other variables which are relevant in determining student's school performance and out of the scope of school control. Using school level cross-section data from Portugal for 9th grade exams between 2005 and 2010, I have explicitly calculated the impact of these variables on school achievement as regards exams. I found an important causal effect between socioeconomic variables and school achievement. This implies that average test scores are an intrinsically flawed instrument. For this reason, this study proposes an adjusted measure of school performance. This measure consists of a ratio between current average school scores and expected average school scores, taking into account the reference variables by municipality.

Keywords: school performance, socioeconomic factors, adjusted measure of school performance, education, Portuguese, 9th grade exams score

I. INTRODUCTION

"Education is a service that transforms fixed quantities of inputs (individuals) into individuals with different qualities." (Hanushek, 1986) In fact, education is an extremely powerful mechanism which holds the potential to create opportunities and promote social mobility.

For Gary Becker, education is a way of investing in *Human Capital.* According to this theory, one can think of education as an investment decision, where current income opportunities are renounced in exchange for improved future income. In light of the Human Capital Theory, education should not be simply seen as a personal benefit (increase in wages), but should also be seen as a way of create social benefit due to the positive externalities associated to it. Consequently government intervention on the educational sector is beneficial and is a potential Pareto improvement.

Many studies have been carried out regarding the factors that influence student achievement and the true contributions of school factors (class size, quality of teachers) and external school factors, namely socioeconomic and cultural factors.

Another relevant topic linked to this discussion is School Performance indicators. Not only are these indicators used by parents when trying to find the best schools for their children, but they are also used by schools to compare their performance with local competitors. The classic indicator used to assess school performance is the mean or median of exam/test scores. In Portugal, newspapers annually publish school rankings based on exam scores. We must take into account, however, that this indicator has serious weaknesses when used to measure school performance (Goldstein and Spiegelhalter, 1996; Meyer, 1995). The most serious flaw is that it ignores both socioeconomic and cultural factors.

The present project explores the main variables that contribute to the explanation of student achievement on Portuguese 9th grade exams. Based on this analysis, it presents an alternative indicator for school performance.

This project addresses these tasks through an empirical analysis based on school's 9th grade exam results in Portugal. There is so far no study like this one that takes up this issue for the 9th grade exams.

This study is especially significant in the Portuguese case, since it is one of the European countries with the highest levels of income inequalities. According to OECD data, the level of inequality in Portugal is only comparable to the level observable in the US, which presents the highest level of inequality in developed countries. (OECD, 2005) Portugal is also one of countries with the highest dropout and failure rate in Europe.

I have found is that an important causal effect between the characteristics of each municipality and school exam results. These characteristics include, but are not limited to, the average per capita income in these municipalities and the education level.

Subsequently, based on these results I propose an alternative and innovative indicator to measure the school performance. The proposed adjusted measure of achievement consists of the ratio between the school's current average score and the expected average score if the school were as successful as the reference variables of the municipality. This indicator allows measuring the true school performance, isolating it from the socioeconomic and cultural factors.

More specifically, I address the following questions: First, I use literature review to ask which are the variables that truly influence student achievement? Additionally, I answer what the implications of relying on school rankings which are based on exam scores as an indicator of the school performance are?

Secondly, to what extent are average school scores influenced by socioeconomic and cultural variables? Thirdly, are there any persisting regional effects after socioeconomic

and cultural variables are controlled? Fourthly, how does the adjusted measure of school performance compare to school rankings?

The project is divided into seven key sections; including the Introduction in Section I. In Section II, I discuss, based on literature and empirical work, the main variables which explain student achievement and a brief analysis of the implications and the consequent disadvantages of using average test scores to assess school performance. In Section III, I will describe the structure of the Portuguese educational system whilst in Section IV I describe the chosen data and the variables. I also present an econometric model to analyze the impact that internal school and municipality variables (socioeconomic and cultural conditions) have on average school exam scores. In Section V, I present the regression results. In section VI, I develop an adjusted measure of school performance. Lastly, in Section VII, I present my main conclusions and some proposals for further research.

II. LITERATURE REVIEW

The existing literature on academic performance indicators, as regards this analysis, can be broadly grouped into two areas. Firstly, many studies analyze the educational performance indicators, discussing their validity and the main limitations of this measure.

Mancebón and Bandrés 1999, in their study described some features of the educational process that should be take into account regarding the assessment of school performance: i) "*the cumulative nature of the educational process"*; student achievement is influenced by many factors, namely, the student's prior years of education, their socioeconomic background and cognitive skills, ii) the importance of exogenous factors to the school. "*The uniqueness of the educational production process implies that a significant effort must be made to filter out what is really provided by each school."*

In the majority of countries, there is no single source that regularly provides appropriate data regarding the performance of schools that can be used for analyzing policies. Therefore, most of the empirical work in this field comes from the school

average scores on the exams, namely the SAT's (Scholastic Aptitude Test), the ACT's (American College Testing program) for United States or PISA for international comparisons. In spite of this, Hanushek (1990) considers that this data is severely limited in the evaluation of school performance. In fact, the use of the average (or median) of this type of test scores has been severely criticized by the literature due to the number of fallacies it contains. Meyer uses simulations to show that this indicator provide a misleading portrait of school specificities of performance for grade levels and its evolution over time, since it is an averaged. Moreover, the author points to the fact that this indicator encourages schools to participate in "cream skimming", that is, schools tend to invest their efforts on those students who tend to achieve higher tests scores in order to increase the school's performance. Bradley and Taylor (2002) argue that this effect is particularly noteworthy in private schools where processes of selective admissions prevail. Reback 2007, studied the school short-run incentives to improve student´s expected performance, and he found that students perform better than expected when their test score is particularly important for the school accountability rating, since the school support more students in this case. Another form of "cream skimming" was pointed out by Shepard (1991), and consists of retaining students at a given grade level or encouraging low performance students to transfer to another school. Other limitations of exams scores as performance indicator are presented in literature. Ladd (2001) points out that schools with poor exams results are labeled as "failing" schools even though these schools may be performing well if the prior performance of their students is taken into account. And most importantly, it fails to distinguish the school's true contribution to improved student achievement from external factors to the school such as the student's '*individual characteristics, family background and neighborhood/community*" (Hanusheck and Taylor 1990).

Second, there are studies that address the contribution of student´s individual´s characteristics, their family and neighborhood features for the children´s achievement.

The Coleman Report in 1966 provided strong evidence for the pivotal role of the family background and cultural factors in determining children's achievement. A large volume of empirical evidence (Datcher-Loury 1989) has supported this claim.

Many authors have proposed an educational production function to measure the efficiency of school inputs on educational output. The production function compares the educational output (e.g. achievement in tests scores, graduation rates) with a set of inputs. Jerrim and Micklewright (2010) concluded that children have better results when parents spend more time with them developing their skills, and the more educated parents tend to be, the more effective in transmitting the knowledge they are. However, the authors face many statistical problems with the inclusion of "family income" in their model. Other authors, namely Strauss and Sawyer (1986) recognize this problem.

In spite of this, researchers such as Becker (1981) and Danziger and Waldfogel (2000), among others, have pinpointed the positive and significant impacts that family income has on student's achievement. Families with high economic resources are more likely to produce important inputs for their children's development, providing greater educational resources (books), better pre-school child-care and, among other things, children have the possibility to attend private tutoring. This last factor is significant in Portugal, according to Neto-Mendes, Costa and Ventura (2003). Acemoglu and Angrist (1999), found also an important correlation between the average schooling in US and the state wage levels, based on an instrumental variables strategy.

Although the relative importance of different home resources is still debatable, it is safe to say that, at least according to the literature, family structure has a significant impact on school achievement. It is becoming increasingly clear that children who live in single-parent-families tend to perform poorly on academic tests compared to those in traditional

families (Astone and McLanahan 1991, others). The causes of this phenomenon remain unclear; one explanation is the economic disadvantages that single–parent families face (Astone and McLanahan, 1994). In terms of family size, there is evidence that larger families tend to spend less time with each individual child (Graaf 1986).

Kalmijn and Kraaykamp (1996) and Graaf, Gaff and Kraaykam (2000), among others, have pointed out that cultural capital is another important variable in explaining student achievement and have incorporated it in their models. The Cultural Capital Theory is related to the socialization process into highbrow activities, such as interest in art and music, museum attendance, and reading. In empirical studies, this variable is generally measured by family reading habits and participation in formal culture (visits to museums, theaters and concerts). However, Povoas (2008) concluded in her project that these variables are not significant in explaining school exam scores.

Many authors have tried to measure the *true efficiency* of schools and proposed alternative evaluation methods for it. Sampaio (2003) has attempted this in Portuguese secondary schools. Taking into consideration exam results for 2002 in Mathematics, he tries to seperate them from school effects, socioeconomic and cultural impacts as well as student's characteristics. He concludes that schools influence only the prior achievement. Hanushek and Taylor (1990) emphasize that the best school performance indicator is valued-added. However, this measure is extremely difficult to implement since the information required for it is rarely available. This topic will be discussed further in Section V.

III. THE PORTUGUESE EDUCATIONAL SYSTEM AT A GLANCE

3.1. The Educational System

The Portuguese Educational system is comprised of Public, Private and State-funded Private schools. At all levels of education, parents can opt for Private schools. Private schools charge fees, although there are some Private schools or some types of Private

schools that are financed by the Government. Both teaching contents and methods are defined by the Ministry of Education at all types of school up to the 12th grade.

The Educational system is represented in Figure 1, found in the Appendix. In Portugal, pre-primary schooling is not compulsory for children between 3 and 5 years of age. Compulsory school is divided into three main cycles: the first cycle which includes grades 1 to 4 (at the 4th grade, students are required to do *provas de aferição*); the second cycle which includes the next two grades (at the end of which students are required to do *provas de aferição)* and finally, the third cycle which lasts 3 years (students are required to do exams in both Portuguese and Mathematics in the 9th grade in order to conclude compulsory school). [1]After this basic education, secondary education follows, which is optional. In secondary school, students can opt between general and technological (work-oriented) courses.

As regards public school ownership, first cycle schools are run by the Central Government and belong to the municipalities. Second and Third cycle schools are both run and owned by the Central Government. Public schools are free of charge; however, complementary financial aid is available for all disadvantaged students. According to the Ministry of Education, this financial aid should help support food, accommodation and school materials expenses.

This project focuses only on 3rd cycle education, specifically 9th grade exam results. Note that the ENEB (Exames Nacionais do Ensino Básico) are only mandated for schools on continental Portugal and Madeira.

3.2. Portuguese School Evaluation

In Portugal, legislation was passed in 2002 which permitted self evaluation and external evaluation of schools.

[1] 9th grade exams were introduced in 2005 and are mandatory at all schools in Portugal except in the Azores. Azores decided not to apply the 9th grade exams due to their autonomy in some matters relative to the central government.

Despite this effort, there is still no systematic method for evaluating school performance in place. In general, evaluation is based on an informal and simplistic method conducted by newspapers which compute school rankings based on average exam grades. Communication of these rankings for basic schools only began in 2005, based on the school results of 9th grade national exams.

In 2006, the Ministry of Education created a "working group for school evaluation", with an aim to define models for self and external evaluation in pre-schools, basic and secondary schools. A year later, a department of the General Inspectorate of Education (IGE) was established, to evaluate 100 schools that voluntarily agreed to participate. The IGE evaluates several aspects (e.g. organization and management of the school, leadership, auto-regulation capacity, and results on various levels) and all visited schools received a report stating the weaknesses and strengths of the school as seen by the IGE. This external evaluation has being extended to all schools in Portugal. In Section V I will discuss this subject further.

IV. DISCUSSION

4.1. Methodology and Data

Table1 summarizes the inputs and output variables used in the study.

Inputs	Outputs
School related variables	School average scores of 9th grade exams
Municipality socioeconomic variables	
Municipality cultural variables	

Table 1: Inputs and Outputs

9th grade exam score data is published by the Portuguese Ministry of Education. This data has been published every year since 2005. The last available year is 2010.

The information for these 5 available years was taken from Direcção Geral de Inovação e Desenvolvimento Curricular (DGIDC), which belongs to the Portuguese Ministry of Education. In the computation of average school exam score is taking into account the both exams Portuguese and Mathematics, and only internal students and first call exams.

A cautionary note is advisable before proceeding. At any type of school in a given year, there are two types of students who may take a national exam: internal and external students. Internal students are regular students who take a national exam as a student belonging to that school whereas external students include those who register for exams on an independent basis[2].On the other hand, for each exam in a given year, there are two calls. The first call is a compulsory phase that occurs in June and includes all regular students who are automatically enrolled at the school. The second phase is in September and is only for students who have not been able to successfully pass the 9th grade in the first phase. Here, I will only consider the first phase.

As regards inputs, I will examine in more detail the variables and the respective proxies in section 4.2. However, it is important at this point to mention the type and the level of analyses. Unfortunately, in Portugal, there are no historical databases regarding student performance and corresponding family background. Furthermore, the national exam database does not contain information regarding the student's prior school results or their socio-cultural background. For this reason, socioeconomic and cultural data is only available at a municipality level.

On the other hand, municipality–level variables are not available on a yearly basis, since the majority of data only pertains to the last census year - 2001. For this reason I do not possess a complete data-panel.

Therefore, I will alternatively use a repeated cross section, where I compare average school grades of a particular year, on that year's school-level explanatory variables and socioeconomic and cultural explanatory variables.

[2.] It could be a potential manipulation bias from the schools, since schools have an incentive to fail some low mark students, which means they will take the national exam as an external student. Therefore, this student's score will not be taken into account whilst calculating the school's average. Theoretically, all school types (Private, Public and State-funded Private Schools) benefit from a higher average score and consequently a higher position in the rankings. Although, in practice, Private Schools have an additional incentive to manipulate these scores since they charge fees and want to attract more students.

In Table 2 I compute the correlation between average school exams scores (the average score of both exams, Mathematics and Portuguese) for the last six years.

	2005	2006	2007	2008	2009	2010
2005	1					
2006	0,77	1				
2007	0,73	0,79	1			
2008	0,72	0,77	0,77	1		
2009	0,71	0,71	0,74	0,74	1	
2010	0,67	0,71	0,74	0,71	0,78	1

Table 2: Pairwise average score correlation coefficient for the six available years.

Correlation is always positive (values are always greater than 0) and the correlation values vary between 0,67 and 0,79, which is close to 1. School exams scores are quite stable across time: this means that one expects that a school that presents a high exam score in a certain year will continue to exhibit high average scores in the following year. Not surprisingly, the correlation values decrease as one moves further from a given year.

I also analyze the correlation between average scores in nation-wide Portuguese and Mathematics exams; the Pairwise correlation table is shown in the Appendix, table 3.

Again, all correlation values are positive and quite large. Correlations between Portuguese and Mathematics exams scores for the same year are represented diagonally.

As one can see, these values are high, ranging between 0,73 and 0,79, which means that the scores for the exam in Portuguese is extremely interconnected with the Mathematics exam score. Again, the correlation between the two exams scores decreases as the temporal interval between them increases.

Based on these correlations, one concludes that school scores are fairly stable through the years. For this reason, in practice is not necessary to do a repeated cross section for the five years; it is only necessarily to do a regression for one year, since school scores are highly correlated throughout the years. In order to ensure a more consistent estimate, I have decided to do a cross section for 2005, since the temporal difference between some of the explanatory variables, namely the socioeconomic variables are only available for the last census (2001) and the output is lower thus eliminating the possibilities of bias.

On the other hand, I have decided to consider the school average score on both exams as a dependent variable, instead of carrying out separate estimates for school scores on Mathematics and Portuguese, since these two variables are also highly correlated.

My sample includes 1374 schools and represents all the schools that participated in the 9th grade exam at least once between 2005 and 2010. In 2005, the number of schools is only 1237. In Table 4, in the Appendix, I demonstrate the relationship between the number of schools and the municipalities. Note that the Azores, due to its independent status, decided not to participate in the 9th grade national exams. For this reason, I will only consider 289 municipalities even though Portugal has 308. All the considered municipalities have at least one basic school that participated in the 9th grade exam. There is no potential source of bias, as occurs in the case of secondary schools (Povoas 2008)[3].Table 5 and 6 summarize the relation between the number of private school and PFPRIV and the municipalities. Through these tables, one can conclude that Private and State-funded Private Schools are concentrated in 45 and 49 municipalities respectively and that the remaining 84% of municipalities in Portugal do not possess any Private schools. Lisbon and Oporto alone have more than 11 Private schools.

4.2. Empirical Model and Variables

Ideally, my objective here would be to explain school exam scores through individual characteristics, family background (parents' income, school variables (infrastructures, teachers' quality, peer effect) and socioeconomic variables that affect the neighborhood. Unfortunately, individual and family background data is not available in Portugal and even school-level data is scarce, as mentioned above.[4]

[3]. There is no occurrence of bias in this sample due to the fact that all municipalities have at least one basic school, and therefore all the students' socioeconomic backgrounds are taken into account. On the other hand, all schools are included in this analysis, even those with a lower number of students, whereas these schools are not generally taken into account in newspaper ranking.

[4].In the estimate there is no bias created by the temporal difference between the explanatory variables (municipality variables only available in 2001) and the school average score in 9th grade exams, (the dependant variable between 2005 and 2010), since explanatory variables can be considered as structural parameters. The structural parameters are variables that, in real terms, are not subject to change. However, in order to ensure a more consistent estimate, I will make the estimation upon the exam results for 2005.

In **table 7** in the Appendix, I describe the variables used in this project and their sources. Therefore, my strategy will be to link average academic scores in 9th grade exams to socioeconomic and cultural variables, that is, match each school to the corresponding socioeconomic and cultural variables of its municipality.

This methodology is justified by the governmental school allocation rule. In Portuguese Public Schools students are allocated according to their place of residence or, alternatively, to where their parents' workplace is located. According to this criterion, students should be allocated to the nearest school to their residence, e.g. the school in their municipality, or alternatively, in some cases, to their parent´s workplace. For this reason, I shall use the municipal-level data as a proxy for students' socioeconomic background.

The main specification that I estimate is as follows:

$$Y_s = \beta_0 + \beta_1 INC_M + \beta_2 EDU_M + \beta_3 CULT_M + \beta_4 BUILD_M + \beta_5 DEM_M + \beta_6 SOCIALCAP_M + \beta_7 school_s + \delta_8 PUB_S + \delta_9 PFPRIV_S + \varepsilon_{SM}$$

Where S refers to the school and M to the municipality where it is located. The dependant variable, **Ys,** refers to the average academic score in 9th grade exams; in terms of the explanatory variables Table 7 presents the definition, source and year of each variable and Table 8 presents the main descriptive statistics.

Now, I will present and justify the main variables and respective proxies.

Municipality Income: The variable $\mathbf{INC_M}$ stands for municipality income. Many authors have included the relationship between educational outcomes and family income in their research (e.g. Blanden and Machin, 2004), and numerous studies have documented a positive relation between parents' income and the school. There is also a conviction that wealthier regions are relatively prosperous. I take into consideration four alternative proxies: Purchasing Power (PP_M); Proportion Purchasing Power (PPP_M)[5];

[5.] PPP_M measures the proportion of purchasing power of a given municipality in relation to the remaining country, and takes into account population size and the real per capita income, i.e. the position of a given municipality in relation to the national average in terms of real per capita income. The sum of the PPP of all municipalities in Portugal equals 100%.

Unemployment Rate ($UNEM_M$) and monthly average income ($AVERAGEINC_M$). In terms of signs, I expect a positive sign for PP_M, PPP_M and $AVERAGEINC_M$ and a negative sign for $UNEM_M$.

Municipality Education: in the specification, municipality education is represented by the variable $\mathbf{EDU_M}$. In order to be successful, children require a certain amount of human resources provision; the importance of these factors were shown by Murnane, Maynard and Ohls (1981) among others, which compare the impact of "human resources" with the impact of "material inputs" (games or reading material), concluding that human resources is relatively more important to children's achievement. Higher educated parents provide intellectual stimulation and are more effective in guiding their child through successful cognitive developments.As regards regions, there is evidence that supports that higher educated regions show a greater concern for the education of future generations, providing a propitious environment to education and a more educational-friendly background (Carneiro 2006, Murnane, Maynard and Ohls 1981). I have tried four different proxies: the percentage of people in the municipality who have completed, at least, mandatory school ($MAND_M$), the percentage of people that have completed higher education ($HIGHER_M$); illiteracy rate ($ILLIT_M$) and dropout rate ($DROP_M$). I expect a positive sign for $MAND_M$ and $HIGHER_M$ and a negative sign for $ILLIT_M$. Please note that all these variables measure long-term effects of the municipal education level, except $DROP_M$, which captures the contemporaneous effect of the surrounding educational background. $DROP_M$ has an ambiguous effect on achievement. On the one hand, a higher dropout rate could indicate higher student selection, this fact has a positive effect in achievement and therefore one could expect a positive sign. But on the other hand, a higher dropout rate could mean an unfavorable academic background, and in this situation, I expect a negative sign.

Municipality culture: **Cult$_M$** stands for *cultural capital*. Graaf (2000), measures the cultural resources by taking into account the family's reading habits and its participation in formal culture. "*Reading habits are measured by the number of hours per week parents spend reading and by the number of visits to libraries. Participation in culture is measured by the number of visits parents make per month to museums, theaters or concerts.*" I have only taken into account *formal culture* as a measure in cultural capital. To reflect this effect, I have introduced a proxy $MONU_M$ that stands for the number of monuments per resident and $ICULT_M$, the cultural infrastructures per resident in each municipality. I also consider a proxy to reflect investment in culture: the amount of per capita cultural expenditures in the municipality ($EXPCUL_M$). One would expect that a more culture-friendly municipality would stimulate students and increase their academic results. I therefore expect a positive sign.

Municipality Demography: In the regression, **DEM$_M$** refers to the demography variable. Póvoas (2008) in her project called attention to the fact that educational variables are dependent on the demographic structure of the population in each given municipality, particularly $MAND_M$ and $ILLIT_M$, as well as some cultural variables. For this reason, I have included some demography proxies, for instance OLD_M, to control the percentage of resident population in a given municipality which is over 65 years old and the average age in the municipality ($AVRGAGE_M$). In my regression I include an immigration variable, the percentage of foreign people residing in the municipality ($FOREIGN_M$). Unfortunately, there is no available data according to race. On the other hand, numerous studies have shown that children from single parent families are at a disadvantage as regards academic results compared with two-parent families.[6] Therefore I have also included a variable to represent the impact of single parent families ($SINGLE_M$). I have complemented the analysis introducing one variable for family size, the percentage of

[6.] McLanahan and Sandefur 1994; McNab and Murray 1985; Murrays and Sandqvist 1990; Pong, Dronkers, and Hampden-Thompson 2003.

families with more than 3 children (CHILDREN_3_M). It is believed that families with many children tend to spend less time with each individual child as compared with families with only one child.

Municipality quality of life: The variable **BUILD$_M$** stands for the average age of buildings in a given municipality. This variable reflects quality of life, insofar as new buildings would be better suited to today's needs. The age of buildings could also be a proxy which corresponds to regional economic dynamics, since places with new buildings receive more investment. The expected coefficient sign is ambiguous. On the one hand, one would a negative sign due to the regional economic dynamics that are lower in regions where buildings are older. But on the other hand, cities have the oldest buildings, so the proxy may also reflect the economic and demographic dynamics in the cities, which would then lead us to expect a positive sign.

Municipality Social Capital: The variable **SOCIALCAP$_M$** refers to the Social Capital. Coleman introduces a new type of capital: Social Capital. According to his study, this type of capital has important effects on child wellbeing, particularly educational achievement and the adoption of new technologies by society. Many researchers have included this variable in their studies, in order to reflect citizenship. I will try two proxies: the abstention rate in local municipal elections (VOTE$_M$) and the percentage of recycle residues per resident (RECY$_M$). In terms of coefficient signs one might expect a negative sign VOTE$_M$ and a positive sign for RECYCLE$_M$.

School variables: Krueger (1999) emphasized the importance of class size and the fact that student achievement increases in small classes, this beneficial effect persists throughout one's life, and the probability to attend university is higher. Hoxby 2000, studied the effect of class size on student achievement using longitudinal variation in the population associated to each grade in 649 schools elementary school. However her estimations indicated that class size doesn't have a statistically significant effect on

student's scores. Unfortunately, there is no available data in terms of class size, so, alternatively, I will use the number of exams per school ($EXAMS_s$) as a proxy for school dimension. A bigger school may have economies of scale (Povoas 2008), it may have more specialized teachers with longer teaching experience in preparing students for the exams. On the other hand, in small schools, teachers could be forced to teach several subjects which could have a negative impact on the children's achievement. However, in smaller schools teachers sometimes have the ability to give more attention to each student, resulting in a more familiar environment (not necessarily a higher teacher/pupil ratio), which would increase average school grades. Therefore the $EXAMS_M$ coefficient sign is ambiguous. I have also considered a variable which takes into account the teacher/pupil ratio: the percentage of 3rd cycle and secondary teachers relative to the number of 3rd cycle and secondary students. Unfortunately, this variable is only available for NUTIII, I have, nevertheless, decided to include it since it proved to be significant in the estimations. Many authors suggest the existence of a gender gap, which is evident in exam scores, and is explained due to the greater effort exerted by female students. I include the percentage of female participation in 9th grade exams per school ($GIRL_S$) as a proxy of gender, and the percentage of students under 16 participating in 9th grade exams per school (AGE_s), as a proxy of age. Please note that students who are over 16 in 9th grade exams signify that these students have stayed back at least one year. In terms of signs, one expects a positive sign for $GIRL_S$ and for AGE .[7] In Portugal there are three types of schools. I will therefore consider two dummies PUB_S and $PFPRIV_S$. The dummy PUB_S is equal to 1 if it is a public school and 0 otherwise. The dummy $PFPRIV_S$ is equal to 1 if it is a State-funded private school and 0 otherwise. For PUB_S and $PFPRIV_s$ one expects a negative sign. Private schools are characterized by either wealthier or more able individuals who wish

[7]. Females face a greater increase in labor market returns from signaling due to their academic performance. Despite this fact, particularly in developing and Asian countries, female investment in human capital is significantly lower as compared with men, which can have a negative influence on female levels of achievement.

to invest additional resources in education besides that which is guaranteed by the state. Obviously this dummy reflects other aspects, namely, the differences of school environments and the peer effect. According to Zimmerman (1999) and others, private schools are expected to be more organized, since they are smaller than public ones and have a higher financial autonomy as compared with the Central Government. Additionally, the existence of peer effects that aid in the creation of a different "academic environment" and "social units" which may have a positive impact on academic results. Hoby 2000 analyzes the impact of gender and race on class performance. She concluded that peer effect are relevant, and having peers that score 1 point higher increase an individual's score by 0,10 to 0,55. This effect is stronger intra-race and a more female peer group increases achievement. I include the variable $COMPET_D$, which corresponds to the number of schools per resident. This variable aims to measure the impact of competition between the schools in each district. There is a continuous claim that increased competition between schools increase levels of student achievement (e.g. Ponzo 2010). "*Moreover, many authors show that students achieve much better outcomes if schools operating in more competitive environments also experience a higher pressure on academic standards coming from parents*". Hence, one expects a positive sign.

In order to cross-check the analysis, other controls are used relative to the selected regressions. I include regional dummies in the regression, which allows me to check whether there are persisting regional effects, even controlling for socioeconomic factors. I cross-check this analysis by using average 9^{th} grade exam scores in schools as dependent variable between 2005 and 2010 for both exams (Mathematics and Portuguese) together and also separately.

V. RESULTS

I have made many estimates, using different combinations of variables. All the estimates made for the baseline specification are presented in table 9. The Reg2

corresponds to the baseline specification. (Consult **Statistical and econometric considerations** in Appendix)

Table 9: Baseline Specification and other regressions.

Variable	Reg1		Reg2		Reg3		Reg4		Reg5		Reg6		Reg7	
constant	1,6706	***	1,7063	***	1,4526	***	1,6267	***	1,6118	***	3,0895	***	3,1544	***
Exams	0,0004	***	0,0004	***	0,0041	***	0,0004	***	0,0004	***				
PUB	-0,3425	***	-0,3429	***	-0,3462	***	-0,3564	***	-0,3587	***	-0,3956	***	-0,3873	***
PFPRIV	-0,2070	***	-0,2165	***	-0,2228	***	-0,2160	***	-0,2248	***	-0,2935	***	-0,2872	***
AGE	1,3903	***	1,3897	***	1,4170	***	1,3891	***	1,4076	***				
HIGH	0,9647	***	0,8328	***	0,7752	***						***	1,3726	***
IMMIG	-1,3381	***	-1,4785	***	-1,5557	***	-1,4268	***	-1,5097	***	-2,3031	***	-1,6687	***
Children_3	-0,9513	***	-0,6023	*	-0,5670	*	-0,9155	***	-0,6043	*	-0,8980	***	-0,4735	
DROP			-2,0254	***	-1,3709	*			-2,2377	***	-2,1179	***	-2,4623	***
TEACHERS					4,2055	**								
PP							0,0015	***			0,0017	***		
INC									0,0002	***				
UNEM											-1,0697	**		
MONO													-1,2651	*
N	1237		1237		1237		1237		1237		1237		1237	
R2	0,401		0,409		0,405		0,394		0,399		0,243		0,247	

Legend: * p<0,05; ** p<0,01; *** p<0,001

As was explained above I choose PP_M as a proxy for income, this variable always presents positive coefficients, and is more significant than PPP_M. As one can see in column 5, the variable INC_M is also a significant variable, however the coefficient value is PP_M, an increase of 1 percentage point in municipality average income increases by only 0,0002% the school average grade. Although unemployment has always had negative coefficients, the amounts are not significant. It is therefore not possible to ensure that schools located in municipalities with a low rate of unemployment have better results, ceteris paribus.

In terms of the educational variables, $MAND_M$ and $HIGHER_M$ variables have always presented positive and significant coefficients. In spite of this, $HIGHER_M$ has a much higher coefficient, meaning that the percentages of residents in each municipality who have attended higher education have a greater influence exam results then the percentage of people who have only attended compulsory education. For this reason, and in order to

avoid a multicollinearity problem in my baseline specification, I have decided to apply the $HIGHER_M$. The level of illiteracy in each municipality doesn´t has any effect on exams score. The dropout variable is significant and presents a negative coefficient, which means that municipalities with high drop-out rates negatively influence average scores, that is, schools located in regions where there is a lower quality educational background present poorer results. I have tried to apply the PP_M and the $HIGH_M$ together; however, this undermines the income variable. This occurs because these two variables are correlated.[8]

As regards school variables, the $GENDER_s$ variable is not significant, meaning that in our model gender does not affect the school's average exam scores. I have introduced two dummies to reflect the type of school; the reference category is Private school. As expected, Public schools and State-funded Private schools do worse than private ones, since the two dummies present both negative coefficients. Please note that public schools present poorer results than state-funded public schools. Unfortunately, upon only these regressions it is impossible to calculate whether this effect is due to the positive link between private schools and privileged socioeconomic backgrounds or to school differences, such as organization or peer effect.

The variable $EXAMS_S$ reflect the number of students per school in the 9^{th} grade, this variable is significant and the coefficient is positive. This means that bigger schools have better results than smaller ones. This can be explained by the fact that teacher's experience in preparing students for the exams and the levels of teacher specialization is higher in bigger schools. On the other hand, the economies of scale and the spillovers due to student's mix characteristics may offset the fact that, at small schools, there may be a more familiar environment. In spite of this, I cannot reject the possibility that a better

[8.] This makes sense, according to the economic theory that the higher the education level is the higher the wages will increase, however, with decreasing marginal productivities. On the other hand, one can see that the impact of higher education on the municipality, in explaining exam scores, is stronger than the effect generated by the income variables PP_M or INC_M. Hence, in my baseline specification I decided to apply the variable $HIGHER_M$.

school attracts more students and not otherwise, (the school is better due to the fact that it is bigger).

Parents may decide to send their children to better schools which, in turn, will increase their number of students. This effect could create a problem of endogeneity. This effect, however, is quite limited for public schools in Portugal due to the student allocation rule which states that students be allocated to the nearest school.

The proxy AGE_S reflects the percentage of students who have never stayed back. As a general rule, *better schools* present lower percentages, therefore, this variable tends to be close to 1. The variable $teachers_M$, corresponds to the number of teachers per student. This variable is only available in terms of NUTIII, although it is a significant variable, and the coefficient is positive and high.

With regards to the competition between schools, I have introduced variable $ratio_M$, the ratio between the number of private schools and public schools in each municipality. However this variable is not significant, this occurs due to the low number of municipalities with private schools (Section 4.1).

In terms of the cultural variables I have applied $EXPCUL_M$, this variable is not significant, which means that according to our model, the expenditures in culture per municipality does not have an impact on the students' grades. Despite this fact, it is not possible to conclude, based simply on this data, that diversity in cultural infrastructures does not have an influence on student achievement. We are only able to capture the investment per municipality in 2001.

With regards to demographic variables, the average age of the residents in a municipality is not a significant variable in explaining average exam results. The $MONO_M$ variable is significant in some regressions, and presents a negative sign as was expected. I have also introduced a variable which represents the size of the family. Based on my regression, the variable CHILDREN_3 is significant and the coefficient is negative, which

means that when families have more than 3 children there is a negative impact on the average exam results. The percentage of immigrants per municipality is also a significant variable. The coefficient is negative, which implies that municipalities with many immigrants have a negative influence on the student´s exams scores. In reality, immigrants tend to work lower-paying jobs and, in some cases, students have to deal with the language barrier which makes the learning processincreasingly difficult. In spite of this, this variable can be a proxy of the neighborhood environment. Some groups of immigrants tend to live in poorer neighborhoods.

In order to consider citizenship, I have introduced the variable $VOTE_M$, which is also not statistically significant. The variable $BUILD_M$ has a negative sign and occurs because regional economic dynamics are lower in regions where buildings are older.

To cross-check, I have done a regression using the school average in Mathematics and Portuguese exams and the school average for the exams from 2005 to 2010 as dependent variables. The results of these regressions are presented in Table 10 in the Appendix.

5.2. Regional Differences

In this section I have introduced Regional dummies in my baseline specification (Reg2). The regional variable allows me to check whether regional effects still persist even after controlling for socioeconomic variables. For this purpose, I have used the NUT II regional division of the Portuguese territory. There are seven NUTII regions in Portugal: Norte, Centro, Lisboa, Alentejo, Algarve, Azores and Madeira. However, I consider only six regions since the Azores did not participate in 9th grade exams. For this reason, I have considered five dummies and the omitted variable is Centro.

The results of the baseline specification including the regional dummies are presented in column 1 (reg8) of Table 11 in the Appendix. Based on the table one can conclude that if a given school is located in Norte, Lisboa or Algarve, it is expected to have lower average grades in exams than a school located in the region of Centro, ceteris paribus.

Unfortunately, although the variables Alentejo and Madeira present a negative coefficient, these variables are not significant and as such one cannot make any conclusion about these regions. The schools located in Alentejo, followed by schools located in Lisboa are the ones that, on average, have a better performance than those in Centro considering only the significant variables.

In terms of the other variables, they maintain the same sign, however, as one can see when I included the regional dummies in the baseline specification, the DROP variable is no longer statistically significant. For this reason, I have presented the same regression without $DROP_M$ in Column 1 (reg8). The results are very similar to the previous specification and the adjusted R-squared is also similar.

The asymmetries between the regions can be explained by natural conditions or historical reasons that influence the educational structure and environment. It may also result from reinforcing forces that attract more people, more and better students and teachers, further reinforcing the attractiveness of the region. On the other hand, immigration could be another explanation, in fact, there are asymmetries between the number of immigrants throughout the regions; immigrants tend to concentrate more on bigger cities such as Lisboa and Porto and in the Algarve region. Another explanation is region labor market dynamics. The Portuguese labor market is characterized by tough models of employment protection and a low dynamic, in terms of job creation and job extinction, which limit worker flows between jobs. Portugal and Blanchard (2001), characterize the Portuguese labor market as a market with "*very low labor mobility*", making the economy more sclerotic. According to the authors, this situation is related to the low work turnover, the influence of job protection legislation on labor demand and regional labor mobility. The Portuguese labor market is considered to be one of the least dynamic in the OECD. The opportunity cost of going to school is very different across the regions, proving to be higher in more stagnated and poorer regions.

VI. ALTERNATIVE SCHOOL MEASURE

The use of the average exam scores as a measure of school quality presents many limitations as has been pointed out above. In this section, I will analyze an alternative measure for school quality.

6.1. The AGE_S variable

In analyzing school quality one can consider three types of variables: Socio-economic and cultural variables, namely family background and neighborhood; school related variables, such as peer effects, class size and student/teacher ratios and the output variables, such as students' average scores. The first two types of variables can be considered as input variables. When analyzing school output variables, the most evident is average exam scores. The AGE variable, however, (percentage of students under 16) can also be interpreted as a school output variable. In fact, this variable is a proxy of the percentage of the students that had never stayed backbefore the 9^{th} grade. (consult table 12 in the Appendix, the regression as dependant variable AGE)

I decided not to exclude the variable AGE of the baseline specification, although I am aware of the possibility that this variable can also be considered an output. I used the Ramsey RESET test to analyze the existence of omitted variables on the baseline specification with the AGE variable and on the model which does not include the AGE variable. In the specification without AGE there is evidence for omitted variables. On the other hand, upon application of AGE to the baseline specification, I do not reject the null hypotheses. For this reason, I have decided to keep the variable AGE and to use reg 2 as my baseline specification.

6.2. Adjusted Measure of School Performance

The adjusted measure of school achievement consists in the ratio between the current average school score and the expected average school score if the school was as successful as the reference variables of the municipality (determinate based on Baseline specification

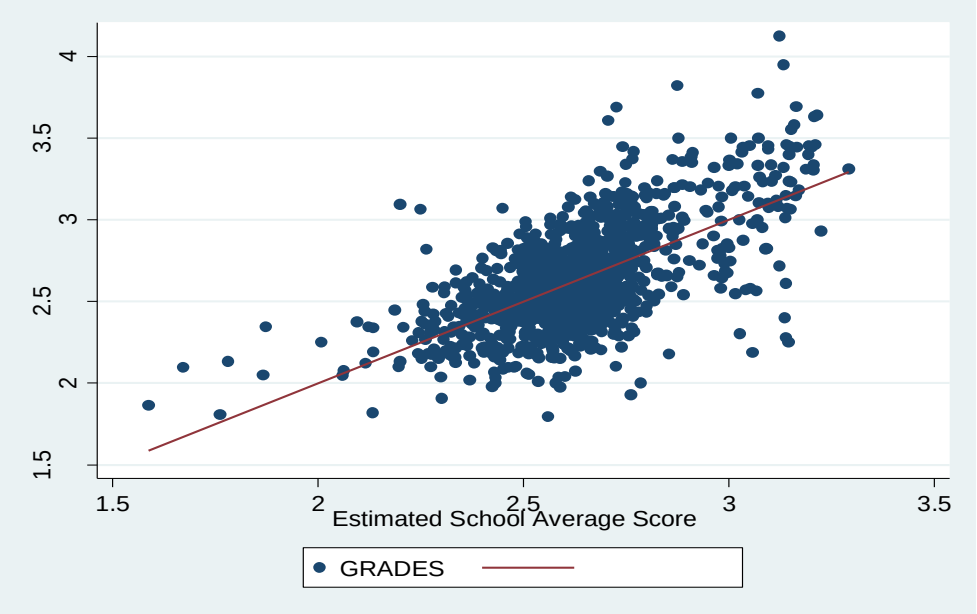
reg2). This indicator enables us to measure school performance using socio-economic and cultural variables. If a school has a ratio equal to one, this means that average school scores are equal to the expected ones, taking into account the municipality features and the school characteristics. On the other hand, if a school has a ratio higher than one, this school has an average exam score which is better than the predicted one, based on the municipality and school conditions. For this reason, these schools are considered to be successful. In cases where schools present a ratio lower than 1 the opposite occurs.

Based on the ratio results, it is possible to construct a ranking, where the schools with the highest ratio are in the top.

I constructed this adjusted school measure for 2005, based on 9th grade exams scores. Firstly, I determined the expected average school score, replacing the specific school values on the baseline specification, regression reg2. I then computed the ratio:

$$School\ adjusted\ score\ ratio = \frac{\text{school average score in 2005 exams}}{\text{expected school average score}}$$

Table 13, in the Appendix presents the summary statistics for these variables.



Graph1: Scatterplot and 45°line for Portugal.

Graph1 summarizes each school result. On the graph it is represented by the 45° line and the scatter plot corresponding to all school observations. If the observation is on the 45°line this means that the school average score is equal to the expected one, and in this case the ratio is 1. On the other hand, if the observation is above the 45° line, the adjusted score ratio is higher than 1. As expected, the plots are concentrated in the middle section of the graph and are slightly skewed to the right, since the expected school exams scores range between 1,59 and 3,29 and average 2,64.

In terms of schools, those presenting higher adjusted score ratios are located in Machico (Madeira), Alijó (Norte), Braga (Norte) and Aveiro (Centro), respectively and all of them are Public schools. The worst ones are located in Montalegre (Norte), Oeiras (Lisboa) and Lisboa (Lisboa) respectively, two of them are private. Consult Table 14 and 15 in the Appendix with the raking based on adjusted score ratio.

I have compared this ranking with the traditional ranking published in newspapers which are based on average exam results. In the Appendix I have constructed the tables 16 and 17 in relation to the top ten school rankings according to average school scores in exams and the ranking for the ten worst schools.

In terms of schools, the ones with the ten highest average score on the exams are all located in Grande Lisboa and Grande Porto, and only two of them are public. The majority of the ten worst schools are also located in Grande Lisboa e Grande Porto, and nine schools are public.

As one can see this traditional ranking based on the average exam results are different from the one based on adjusted score ratio. The main differences are in the location and on the type of schools. In fact in the ranking based on the adjusted score ratio the top ten schools are not only located in Grande Lisboa and Grande Porto, but some of them are located in poorer regions such as Machico and Alijó. On the other hand the top ten schools in this ranking are mainly public schools.

However, despite these differences, the correlation between the school positions in both rankings are positive and relatively high- approximately 0,89.

I have also analyzed each region separately; consult Graphs 2 to 7 in the Appendix. Proportionately, the Norte is the region with more schools with an adjusted score ratio lower than 1, in fact, the majority of schools in this region are concentrated below the 45° line. On the other hand, Centro is the region where, proportionally, schools ratios are more concentrated around 1.

VII. CONCLUSION

The typical indicator used to assess school performance is the average and median achievement test scores. This indicator, however, is subject to controversy. Hanushesk (1990) considers it extremely limited in its evaluation of school performance. In fact, this indicator suffers from three main inefficiencies: it creates incentives for school cream skimming; it fails to take into account past student performance and does not reflect the individual socioeconomic context of the school.

The first aim of this project is to estimate the importance of these external factors in school achievement. The study provides confirmation for existing theories about the ways in which family structure, income and education influence school performance. In fact, a community with a lower percentage of families with more than three children, and a higher percentage of residents with higher education, positively affects school achievement. The results also suggest that smaller schools, Public or State-funded Private schools and low regional teacher/student ratios negatively influence school scores. The cultural variables are, on the most part, irrelevant. Furthermore, regional effects still persist after socioeconomic and cultural variables are controlled. These effects are justified by natural or historical reasons and labor market dynamics.

The second aim of this work is to develop a more efficient indicator of school performance. This adjusted measure consists in a ratio between current average school

scores and the expected average school scores if the school was as successful as the reference variables of the municipality. This indicator has the added advantage of potentially eliminating the bias that exists in average school scores due to the socioeconomic and cultural variables and could eradicate incentives to cream-skimming.

The main limitations of this study are the nonexistence of a complete dataset for student´s and parent´s level. The existences of it may allow developing a more significant model with a higher R squared. On the other hand, one important missing variable on the analysis is the past student performance, again there is no available data.

Based on this project, the main implications as regards policies are: Firstly, education policies should be innovative and recognize that socio-economic factors, namely family income and structure are the fundamental institutions of education and that the traditional role of input-based school policies has proved extremely limited. Secondly, human capital policy has important intergenerational consequences: not only does it improve the skills of the current generation but it also has major effects on future generations. Lastly, further information is needed to assess the sensitivity of the proposed school performance indicator to alternative statistical models.

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STATISTICAL AND ECONOMETRIC CONSIDERATIONS APPENDIX

In terms of the multicolinerity, there could be evidence of it. This problem could occur if the correlation between the two variables is too high. This may lead to unreliable estimates with standard errors and unexpected signs or magnitudes.

	PPP_M	PP_M	$AVERAGEINC_M$
PPP_M	1		
PP_M	0,82	1	
$AVERAGEINC_M$	0,84	0,8	1

Table 24: Correlations between the municipality income variables

I present three proxies of municipality income (Purchasing power; proportion of the purchasing power and municipality monthly average income). These three variables are positively correlated, with correlation coefficients higher or equal to 0,8, making it redundant to include the three variables. For this reason, I have decided to only include Purchasing Power. The Purchasing Power variable reflects the wealth of the municipality. Because schools from all municipalities have been included, it is not necessary to use a variable that accounts for each municipality wealth as compared with the total wealth in Portugal, such as PPP_M (Proportion of the purchasing power). Thus, in the baseline specification I have used PP_M, the other two proxies (PPP_M and $AVERAGEINC_M$) are used to cross-check.

	HIGH	MAND	DROP	ITTIT
HIGH	1			
MAND	0,89	1		
DROP	-0,45	-0,59	1	
ITTIT	-0,61	-0,74	0,32	1

Table 25: Pairwise Correlations between Educational variables

In Table 22 one can see that municipality education proxies are also extremely correlated. I run regressions using only a subsample of education-related variables.

The multicollinearity problem could lead to underestimated coefficients and t-statistics, so that it would be difficult to access their impact on the grades of 2005. I have therefore decided to apply the _rmcoll command in Stata to check the existence of multicollinearity on the baseline consideration, and there is no evidence of multicollinearity.

The used data is extremely heterogeneous, for instance, the proxies for income vary significantly from municipality to municipality, and the impact in grades in wealthier municipalities will empirically be very different. There is therefore a suspicion of heteroscedasticity. The presence of heteroscedasticity implies the violation of constant error variance, one of the Gauss Markov assumptions. Even if it neither causes bias nor inconsistency of OLS estimators, the estimators' variances are no longer valid, nor are there conclusions about the statistical significance of the OLS estimates based on t-statistics. To evaluate the presence of heteroscedasticity I have applied the Breush-Pagan test. This method tests the null hypothesis that error variances are all equal versus the alternative that error variances are, in fact, a multiplicative function of one or more variables. A large chi-square would indicate that heteroskedasticity was present. The results for the baseline specification are presented below:

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of GRADES

chi2(1) = 57.02

Prob > chi2 = 0.0000

The chi-square is quite large which indicates a presence of heterocedasticity. As such, I use robust standard errors in my regressions. Though it does not eradicate heteroscedasticity, it corrects standard errors making them consistent whilst increasing the significance of truly significant parameters.

Some socio-economic and cultural variables are unobserved on conventional data, such as parent's ability. This unobservable data can create a bias on estimation. I therefore use a wide range of proxies, in such a way as to, according to Coulon, Meschi, Vignones and others, eliminate evidence of omitted variables. To confirm this statement, I decided to do the Ramsey RESET test to check the existence of omissions in the baseline specification. As expected, there was no evidence of omitted variables

Ramsey RESET test using powers of the fitted values of GRADES

Ho: model has no omitted variables

F(3, 1224) = 19.17

Prob > F = 0.0000

TABLES AND GRAPHS APPENDIX

LEVEL		GRADE	AGE
Pre-School		----	3-6
Compulsory School	1st Cycle	1st- 4th grade	6-10
	2nd Cycle	5th - 6th grade	10-12
	3rd Cycle	7th - 9th grade	12-15
Secondary School	General Courses	10th- 12th grade	15-18
	Tecnological courses		

Figure1: Portuguese Education

	2005 mat	2006 mat	2007 mat	2008 mat	2009 mat	2010 mat
2005 port	**0,73**	0,63	0,57	0,64	0,56	0,51
2006 port	0,64	**0,76**	0,64	0,63	0,55	0,55
2007 port	0,63	0,67	**0,74**	0,65	0,58	0,58
2008 port	0,62	0,66	0,7	**0,72**	0,6	0,6
2009 port	0,63	0,66	0,65	0,63	**0,76**	0,65
2010 port	0,62	0,67	0,66	0,64	0,65	**0,79**

Table 3: Pairwise average score between the exams for the six years.

Number of schools per municipality	Total number of municipalities	Percentage of total municipalities	Cumulative percentage of total municipalities
0	0	0,0%	0,0%
1	90	31,1%	31,1%
2	49	17,0%	48,1%
3	42	14,5%	62,6%
4	18	6,2%	68,9%
5	19	6,6%	75,4%
6	16	5,5%	81,0%
7	11	3,8%	84,8%
8	7	2,4%	87,2%
9	6	2,1%	89,3%
> 10	31	10,7%	100,0%
Total	**289**	**100,0%**	

Table 4: Relation between the number of schools and municipalities

Number of schools PRIV per municipality	Total number of Municipalities PRIV	Percentage of total municipalities	Cumulative percentage of total municipalities
0	**244**	**84,4%**	**84,4%**
1	31	10,7%	95,2%
2	4	1,4%	96,5%
3	5	1,7%	98,3%
4	2	0,7%	99,0%
5	0	0,0%	99,0%
6	0	0,0%	99,0%
7	0	0,0%	99,0%
8	0	0,0%	99,0%
9	0	0,0%	99,0%
10	1	0,3%	99,3%
>11	2	0,7%	100,0%
Total	**289**	**100,0%**	

Table 5: Relation between the number of Private schools and municipalities

Number of schools PFRIV per municipality	Total number of Municipalities PFRIV	Percentage of total municipalities	Cumulative percentage of total municipalities
0	240	83,0%	83,0%
1	36	12,5%	95,5%
2	7	2,4%	97,9%
3	3	1,0%	99,0%
4	1	0,3%	99,3%
5	1	0,3%	99,7%
6	0	0,0%	99,7%
7	0	0,0%	99,7%
8	0	0,0%	99,7%
9	1	0,3%	100,0%
Total	**289**	**100,0%**	

Table 6: Relation between the number of State-funded Private schools and municipalities

Table 7: Variable description and sources

	Variables		Source	Year	Description
	Grades	GRADE	Ministry of Education	2005-2010	Average school grades in 9th grade exams
Municipal Income	Purchasing Power	PP	National Institute of Statistics	2005-2007	
	Proportion of Purchasing Power	PPP	National Institute of Statistics	2005-2007	Percentage of total purchasing power per municipality
	Monthly average income	INC	National Institute of Statistics	2001	Percentage of total purchasing power in that municipality
	Unemployment rate	UNEM	National Institute of Statistics	2001	Unemployed population in the broad sense / Total active population in the broad sense
Municipal Education	Percentage of people that completed higher education	HIGH	National Institute of Statistics	2001	Resident population that completed high education/ Resident population
	Percentage of people having completed compulsory education at least	MAND	National Institute of Statistics	2001	Resident population that have completed compulsory school/ Resident population
	Dropout rate	DROP	National Institute of Statistics	2001	People that did not complete the 9th grade from the resident population of 10-15 years of age / Resident population of 10-15 years of age
	Illiteracy Rate	ILLIT	National Institute of Statistics	2001	Resident population that cannot read or write over 10 years of age / Resident population over 10 years of age
Municipal Culture	Amount of cultural expenditures per resident	EXPCUL	National Institute of Statistics	2005-2009	Cultural expenditures in thousand Euros/ Resident population
	Cultural infrastructures per resident	MONU	National Institute of Statistics	2005	Total number of monuments in the municipality/ Total resident population in the municipality
	Number of cultural infrastructure per resident	ICULT	National Institute of Statistics	2005	Total number of cultural infrastructures/ Total resident population in the municipality
Municipal Demography	Percentage of people with 65 years of age or more	OLD	National Institute of Statistics	2001	Resident Population with 65 years of age or more/ (Total resident population in the municipality)
	Average age	AVRGAGE	National Institute of Statistics	2001	Average age of resident population per municipality
	Single-Parent families	MONO	National Institute of Statistics	2001	Total number of single-parents families/ Total number of families in the municipality
	Percentage of immigrants	IMMIG	National Institute of Statistics	2001	Resident population with foreign nationality/ Total resident population in the municipality
	Percentage of families with more than 3 children	CHILDREN_3	National Institute of Statistics	2001	Total families with more than 3 children / Total number of families
Municipal quality of life	Average Building Age	BUILD	National Institute of Statistics	2001	Weighted average age of the buildings
Municipal Social Capital	Abstention Rate	VOTE	National Elections Commission	2005	Abstention rate in local government elections in 2005
	Percentage of recycle residues per resident	RECY	National Institute of Statistics	2001	Recycle residues in the municipality (KG)/ Resident population in the municipality (hab)
	Teacher/pupil ratio per NUTIII	TEACHERS	National Institute of Statistics	2001	Total number of 3rd cycle and secondary teachers/ Total number of 3rd cycle and secondary students
School	Number of exams	EXAMS	Ministry of Education	2005-2010	
	Public school (dummy)	PUB	Ministry of Education	2005-2010	Equals 1 if the school is Public and equals 0 otherwise
	Private school financed by the Government (dummy)	PFPRIV	Ministry of Education	2005-2010	Equals 1 if the school is a State-funded Private school and equals 0 otherwise
	Percentage of girls	GIRLS	Ministry of Education	2005-2010	Percentage of girls in 9th grade exams per school
	Percentage of students under 16	AGE	Ministry of Education	2005-2010	Percentage of students under 16 in 9th grade exams per school

Variable	Obs	Mean	Std. Dev.	Min	Max
GRADES	1237	2.636029	.3098439	1.794118	4.125
EXAMS	1237	127.118	76.52066	8	569
PUB	1237	.8415521	.3653081	0	1
PFPRIV	1237	.0622474	.241702	0	1
AGE	1237	.9072557	.085702	.1818182	1
GENDER	1237	.537732	.1095078	0	1
TEACHERS	1237	.0503278	.0054209	.0367354	.0617324
PP	1237	95.26152	31.52398	47.25	173.33
INC	1237	792.4614	175.8695	521.9	1487.3
PPP	1237	3.157754	8.613211	.009	36.105
UNEM	1237	.0687486	.0207262	.025	.221
HIGH	1237	.0842196	.0547534	.0144	.2267
MAND	1237	.3704771	.1244281	.1272	.6403
DROP	1237	.0261941	.0133237	0	.0953
ITTIT	1237	.0957456	.049728	.0375	.321
COMPET	1237	125.6055	84.58746	23	254
ratio	1234	.1489322	.2396707	0	1
EXPCUL	1237	1.880988	13.27395	.0112012	116.5287
MONU	1207	.0002881	.0002424	.0000867	.001394
OLD	1237	.1732215	.0570454	.085	.406
AVERAGE	1237	39.34856	3.337227	30.66	52.71
IMMIG	1237	.021658	.0201404	.0018	.0948
MONO	1237	.1128868	.0258757	.06	.226
DEN	1237	937.4221	1491.628	5.8	7379.7
children_3	1237	.0986385	.0340156	.0492578	.3180934
BUILD	1237	34.82402	8.032932	18.93	56.51
VOTE	1237	.3858836	.0820109	.177	.537

Table 8: Descriptive Statistics for 2005 exams data.

Variable	MAT	PORT	FIVEYEARS
EXAMS	.00038439**	.0003315***	.00012103
PUB	-.43413586***	-.24996138***	2.5099843***
PFPRIV	-.28086937***	-.15609305***	.72775581***
AGE	1.6395257***	1.1634295***	-2.2974975**
HIGH	.80182191***	.86678747***	-.61077915
DROP	-2.9449184***	-1.1023289	-.82590915*
IMMIG	-2.1970829***	-.74209285*	-.28747629***
children_3	-.57104367*	-.62517134*	-.17388571**
_cons	1.1624937***	2.2248254***	.90045933***
df			
N	1237	1237	548
r2	.37723583	.32426248	.59448051
F	64.96841	60.776974	55.701022

legend: * p<.05; ** p<.01; *** p<.001

Table 10: Regressions in Mathematics and Portuguese exams in 2005 as dependent variables, and the average of the five years.

Variable	reg8	reg9	reg11
EXAMS	.00068789***	.00044211***	.00038705***
PUB	-.43036696***	-.35063798***	-.36105406***
PFPRIV	-.3492913***	-.2393771***	-.24151051***
AGE		1.4157723***	1.4034093***
PP			.00161526***
HIGH	1.6962565***	1.0402923***	
TEACHERS		2.767241	
children_3	-1.0127677***	-.74386471**	-.75454246**
NORTE	-.08601452***	-.06123517**	-.07701962***
LISBOA	-.12296487***	-.11137351***	-.10362317***
ALENTEJO	.00497683	-.02641178	-.04406674
ALGARVE	-.08440663	-.13327069***	-.17309628***
MADEIRA	-.11017223	-.00024734	-.00543398
df			
N	1237	1237	1237
r2	.28573005	.41509719	.40580714
F	29.878027	48.872818	50.056554

legend: * p<.05; ** p<.01; *** p<.001

Table 11: Regressions with the regions dummies

AGE	Coef.	Std. Err.	t	P>|t|
EXAMS	.0002126	.0000316	6.74	0.000
PUB	-.0500405	.0082806	-6.04	0.000
PFPRIV	-.0598951	.0123215	-4.86	0.000
IMMIG	-.4309902	.1355414	-3.18	0.002
FILHO_3	-.448155	.0756578	-5.92	0.000
COMPET	.000055	.0000324	1.70	0.090
GENDER	.0581188	.0215528	2.70	0.007
TEACHERS	-1.445482	.4927148	-2.93	0.003
_cons	1.014194	.0327464	30.97	0.000

Table 12: Regressions with age as dependant variable

Variable	Obs	Mean	Std. Dev.	Min	Max
Expected Grades	1237	2.636029	.1972461	1.586908	3.291654
GRADES	1237	2.636029	.3098439	1.794118	4.125
RATIO	1237	1.000178	.0896985	.6984071	1.407005

Table 13: Summary Statistics of School adjusted score ratio

Table 14: The top ten schools according to 9th grade exams Ranking based on school adjusted score ratio for 2005

Ranking	School	Description	Municipality	Region	School Type	Average School Score	Expected Average Score	Ratio
1	390079	Escola Básica com Ensino Secundário de Porto Moniz	Porto Moniz	Madeira	pub	3,096	2,201	1,407
2	343791	Escola Básica dos 2º e 3º Ciclos de Pinhão	Alijó	norte	pub	3,063	2,250	1,361
3	404251	Escola Secundária Artística do Conservatório de Música de Calouste Gul	Braga	norte	pub	3,689	2,727	1,353
4	401961	Escola Secundária com 3º Ciclo de José Estevão	Aveiro	Centro	pub	3,608	2,708	1,332
5	380358	Escola Inglesa de São Julião	Cascais	Lisboa	pfpriv	3,821	2,875	1,329
6	506308	Externato Nossa Senhora da Paz	Porto	norte	priv	4,125	3,124	1,321
7	505961	Externato Escravas Sagrado Coração de Jesus	Porto	norte	priv	3,950	3,134	1,260
8	340935	Escola Básica dos 2º e 3º Ciclos de D. Pedro IV (Massamá)	Sintra	Lisboa	pub	3,447	2,741	1,257
9	340297	Escola Básica dos 2º e 3º Ciclos de Aquilino Ribeiro - Vila Nova de Pa	Vila Nova de Paiva	Centro	pub	3,070	2,450	1,253
10	400233	Escola Secundária com 3º Ciclo de Gil Eanes	Lagos	Algarve	pub	2,097	1,673	1,253

Table 15: The worst schools according to 9th grade exams Ranking based on school adjusted score ratio for 2005

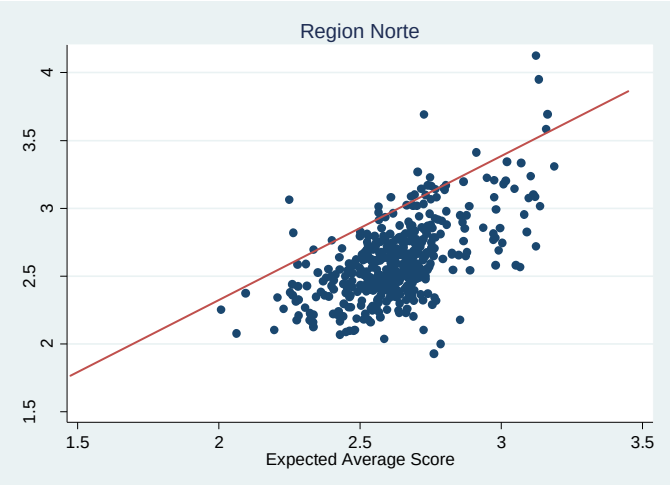
Ranking	School	Description	Municipality	Region	School Type	Average School Score	Expected Average Score	Ratio
1228	504063	Externato Nacional de Moscavide	Lisboa	Lisboa	priv	3,136	2,400	0,765
1229	341174	Escola Básica dos 2º e 3º Ciclos de Dr. Joaquim de Barros	Oeiras	Lisboa	pub	2,589	1,977	0,764
1230	950013	Colégio Jardim das Cores I	Vila do Conde	norte	priv	2,855	2,176	0,762
1231	380078	Colégio Nossa Senhora da Conceição	Lisboa	Lisboa	priv	3,028	2,304	0,761
1232	380181	Colégio D. Maria Pia	Lisboa	Lisboa	priv	3,139	2,278	0,726
1233	344047	Escola Básica dos 2º e 3º Ciclos de Miragaia	Porto	norte	pub	2,787	2,000	0,718
1234	380079	Colégio D. Nuno Álvares Pereira	Lisboa	Lisboa	priv	3,057	2,188	0,715
1235	380826	Colégio Sociedade Benef. A Voz do Operário	Lisboa	Lisboa	priv	3,146	2,250	0,715
1236	330140	Escola Básica Integrada com Jardim de Infância de Sophia de Mello Brey	Oeiras	Lisboa	pub	2,561	1,794	0,701
1237	950015	Cooperativa de Ensino Misarelacoop	Montalegre	norte	priv	2,761	1,929	0,698

Table 16: The top ten schools according to 9th grade exams Ranking national exams for 2005

Ranking	School	Description	Municipality	Region	School Type	School Average Score
1	506308	Externato Nossa Senhora da Paz	Porto	Norte	priv	4,125
2	505961	Externato Escravas Sagrado Coração de Jesus	Porto	Norte	priv	3,950
3	380358	Escola Inglesa de São Julião	Cascais	Lisboa	pfpriv	3,821
4	501062	Colégio Nossa Senhora do Alto	Faro	Algarve	priv	3,773
5	505810	Colégio Luso - Francês	Porto	Norte	priv	3,692
6	404251	Escola Secundária Artística do Conservatório de Música de Calouste Gul	Braga	Norte	pub	3,689
7	502273	Colégio São João de Brito	Lisboa	Lisboa	priv	3,642
8	504026	Colégio Moderno	Lisboa	Lisboa	priv	3,633
9	401961	Escola Secundária com 3º Ciclo de José Estevão	Aveiro	Centro	pub	3,608
10	506060	Colégio Nossa Senhora de Lourdes	Porto	Norte	priv	3,582

Table 17: The worst schools according to 9th grade exams Ranking based on national exams for 2005

Ranking	School	Description	Municipality	Region	School Type	School Average Score
1228	344047	Escola Básica dos 2º e 3º Ciclos de Miragaia	Porto	Norte	pub	2,000
1229	330814	Escola Básica Integrada com Jardim de Infância de Monte da Caparica	Almada	Lisboa	pub	2,000
1230	401663	Escola Secundária com 3º Ciclo de Eça de Queirós (Lisboa)	Lisboa	Lisboa	pub	1,979
1231	341174	Escola Básica dos 2º e 3º Ciclos de Dr. Joaquim de Barros	Oeiras	Lisboa	pub	1,977
1232	950015	Cooperativa de Ensino Misarelacoop	Montalegre	Norte	priv	1,929
1233	330371	Escola Básica Integrada de Apelação	Loures	Lisboa	pub	1,906
1234	403866	Escola Secundária com 3º Ciclo de Castro Verde	Castro Verde	Alentejo	pub	1,864
1235	400981	Escola Secundária com 3º Ciclo da Bela Vista	Setúbal	Lisboa	pub	1,818
1236	401420	Escola Secundária com 3º Ciclo de Dr. Azevedo Neves	Amadora	Lisboa	pub	1,807
1237	330140	Escola Básica Integrada com Jardim de Infância de Sophia de Mello Brey	Oeiras	Lisboa	pub	1,794

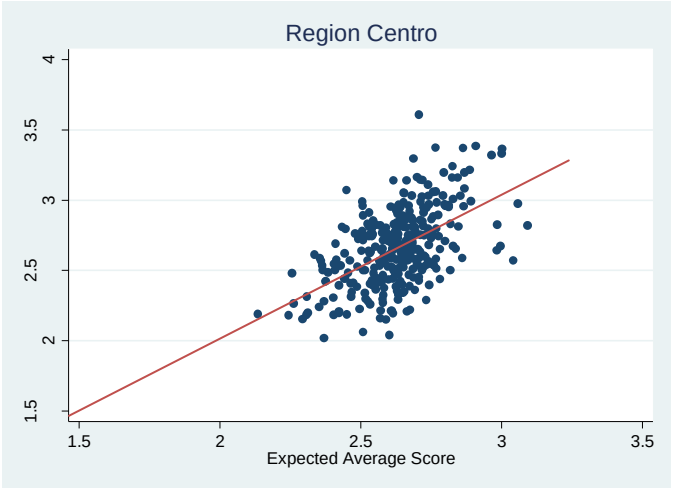


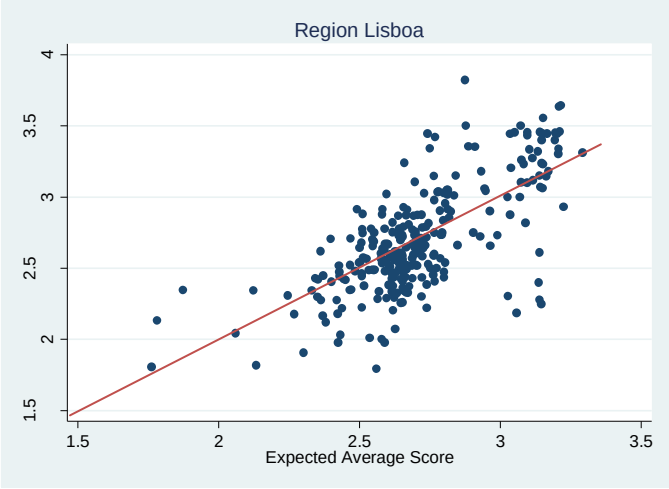
Variable	Obs	Mean	Std. Dev.	Min	Max
expected_g~s	432	2.628823	.1850553	2.008155	3.188664
GRADES	432	2.607871	.2965344	1.928571	4.125
RATIO	432	.9922564	.0880853	.6984071	1.361213

Graph 2 and **Table 18**: Scatterplot graph and summary statistics for **Region Norte**

Graph 3 and **Table 19**: Scatterplot graph and summary statistics for **Region Centro**

Variable	Obs	Mean	Std. Dev.	Min	Max
expected_g~s	326	2.630086	.1420685	2.134557	3.09247
GRADES	326	2.662818	.2703288	2.017857	3.607843
RATIO	326	1.012429	.0862208	.7838026	1.332436



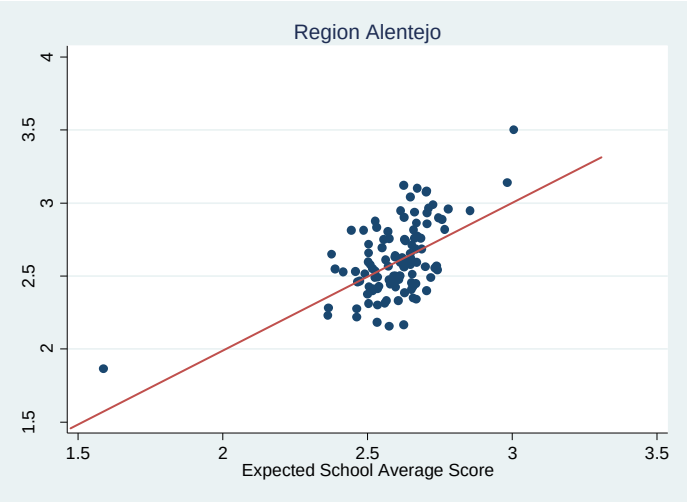


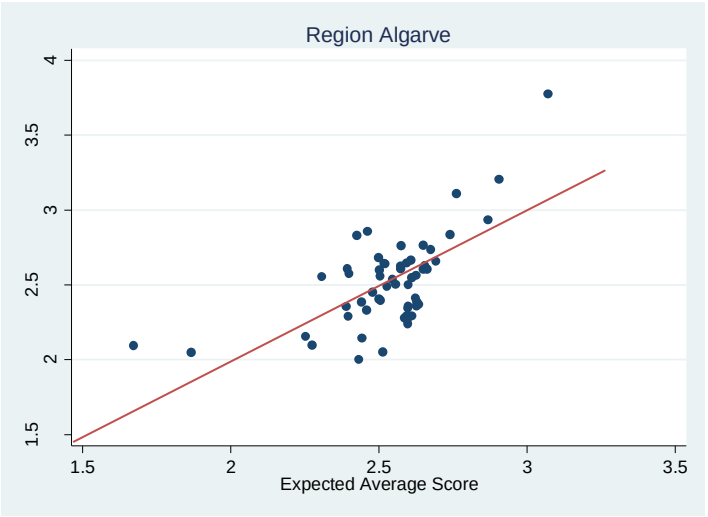
Variable	Obs	Mean	Std. Dev.	Min	Max
expected_g~s	283	2.707535	.247367	1.76129	3.291654
GRADES	283	2.694407	.3740867	1.794118	3.821429
RATIO	283	.9947678	.0964909	.7005504	1.329278

Graph 4 and **Table 20**: Scatterplot graph and summary statistics for **Region Lisboa**

Variable	Obs	Mean	Std. Dev.	Min	Max
expected_g~s	109	2.597525	.1454622	1.586908	3.005814
GRADES	109	2.608982	.2536196	1.863636	3.5
RATIO	109	1.004663	.0795616	.8250698	1.189557

Graph 5 and **Table 21**: Scatterplot graph and summary statistics for **Region Alentejo**





Variable	Obs	Mean	Std. Dev.	Min	Max
xb	57	2.536486	.2051319	1.672835	3.071462
GRADES	57	2.520327	.3036533	2	3.772727
RATIO	57	.9947741	.0931006	.8165468	1.253425

Graph 6 and **Table 22**: Scatterplot graph and summary statistics for **Region Algarve**

Variable	Obs	Mean	Std. Dev.	Min	Max
expected_g~s	30	2.458864	.2436903	2.116873	3.031364
GRADES	30	2.51778	.3013695	2.0375	3.415254
RATIO	30	1.026145	.0985132	.8450949	1.407005

Graph 7 and **Table 23**: Scatterplot graph and summary statistics for **Region Madeira**