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ABSTRACT

Do Fiscal and Political Decentralization Raise Students' Performance? A Cross-Country Analysis^{*}

The low quality of education is a persistent problem in many developed countries. Parallel to in the last decades exists a tendency towards decentralization in many developed and developing countries. Using micro data from the Programme for International Student Assessment (PISA) referred to 22 countries, we test whether there exists an impact of fiscal and political decentralization on student performance in the areas of mathematics, reading skills and science. We observe that fiscal decentralization exerts an unequivocal positive effect on students' outcomes in all areas, while the effect of political decentralization is more ambiguous. On the one hand, the capacity of the subnational governments to rule on its region has a positive effect on students' performance in mathematics. On the other hand, the capacity to influence the country as a whole has a negative impact on mathematics achievement. As a general result, we observe that students' performance in Mathematics is more sensible to these exogenous variations than in Sciences and reading skills.

JEL Classification: H11, H77, I21

Keywords: school outcomes, PISA, fiscal decentralization, political decentralization

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1 – Introduction

The low quality of education is a persistent problem in many developed countries. It is common to see many of the most developed countries in not very favorable positions with the publication of various international tests that measure academic outcomes in compulsory education. That's why many of these countries have increased their efforts to try to improve the quality of their educational system. Indeed, this has been one of the priorities for the EU, as it was included in the Lisbon Strategy.¹ Parallel to this situation in the last decades exists also a tendency towards decentralization in many developed and developing countries. The implications of increasing the quality of education raise the importance of the issue we deal with, that is the potential existence of a link between academic achievement and decentralization.

In public economics, the relationship between the provision of universal public services and decentralization is a recurring theme. However, one of the main problems in this analysis is that it is very difficult to measure the quality of and the efficiency in the provision of these services. We claim that this link between the efficient provision of public services and decentralization should receive more attention. We think that the connection of efficiency and equity in public services with decentralization should be at the core of the debate. The public services that should be the focus are education, health, and social protection for constituting these the three pillars of the welfare state, and we should expect these public services to be affected by decentralization processes. After all, the decentralization theorem (Oates, 1972, 1999) is about to deliver services closer to the people because of informational advantages of local governments about economic

¹ Since March 2000, the EU formulated its policies in line with the ambitious objectives of the so-called Lisbon Strategy, which sets a framework for action until 2010. Lisbon aims specifically for economic as well as social and environmental renewal. Improving students' performance in compulsory education in the EU was one of the priorities in the agenda.

or social characteristics of regions. In the case of education, which is the focus of this paper, fiscal and political decentralization should promote a more efficient provision of this public good that would have to be translated into better students' performance. We think that at last students' grades is a good indicator of efficiency in the provision of public education.

Most studies devoted to analyze the effect of decentralization do it on economic ground such as economic growth, income inequality, and redistribution of wealth. However, these studies lose sight of that the main objective of decentralization is not economic growth or the redistribution of income, but better provision of public services to citizens. Recently, some studies are beginning to study the role of decentralization on variables involving happiness/satisfaction or the voters' perception of institutions. We find these studies are closer to the focus on what the analysis on the effects of decentralization should be. Our study seeks to be framed within this group of works, which try to determine the direct effect of decentralization on basic services, as in our case the education.² Despite the relevance of this topic, the literature is virtually nonexistent.

The aim of this paper is to determine the role played by fiscal and political decentralization on academic performance (using academic results as a measure of efficiency of public education). With this goal, academic results will be used on areas as math, science or reading skills for more than 400,000 students from 22 countries belonging to all PISA studies available to date (2000, 2003, 2006 and 2009). This study is the first to use micro data on analyzing the role of the decentralization in education.

² Falch and Fischer (2010), and Diaz-Serrano and Rodriguez-Pose (2012) are two exceptions. This work will be discussed in more detail in the next section.

We have to mention that our measures of fiscal and political decentralization are not specific of education. However, we should expect that a more decentralized country in the broader sense, will be also more decentralized in that regarding education.³. Our results are similar to the ones obtained in Diaz-Serrano and Rodríguez-Pose (2012) and suggest that the effect of fiscal decentralization is unequivocally positive, while the effect of political decentralization is more ambiguous. The authority of subnational governments over their own citizens reports a positive impact. By contrast, the capacity of subnational governments to influence the country as a whole exerts a negative impact.

With the objectives described above, the paper is structured as follows: Section 2, provides the conceptual framework of the study. Section 3 reviews the literature related to decentralization and education. In the section 4 are described the empirical methods used for analysis. Section 5 discusses the results. And finally section 6 contains the conclusions.

2 – Conceptual framework

The use of the word decentralization has become increasingly common in both economic and political language, although there is no a clear definition for execution. In both, public and private sector the word decentralization implies a change of authority in favor of lower levels of government hierarchy. One of the first authors to study the decentralization was Oates (1972) who establishes that decentralization bringing decisions closer to the population improves social welfare by reducing information asymmetry allowing for a better adjustment between local supply and heterogeneous

³ We find this might be a potential limitation of our analysis. However, as far as we are aware education specific decentralization measures are generally not available.

local demand. Thus, a decentralized fiscal system is expected to know and use public spending tight to the preferences of the population, obtaining the corresponding benefits to society in terms of efficiency gains. Tax revenues by the subnational governments provides incentives for good functioning of the decentralized system because, when part of local expenditures are financed with their own tax revenues, local authorities become directly accountable to the voters of the items where these taxes have been spent. Voters should be capable of evaluating correctly the performance of local governments and to give its verdict through the ballot box.

On the other hand, it is also possible that the different subnational governments compete to establish better baskets of goods and services in order to maintain their tax bases or attract taxpayers from other regions starting an expenditure competence. Similarly, it may occur that decentralization improves public service provision when local communities do not have the capacity to impose their views or local elites monopolize public resources on their own preferences (Bardhan and Mookherjee, 2005). For example, if these elites do not use the public health or educational system, they will push the government to destine the spending to other items. Smith (1985) shows that with decentralization of public services provision may not be efficient if subnational governments are less technically capable than the national governments to properly distribute public goods. Rondinelli et al (1984) identifies the problem of using decentralization in order to serve political objectives. In this way, the decentralization process is not evaluated by improvements in efficiency but also by how good or bad it satisfies the policy objectives. With this premise, it is common for central and subnational governments to have some tolerance when decentralization reforms

translates into inefficient processes if the policy objective is met and the quality of public services does not decrease so as society expresses its rejection.

In the educational field, the need for decentralization comes from the new global economic conditions, McGinn and Welsh (1999). The discussion on the efficiency of a decentralized education system has been preceded by the adoption of market policies by most countries in both developed and developing countries. The increase of the universality of education has resulted in an increase on number of students enrolled in schools, therefore, spending on education has also been increased. In this scenario, many governments face great budget in educational matters that do not always translate into good results, this may involve an increase in the demand for skills on the part of governments.

Some reasons why governments decide to initiate decentralization processes around education are seeking improvements in efficiency, improvements in financing and redistribute power to of decision making bodies with better knowledge of educational needs. The efficiency goal is argued on the basis that a centralized system is often characterized by having a high bureaucratic burden thus incurring losses of resources and time. By decentralizing decisions, they are accelerated and at the same time, better information is available to run. The efficient allocation of resources by subnational governments allows to adjust better of the allocations in education as opposed to large national budgets that are not always allocated efficiently. On the other hand, the redistribution of decision-making is seen as a way to include the less weighted groups giving better facilities in attending their needs. The undesirable situations of the decentralization process may succeed if the resources are captured by local elites to be

used in their favor or the inability (due to lack of sufficient material resources, intellectual or information) of the subnational government to run efficient policies. We think that students' outcomes (e.g. grades) are the best way of measuring efficiency in the education system.

Currently, most educational systems are based on the distribution of responsibilities across different levels of government. It is common that the central government set minimum requirements on the activities of subnational governments, which implies that are held accountable to central government.

3 – Literature review

3.1- Decentralization

Both from an empirically and theoretically view, the majority of studies relate the decentralization with the economic growth and results are not unambiguous. Another common feature of this literature is that only considers the impact of fiscal decentralization, while political decentralization is ignored. For instance, Davoodi and Zou (1998) in a study for 46 countries, and Rodríguez-Pose and Ezcurra (2010) in a study for 21 OECD countries find empirical evidence that the relationship between fiscal decentralization and economic growth is negative. Rodríguez-Pose and Ezcurra (2010) disaggregate the expenditure and find that the portion on education maintains the negative relationship with economic growth. This negative relation increases as countries intensify their process of fiscal decentralization. In contrast, Iimi (2005) observes a positive relationship between decentralization and growth in GDP per capita. In an empirical study for Spain, Carrion-i-Silvestre et al. (2007) report ambiguous

effects of fiscal decentralization depending on whether they consider aggregated (negative) or regional (positive) level.

Another important topic of discussion is the role of decentralization as a depressor of poverty and inequality. In this vein, the World Bank included it as part of its poverty reduction program contained in the Development Committee (2006). Under tax competition, the richer regions may be more attractive to mobile factors to the fact that they offer better human capital or better infrastructure, under this premise and as Prud'homme (1995), this regions will become richer and the poor poorer. On the other hand, Ezcurra and Pascual (2008), Lessman (2009) and Qian and Weingast (1997) find that decentralization exerts a positive impact on the reduction of regional inequality. Thus less developed regions may offer attractive investment conditions such as more flexible labor markets, lower wages or lower tax rates. These investments could lead to improve the process of regional convergence. To Sepulveda and Martinez-Vazquez (2010), results vary depending on the level of total public expenditure, where fiscal decentralization could be a good way to reduce poverty if this represents a third or less of total spending. For higher levels, decentralization leads to an increase in levels of poverty.

Recently, there is a growing interest in studying the social dimension of decentralization. Thus, the literature linking decentralization and subjective well-being (SWB) seems to be taking off.⁴ The few existing empirical studies found that fiscal decentralization is important for subjective well-being (Frey and Stutzer, 2000; Bjørnskov et al., 2008, Diaz-Serrano and Rodríguez-Pose, 2012). The latter authors

⁴ In the literature devoted to study the determinants of subjective well-being (SWB), the terms SWB, happiness and life satisfaction are often interchangeable.

were also the firsts to study the effect of political decentralization, and observe that the effect on SWB is also positive. However, we think that focusing on the implications of decentralization for overall economic growth and territorial disparities, poverty, interpersonal inequality, social capital or SWB could be somewhat missing the point. While these factors may certainly be an indirect consequence of decentralization, the original aim of decentralization is fundamentally to improve the delivery of public goods and services to individuals by the creation of more legitimate tiers of government, closer to the people and, therefore, more responsive to their needs and wants. Decentralization is thus first and foremost about improving the delivery of public policies and, consequently, the level of satisfaction of the population with government and political institutions. At these regard, Diaz-Serrano and Rodriguez-Pose (2012) are also the first to study the effect of decentralization on the perception of institutions by citizens (government, economy and democracy), while in Diaz-Serrano and Rodríguez-Pose (2011) the link between decentralization and satisfaction with health and educational system is also analyzed. These authors observed that fiscal and some forms of political decentralization have a positive and significant effect on the subjective well-being of citizens. On the other hand, fiscal decentralization has a different effect on the perception of institutions depending on whether we consider revenues or expenditure. In the same way, political decentralization also varies his effect on the level of satisfaction with institutions depending on whether the capacity of local governments to influence national politics or to exert authority over their own citizens. These results coincide with the ones we get here. From our point of view, the analysis we propose here is still better targeted on the problem, since we focus on the effect of decentralization on the, namely, efficiency of the education system through its effect on students' outcomes.

3.2- Students' performance

The literature regarding the determinants of academic achievement can be disaggregated into three main groups: family and student background, school characteristics and institutional factors.

In terms of family and student background literature agrees on the importance of these factors in determining student performance. For example, having books at home is seen as a good indicator of social, educational and economic background of the student and therefore is presumed that this is causally related to student performance (Hanusek and Woessmann, 2011). The strong link between student achievement and socio-economic background is showed in cross-country studies at student level (Woessmann, 2003b) and country level (Lee and Barro, 2001)

Regarding effect of the school characteristics on school outcomes, the most studied issue are the inputs at it's disposal (Hanushek, 2006). If we consider the expenditures per student for schools, we see that there is no positive relationship between this factor and student achievement for both country-level analysis (Lee and Barro, 2001) and student level (Fuchs and Woessmann, 2007). This result might be due to what Hanusek (1997) called "productivity collapse in schools". In reference to other aspects related to the characteristics of the school, Lee and Barro (2001) find positive impact on a lesser number of students per class and the performance of these. The shortage of material and the intensive use of computers is presented as a factor that exerts a negative effect on student performance (Fuchs and Woessmann, 2004). As regards the scope of teachers, the educational level of those is presented as a factor that positively affects student performance as well as their wage level (Lee and Barro, 2001).

The impact of the nature of school (public or private) has been extensively analyzed. Private schools are positively related to a better academic performance than the public ones (Woessmann et al, 2009). Another frequently discussed aspect is the level of autonomy of schools. Gunnarsoon, et al (2004) analyzed data from 10 primary schools in Latin America countries to estimate the impact of school autonomy and community participation in decision-making power of the schools (as proxies for the level of decentralization) on academic performance. They conclude that the effect is positive. Regarding the effect of institutional characteristics on academic achievement the literature is quite scarce. These institutional or constitutional features are not specific to the school but the education system. For example, (Bishop, 1997 and Bishop, 2006), show a positive impact on student achievement by the introduction of external curriculum tests.

3.3- Decentralization and educational outcomes

Although decentralization should be expected to be important for educational outcomes, the link between decentralization and education is undoubtedly under researched. Galiani et al (2008) study the impact of decentralization on the quality of education in Argentina. They find that decentralization has a positive impact on student academic performance. But also notes that the benefits of political decentralization do not reach students with less resources; therefore, their distribution is uneven. In the same line as the previous author, Barankay and Lockwood (2006) find that decentralization of expenditure in Switzerland allows reaching higher levels of academic achievement. Falch and Fischer (2010), using a panel of international student achievement for 23 OECD countries find that government expenditure decentralization has a positive effect on student performance. Behrman et al (2002) shows that there is little evidence that

decentralization improves academic outcomes in developing countries. However, they claim that this result could be due to the lack of suitable data. Gunnarsoon, et al (2004) analyzed data from 10 primary schools in Latin American countries to estimate the impact of school autonomy and community participation in decision-making power of the schools (as proxies for the level of decentralization) on academic performance. They conclude that the effect is positive. Merrouche (2007), in an analysis for the Spanish case, argued that there was no improvement in human capital with the introduction of decentralization in education spending during the 80's. In contrast, Salinas and Solé-Ollé (2009) found that this relationship is positive. Akai et al (2007) reached the same conclusion for high school students. Clements (1999) also studied the effect fiscal decentralization on academic performance in Portugal. He concluded that the worsening or not of improving academic performance may be evident due to inefficient spending on education.

4 – Empirical framework and data

4.1 – Empirical model

Models on the determinants of academic achievement are generally represented by an Educational Production Function (hereafter, EPF). This function is used as a way to understand the production processes by estimating the effects of various inputs on academic performance. Generally, this inputs includes information regarding student's background (individual and family characteristics) and school characteristics. The usual EPF can be represented by the following linear relationship:

$$A_{is} = \alpha + \beta X_{is} + \gamma Z_s + \varepsilon_{is} \quad (1)$$

Where A_{is} is the academic achievement for student i , studying in school s , X_{is} contain the variables that characterize the student, Z_s is a set of school characteristics, which are equal for all students attending the same school, ε_{is} is a random error term, and α, β, γ are the set of parameters to be estimated. Since our dataset consists in a pool of cross-sections regarding different countries and periods, we expand the EPF expressed in equation (1) as follows:

$$A_{isct} = \alpha + \beta X_{isct} + \gamma Z_{sct} + \mu Y_{ct} + \lambda_c + \delta_t + \varepsilon_{istc} \quad (2)$$

where and Y_{ct} is a set of country characteristics including our variables of interest, i.e. political and fiscal decentralization,. δ_t are time effects and λ_c are unobserved specific country effects. Time effects are included as dummy variables and are considered in order to control for any unobserved temporary shock that can alter the response variable and are not picked up by any of the other variable. On the other hand, λ_c are considered in order to control for country unobserved heterogeneity. Furthermore, the inclusion of λ_c is also necessary in order to identify the effects of the country variables of, among which we include decentralization indexes.

The estimation method selected to estimate equation (2) is the pooled linear model, where the temporary effects δ_t are introduced as dummy variables for each year. In order to control for cross-country unobserved heterogeneity the country-specific effects λ_c can be considered as fixed or random-effects. If unobserved heterogeneity across the countries (each country has its own specific characteristics that might influence the outcomes) is correlated with the covariates, then random-effects estimator is

inconsistent, since this model imposes as estimation restriction that this correlation is zero. Therefore, we choose the fixed-effects model. Since, the time dimension introduced in our model allows for variation throughout time of our country variables, as in panel data models we deal with country fixed-effects using the mean-differencing transformation. This method consists in differencing, for all variables in the model, each individual observation and the average of the country as follows:

$$(A_{isct} - \bar{A}_c) = (X_{isct} - \bar{X}_c)\beta + (Z_{sct} - \bar{Z}_c)\gamma + (Y_{ct} - \bar{Y}_c)\mu + (\varepsilon_{isct} - \bar{\varepsilon}_c) \quad (3)$$

In equation (3), the within estimator at country level provides a consistent estimate of the fixed-effects model, at the time that allows to remove the country time-invariant specific component λ_c .

In order to carry out the estimation of equation (1), PISA recommends the use of balanced repeated replication (BRR) method, which provides statistically consistent estimator of the variance. For our empirical analysis we used the STATA module designed by Kevin MacDonald allowing us to estimate with multiple dependent variables (five test scores per student and subject, referred above as plausible values) by calculating the statistics for each dependent variable and then their average. In our case, we use this method to estimate equation (3).

4.2 – Data

The data used in this study are part of the Program for International Student Assessment (PISA). The PISA report is a international standardized study that provides academic results in the areas of math, science and reading. The study also collects information

regarding the student and the family environment. There are four available waves conducted in a total of 43 countries in 2000, 41 countries in 2003, 57 countries in 2006 and 65 countries in the last edition of 2009.

Decentralization data is divided into political and fiscal decentralization variables. They come from two different sources. Political decentralization indexes are taken from Hooghe *et al.* (2008) Regional Authority Index (RAI) covering 42 countries for the period 1950-2006. The RAI is measured along eight dimensions, blending different areas of decentralization. On the other hand, fiscal decentralization data consist of yearly indicators calculated as the ratio between subnational and national expenditures or revenues covering the period 1972-2005. The source of these variables is the Government Finance Statistics of the International Monetary Fund.

In order to test the impact of decentralization on academic achievement we match the PISA database with the decentralization data. All students surveyed in PISA data and residing in the same country are assigned the same value of corresponding decentralization indicator. In this matching, we have not only taken into consideration the spatial but also the appropriate time horizon. We assign to each country the average of the last ten years of the decentralization index prior to each PISA wave. Since the decentralization indexes are comprised between 1965 and 2006, for the PISA wave of 2009 we assign the same values of the decentralization indexes as in 2006.

Since our decentralization data covers a more reduced number of countries than those in the PISA database, our final sample is composed of 22 countries. In Table 1 (see Appendix) we report sample size by country and year.

4.2.1 – Dependent variables

In PISA database, students' scores on math, science and reading skills are presented in the form of five plausible values⁵ for each student and subject. The plausible values (PV) were used for the first time in the National Assessment of Educational Progress (NAEP) in 1983-1984. The PV are also used in TIMSS and PISA evaluations of education. They were developed to obtain consistent estimates of population characteristics in assessing situations where there are not enough resources to make an accurate estimate of their abilities.

The statistics concerning the aggregated academic results by country are shown in Table 2 (see Appendix). This summary statistics is not referred to all the countries participating in PISA, but to the 22 countries in our final sample. We can see that the best five performing countries in mathematics are Finland, Holland, Switzerland, New Zealand and Belgium. Regarding reading skills, Finland repeats again as the first in the ranking followed by New Zealand, Holland, Ireland and Australia. Finally, the countries with the highest average score in science are Finland, Netherlands, Czech Republic, New Zealand and Australia. It should be noted that Finland is maintained in the first position of the ranking in the three subjects, while the Netherlands and New Zealand are always among the top five countries. The worst results are obtained by Greece who appears on the last position in the three achievements. Portugal's performance is ranked the second worst in the three subjects tested. Regarding the third worst place, is held by the United States in mathematics, by Spain in reading skills and by Denmark in science.

4.2.2 – Independent variables

⁵ The plausible values are students imputed values that are similar to the individual test scores and have approximately the same distribution as the measured latent feature.

In order to determine the effect of decentralization on academic achievement we include a number of covariates consisting of student characteristics, characteristics of the school and specific country variables to which the student belongs including our key variables of political and fiscal decentralization.

Student characteristics comprise a set of individual's and the family characteristics. These are gender, age, birthplace of the student and their parents, the number of books they have at home, and the cultural level of the father and mother⁶. This type of variables that define the individual and their background represent the most important factors in addition to the unobserved innate ability to explain the performance of students (Woessmann, 2000).

The variables used to characterize the school the student belongs includes the type of urban area in which the school is located (it can take 5 values based on its size), the type of school (public school, private school independent of government and government-dependent private school) and the ratio between the number of students and teachers.

In order to identify the effect of the country decentralization indexes on students' outcomes, in addition to estimate a country fixed-effects models, we also include a number of country-level variables. These variables are the GDP per capita at constant 2000 prices,⁷ the annual expenditure on educational institutions per student, secondary

⁶ This level is measured by the International Standard Classification of Education (ISCED), which refers to the standardized classification of the different educational levels established by UNESCO, which allows comparison between countries.

⁷ World Development indicators: World Bank.

education teacher salaries and total education expenditure as a percentage of the GDP,⁸ the unemployment youth rate⁹ and an index of corruption perception in the public sector.¹⁰

Our key independent variables are the fiscal and political decentralization indicators. Political decentralization variables come from the Regional Authority Index (RAI), which was constructed by Hooghe *et al.* (2008). We use two aggregated indexes (Self-rule and Shared-rule) covering two dimensions of political decentralization for 42 countries covering the period 1950-2006.¹¹ Self-rule is a measure of the authority exercised by subnational governments over their own citizens. Shared-rule refers to the capacity of subnational governments or its representatives to influence the country as a whole.

Fiscal decentralization indexes are from the Government Finance Statistics of the International Monetary Fund for the period 1972-2005. These are the ratio between subnational and total expenditures and revenues. This dataset provides separate indexes for current and capital expenditure. Regarding the revenue side, we distinguish between total revenues and revenues coming from taxes.

In Table 6 (see Appendix) we show the ranking of countries according to their level of political and fiscal decentralization. For fiscal decentralization, the ranking is constructed by averaging the five indexes used in the analysis (total expenditure, capital expenditure, current expenditures, total revenues and tax revenues). The three most

⁸ Education at a Glance: OECD Indicators.

⁹ Labour Force Statistics: OECD.

¹⁰ Transparency International Corruption Perceptions Index.

¹¹ The RAI was validated in Schakel (2008).

fiscally decentralized countries are Switzerland, Germany and Denmark, while Portugal, Iceland and the UK are at the bottom of the ranking. Regarding political decentralization,, the top of the ranking is composed by Germany, Belgium, United States, while Czech Republic and Portugal are at the bottom.

It is important to distinguish between political and fiscal decentralization, since not all the most fiscally decentralized countries are the most politically decentralized, and vice-versa (see Figure 1). For instance, Germany, Spain, Belgium, Switzerland and the United States combine high levels of both political and fiscal decentralization. However, countries as Sweden or Denmark are characterized by high levels of fiscal decentralization combined with low levels of political decentralization, while in the UK and Hungary it is the other way around.

5 – Econometric results

Table 7 (see Appendix) reports the results obtained in the estimation of equation (2) for the three outcome variables: math achievement, read achievement and science achievement.

The top part of the table comprises the individual characteristics. These variables are statistically significant for all academic outcomes, which coincides with the previous empirical evidence using the PISA data. With the exception of gender, estimated coefficients associated to individual characteristics report the same sign for the three outcome variables. Women tend to exhibit worse results than men in math and science but better in reading skills. Regarding the student's household environment, we observe that estimated coefficients also behave according to expectations. The number of books

at home and the educational attainment of the parents exert a positive impact on academic performance. On the contrary, the foreign-born status of the student and the parents affects student's performance negatively. School characteristics have also turned out to be statistically significant in determining our three outcome variables. Students' scores are higher in private schools than in public or semi-public schools. Student's performance also improves as city size and the ratio between teachers and students increases.

As one could expect, country specific variables have also turned out to be statistically significant. We observe that in countries with larger education expenditure per student, larger GDP per capita and larger expenditure in education as a percentage of GDP, students performance is poorer. This holds for the three subjects of study and reinforces the idea mentioned in the introduction that quality of education in richer countries is a persistent problem. On the contrary, the level of secondary education teachers salaries exerts a positive impact on school outcomes. The unemployment youth rate (between 15 and 24) has a positive effect on performance. This result indicates that exists incentives among students to improve school performance in a context of high youth unemployment in order to become more competitive in the labor market. Finally, we observe that the corruption index has a positive and significant effect, which again is in line with a poorer performance in more developed countries.

Now we focus on the results coming our variables of interest, i.e. fiscal and political decentralization. We observe that while fiscal decentralization exerts an unambiguous positive effect on all outcomes (mathematics, science and reading skills). Results regarding political decentralization are ambiguous. This results fit with the findings in

Diaz-Serrano and Rodríguez-Pose (2012) regarding the effect of decentralization on subjective well-being and the perception of institutions.

Regarding the impact of fiscal decentralization, we observe that subnational current expenditure, which mainly regards to human resources, exerts a statistically significant positive effect in all subjects of study. However, subnational capital expenditure reports this positive effect only for math scores, and being non statistically significant for sciences and reading skills. Analogously, subnational revenue also exerts a significant positive effect on all students' outcomes. In contrast with the evidence regarding fiscal decentralization, the effect of political decentralization on student's performance is more limited and ambiguous. We observe that our indicators of political decentralization exert a statistically significant effect only for math scores. The effect of the capacity of subnational governments to rule over their own citizens (self-rule) is positive, while the capacity of subnational governments to influence the country as whole (shared-rule) exerts an negative impact. All these results taken together, i.e. significance and magnitude of the estimated marginal effects, suggests not only that decentralization matters for school outcomes, but students' performance in mathematics is more sensitive to more decentralized educational policies than other subjects as sciences or reading skills.

So far, the combination of the ambiguous and more limited effect of political decentralization with the unambiguous positive effect of fiscal decentralization is interesting. From these results it follows that for school outcomes it is more important the capacity of subnational governments to deliver than the capacity to decide on their own educational policies.

6 – Conclusions

This paper has analyzed the impact of fiscal and political decentralization on students performance. With this aim, we resort to the four available waves of the PISA micro-data regarding 22 countries for the years 2000, 2003, 2006 and 2009.

After controlling for a large number of individual, school and country characteristics our results indicate that decentralization matters for students' performance. For fiscal decentralization, estimated effects are positive in all outcomes for both expenditures and revenues. This result indicates that in countries where subnational governments have more capacity to manage their own budgets, from both the expenditure and revenue side, students perform better. This is because local governments are more efficient allocating their expenditures. On the contrary, the effect of political decentralization is only significant in math scores but ambiguous, i.e. positive for self-rule and negative for shared-rule. This result also supports the notion that local governments on gaining autonomy to articulate its own policies are able to run with greater efficiency. However, it is not so when the same local governments have the capacity to have an influence on national policies. . Another interesting result regards the fact as other studies has shown, math scores seems to be more sensitive to policy and budgetary changes that other subjects as science or reading skills.

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Annex

Table 1: Observations by country and year

	2000	2003	2006	2009
Australia	1.122	12.551	14.170	14.251
Austria	1.091	4.597	4.927	6.590
Belgium	1.563	8.796	8.857	8.501
Czech Republic	1.326	6.320	5.932	6.064
Denmark	957	4.218	4.532	5.924
Finland	1.085	5.796	4.714	5.810
France	1.044	4.300	4.716	4.298
Germany	1.157	4.660	4.891	4.979
Greece	1.040	4.627	4.873	4.969
Hungary	1.229	4.765	4.490	4.605
Iceland	743	3.350	3.789	3.646
Ireland	849	3.880	4.585	3.937
Italy	1.109	11.639	21.773	30.905
Netherlands	553	3.992	4.871	4.760
New Zealand	814	4.511	4.823	4.643
Norway	918	4.064	4.692	4.660
Portugal	1.030	4.608	5.109	6.298
Spain	1.362	10.791	19.604	25.887
Sweedeen	976	4.624	4.443	4.567
Switzerland	1.385	8.420	12.192	11.812
United Kingdom	2.078	9.535	13.152	12.179
United States	843	5.454	5.611	5.233

Table 2: Summary statistics for the results in mathematics, reading and science

	Maths achievement			Reading achievement			Science achievement		
	mean	s.d.	rank	mean	s.d.	rank	mean	s.d.	rank
Australia	515.72	90.16	7	513.54	95.61	5	522.30	99.13	5
Austria	506.25	90.15	9	487.47	98.08	19	503.25	93.31	12
Belgium	525.91	101.16	5	509.20	101.25	6	511.77	99.32	8
Czech Republic	524.99	99.46	6	502.78	98.55	8	530.26	99.03	3
Denmark	503.84	85.10	11	488.46	84.99	16	483.85	92.88	20
Finland	542.51	77.38	1	540.25	79.35	1	550.30	83.78	1
France	504.07	91.36	12	497.10	96.98	11	503.34	99.42	13
Germany	506.74	96.07	10	495.83	101.83	14	512.67	99.65	7
Greece	457.38	87.37	22	472.07	94.57	22	475.98	87.61	22
Hungary	492.08	87.65	18	487.92	86.99	17	504.71	85.78	11
Iceland	509.20	84.80	8	492.45	91.97	15	493.58	90.36	17
Ireland	498.60	80.46	15	512.52	88.10	4	508.59	90.07	9
Italy	485.01	89.07	19	488.27	94.76	18	496.23	92.42	16
Netherlands	538.52	85.81	2	516.85	85.74	3	530.77	92.05	2
New Zealand	524.44	91.92	4	523.27	100.22	2	530.05	101.67	4
Norway	494.56	85.19	16	494.81	95.81	13	491.14	91.18	19
Portugal	474.14	85.84	21	480.51	88.31	21	479.06	83.45	21
Spain	494.84	86.28	17	484.19	85.35	20	495.92	86.31	15
Sweedeen	502.56	88.42	13	506.71	92.74	7	502.16	94.62	14
Switzerland	526.30	91.24	3	494.83	87.75	10	506.57	93.28	10
United Kingdom	500.88	86.08	14	500.68	93.96	9	515.00	98.44	6
United States	480.71	87.63	20	495.52	94.61	12	492.66	96.92	18

Table 3: Description of the variables of individual characteristics

Variable	Description
Female	Dummy that takes value 1 if the individual is female.
Age	Age of the student
Student born in foreign country	Dummy that takes value 1 if the student was not born in the country of performance of the test
Mother born in foreign country	Dummy that takes value 1 if the mother of the student was not born in the country of performance of the test
Father born in foreign	Dummy that takes value 1 if the father was not born in the country of performance of the test
Books at home	Number of books that the individual has at home. Can take the values none, 1 to 10, 11 to 50, 51 to 100, 101 to 250, 251 to 500 and more than 500
Father isced qualification	Father ISCED rating 0: preschool 1: primary 2: low secondary education 3: high secondary education 4: postsecondary education 5: low tertiary education, diplomas, degrees and postgraduate 6: high tertiary education, doctoral and master certain, includes part of research
Mother isced qualification	Mother ISCED rating

Table 4: Description of the variables of school characteristics

Variable	Description
Location	It takes the following values depending on where the school is located: Village: less than 3,000 inhabitants Small town: between 3,000 and 15,000 inhabitants Town: between 15,000 and 100,000 City: between 100,000 and 1,000,000 people Large city: more than 1,000,000 inhabitants
School type	Can take the following values: Public: if the school is owned by the government Private: If the school is private and independent of government Private government-dependent
School size/teachers ratio	Ratio between number of students and teachers

Table 5: Description of the variables at the country level

Variable	Description
GDP per capita constant prices 2000	PIB per capita constant 2000 prices
Expenditure per student	Annual expenditure on educational institutions per student converted to dollars using PPP.
Teacher salary at primary education	Primary annual initial salary converted to dollars using PPP
Teacher salary at low secondary education	Low secondary annual initial salary converted to dollars using PPP
Teacher salary at upper secondary education	High secondary annual initial salary converted to dollars using PPP
Total expenditure in education as % of GDP	Public expenditure on educational institutions of primary and secondary schools as a percentage of GDP
Unemployment rate 15 – 24 years	Unemployment youth rate between 15 and 24 years
Corruption index	Perception of the corruption index

Table 6: Average rates of political and fiscal decentralization by country

	Self Rule		Shared Rule		Subnational Fiscal Decentralization	
	Score	Rank	Score	Rank	Score	Rank
Australia	12.9446	8	6.0334	4	0.4971	6
Austria	12	9	6	5	0.4095	10
Belgium	21.0046	1	7.6170	2	0.4656	7
Czech Republic	3.3687	21	0	14		
Denmark	10.0794	10	0.1138	12	0.5160	3
Finland	6.76762	18	0.0299	13	0.4289	9
France	16	6	0	14	0.2931	15
Germany	20.3375	2	9	1	0.5632	2
Greece	9.25	14	0	14		
Hungary	9.5	13	0	14	0.2719	16
Iceland	0	22	0	14	0.2636	18
Ireland	5.6250	19	0	14	0.3498	14
Italy	18.6883	4	1.4900	9	0.3561	13
Netherlands	7.925	17	6.5	3	0.3790	12
New Zealand	9	15	0	14		
Norway	11	11	0	14	0.3893	11
Portugal	3.3830	20	0.1645	11	0.2097	19
Spain	18.9156	3	3.0174	8	0.4512	8
Sweden	10	11	0	14	0.5072	5
Switzerland	15	7	4.5	7	0.5692	1
United Kingdom	8.1079	16	0.3110	10	0.2709	17
United States	17.6987	5	5.4888	6	0.5151	4

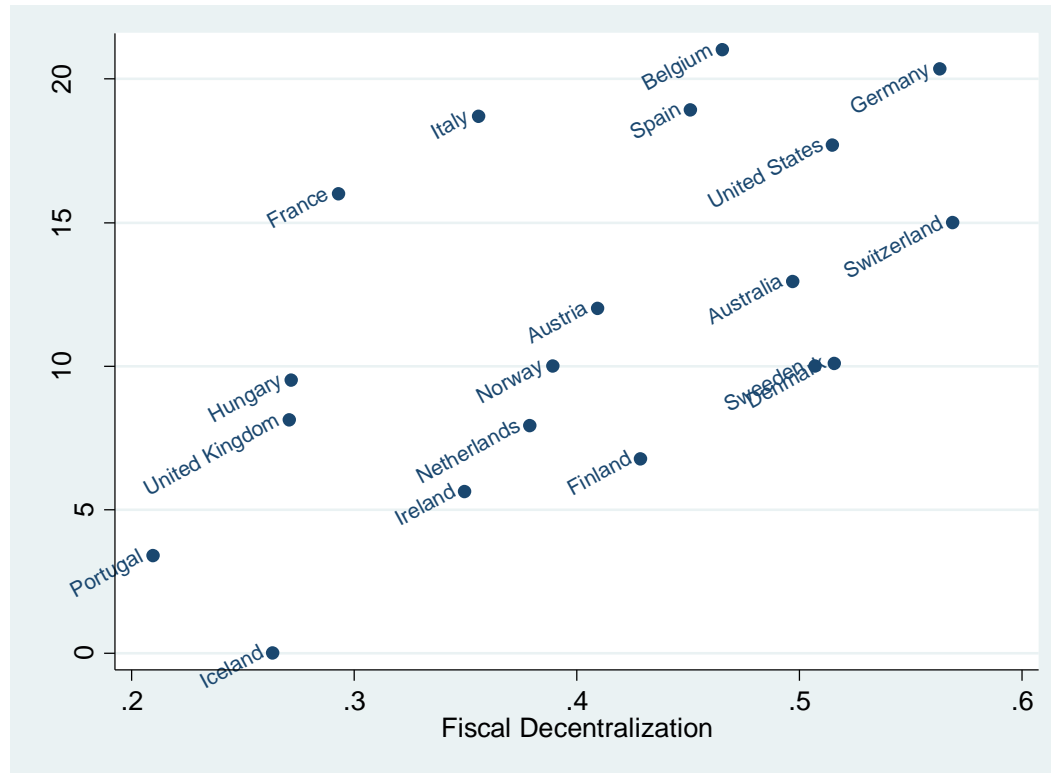


Figure 1: Relationship between Fiscal and Political decentralization

Table 7: Estimation with fixed effects of equation (2). The fixed effects and standard errors are clustered at country level.

	Math achievement		Reading achievement		Science achievement	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Constant	0.0108	6.31***	0.0660	18.02***	0.0127	7.59***
Individual characteristics						
Female	-0.0030	-9.93***	0.0664	22.02***	-0.0102	-3.55***
Age	0.0014	3.14***	0.0035	3.32***	0.0012	0.94
Student born in foreign country	-0.0331	-4.13***	-0.0365	-4.17***	-0.0258	-4.14***
Mother born in foreign country	-0.0185	-3.43***	-0.0246	-3.48***	-0.0034	-2.82***
Father born in foreign	-0.0428	-6.79***	-0.0405	-5.85***	-0.0223	-4.66***
<i>Books at home (Base: None)</i>						
1 – 10 Books	0.0477	9.12***	0.0685	11.72***	0.0559	10.55***
11 – 50 Books	0.1118	22.58***	0.1356	24.81***	0.1214	25.49***
51 – 100 Books	0.1553	28.12***	0.1784	30.50***	0.1556	29.07***
101 – 250 Books	0.1915	35.14***	0.2137	39.33***	0.1871	33.61***
251 – 500 Books	0.2099	31.81***	0.2296	34.46***	0.1946	30.48***
More than 500	0.2228	20.80***	0.2433	22.31***	0.1942	17.62***
Father isced qualification	0.0096	11.05***	0.0103	9.87***	0.0131	13.99***
Mother isced qualification	0.0086	8.93***	0.0107	9.43***	0.0103	10.66***
School characteristics						
<i>Location (Base: village, less 3.000)</i>						
Small town (3.000 to 15.000)	0.0168	2.81***	0.0163	2.87***	0.0051	2.17**
Town (15.000 to 100.000)	0.0325	5.11***	0.0369	6.08***	0.0372	3.85***
City (100.000 to 1.000.000)	0.0301	4.06***	0.0361	4.92***	0.0359	3.68***
Large city (more 1.000.000)	0.0229	2.42**	0.0384	1.17	0.0260	2.28**
<i>School type (Base: private government dependent)</i>						
Public	-0.0108	-1.24	-0.0040	-0.17	-0.1259	-1.60
Private, government independent	0.0450	3.28***	0.2387	5.24***	0.2591	4.15***
School size / number of teachers ratio	0.0011	2.17**	0.0029	5.64***	0.0017	3.89***
Country characteristics						
Log GDP per capita constant prices 2000	-0.1741	-2.10**	-0.0596	-0.62	-0.1370	-1.69*
Log GDP per capita constant prices 2000, squared	-0.0010	-0.86	-0.0167	-4.67***	-0.0181	-4.39***
Log expenditure per student	-0.0887	-2.59**	-0.0961	-2.75***	-0.0855	-2.39**
Teacher salary at upper secondary education	8.911e-06	3.17***	9.317e-06	2.97***	1.26e-6	3.22***
Total expenditure in education as % of GDP	-0.0313	-3.61***	-0.0209	-2.61***	-0.0167	-1.90*
Unemployment rate 15 – 24 years	0.0061	5.40***	0.0044	3.26***	0.0024	2.12**
Corruption index	0.0045	7.05**	0.0055	6.72***	0.0019	2.50**
<i>Year (Base: 2000)</i>						
2003	0.5987	3.57***	0.6370	3.46***	0.1753	0.83
2006	0.6030	3.57***	0.6311	3.41***	0.2023	0.96
2009	0.5695	3.34***	0.5665	3.02***	0.1916	0.21

Significant at *** 1%, ** 5% and *10% level

Table 7 (continuation)

	Math achievement		Reading achievement		Science achievement	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Decentralization indexes						
<i>Political decentralization</i>						
Self-rule (SR) ID+PS+FA+RP	0.0141	3.70***	-0.0045	-1.11	0.0012	0.28
Shared rule (SHR) LM+EC+FC+CR	-0.0182	-2.68***	-0.0073	-1.03	-0.0063	-0.80
Average R-Squared		0.2046		0.2122		0.1534
Sample size		437.105		432.994		437.108
<i>Fiscal decentralization</i>						
Sub-national Government Expenditure	1.0863	4.78***	0.6415	2.43**	0.7039	2.68***
Sub-national Current Expenditure	0.4519	2.72***	0.4820	2.56**	0.4221	2.47**
Sub-national Capital Expenditure	0.6072	5.79***	-0.0536	-0.47	-0.0249	-0.15
Sub-national Revenue	1.3064	5.49***	1.0480	3.88***	0.8878	3.25***
Sub-national Tax Revenue	1.3096	8.11***	0.3111	1.76*	0.3477	1.42
Average R-Squared		0.2085		0.2142		0.1556
Sample size		393.796		389.687		393.799

Significant at *** 1%, ** 5% and *10% level