Decentralization and Academic Achivement:
An Empirical Approach

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Abstract

The low quality of education is a persistent problem in many developed countries. Parallel to in the last decades exist a tendency towards decentralization in many depeloped and undeveloped countries. Using micro data from the Programme for International Student Assessment (PISA) of 22 countries, we analyze the impact of fiscal and political decentralization on student achievement in mathematics, reading skills and science. Our results show an ambiguous effect depending on the type of decentralization. On the one hand, political decentralization has a negative effect on academic performance while fiscal decentralization has a positive effect.

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 compulsary education. That's why many of these countries have increased their efforts to try to improve the quality of their education system. Parallel to in the last decades exists a tendency towards decentralization in many depeloped and undeveloped countries. The implications of increasing the quality of education and academic performance increase the importance of the issue we deal with, the potential existence of a link between academic achievement and decentralization processes that are occurring along the last decades in developed countries and developing countries.

In public economics, the relationship between the provision of public services and decentralization is a recurring theme, although measuring the quality of these services is a difficult task. Two of the public services on which should be the focus are education and health, for constituting these, two of the basic pillars of the welfare state. We should expect these two public services to be affected by decentralization process. In the case of education, all efficient measures of decentralization should promote finally the improvement in the provision of this public good, in our case, would have to be translated into better academic results. We believe that academic results together with the universality of service is the more objective measure of the quality of the education in a country.

Most studies devoted to analyze the effect of decentralization do it on economics 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.

Only recently, some studies are beginning to study the role of decentralization on variables involving happiness or satisfaction of the voters. Present 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.[1] 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 (Assesing academic results as an outcome or measure of efficiency of public services). With this goal, academic results will be used on areas as math, science or reading skills for more than 200,000 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 analyze the role of the decentralization in education. Is worth mentioning that our measures of decentralization are not specific of education, both concerning fiscal and policy decentralization. Our results are similar to the ones obtained in Díaz-Serrano and Rodriguez-Pose (2012) and suggest that the effect of decentralization is ambiguous. On one hand, we observe that the measures of fiscal decentralization have an unequivocal positive impact on the three types of academic performance. By contrast, the measure of political decentralization, the one who measures the authority of the regional goberment over those woho live in the region and the authority exerciced by the regional goberment in the country as a whole has reported the opposite sign.

With the objectives above, the paper is structured as follows: Section 2, provides the theoretical 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 – Theoretical 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.

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[1] Falch and Fischer (2010), and Diaz-Serrano and Rodriguez-Pose (2011) are two exceptions. This work will be discussed in more detail in the next section.

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 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 can reach the situation where 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 a expenditure competence. Can also occur a competitive situation on revenue through tax rates in different regions. 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 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.

At this point we have a conflict, since decentralization is intended to increase efficiency, enhance local democracy and participation, however, the various organs of government put their political objectives. In democratic countries, citizens can expel their representatives if they have not met their expectations in public services provision. This type of evaluation is more complicated in non-democratic countries. In this context Rondinelli et al (1984) proposed to be evaluated according to criteria of: attainment of general objectives such as economic development or stability, improved degree of response to social needs, improvements in the efficiency of public administration or if the process of decentralization has helped to give more autonomy to lower levels of government. As we see the evaluation process of decentralization has complicated by the wide variety of interests to consider. In short, decentralization in the public sector comprises many background objectives such as: increasing efficiency, improve democracy and public participation, although you can create undesirable situations with an inefficient implementation of decentralization processes.

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 accelerate and at the same time, better information is available to run. The efficient allocation of resources by subnational governments allows to better adjust 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 in the decision-making system the less weight 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.

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

Both from an empirically and theoretically view, the majority of studies relate the decentralization with the economic growth. 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. These second authors 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.

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) or Qian and Weingast (1997) are authors who 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. For Sepulveda and Martinez-Vazquez (2010) results vary depending on the level of total public expenditure, where fiscal decentralization is presented as 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.

Another relatively recent line of research, but from our point of view better targeted on the problem is the one which links decentralization and happiness. In this context, studies related to these issues coincide in that institutions are important for subjective well-being and happiness is affected by the institutional context (Frey and Stutzer, 2000; Bjørnskov et al., 2008, Diaz-Serrano and Rodríguez-Pose, 2011). Diaz-Serrano and Rodriguez-Pose (2012) are also the first to study the effect of decentralization on the perception that citizens have in institutions such as government, economy and democracy. These authors observed that the effect is ambiguous depending on the type of institution and whether fiscal or political decentralization refers to the expenditure or revenue or is related to the ability of subnational governments to govern their own citizens or to influence on national politics. These results coincide with the ones we get here.

On the other hand, the literature concerning the determinants of academic achivement can be disaggregated into three main groups: the family and student background, the characteristics of the school and what could be called institutional characteristics.

In terms of family and student background literature agrees on the importance of these factors in the determination of student performance. For example, the fact of having books at home is seen as a good indicator of social, educational and economic background of the studen and therefore is presumed that this causally related to student performance (Hanusek and Woessmann, 2011). The performance of immigrant students has also been discussed in the literature (Enfort and Minoiu, 2005) also the starting age for schooling (Sprietsma, 2010). The strong link between studen achivement and socio-economic background is proven in cross-country studies both at student level (Woessmann, 2003b) and country level (Lee and Barro, 2001)

With respect to the characteristics of the school, 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 studen achivement for both country-level analysis (Lee and Barro, 2001) and student level (Fuchs and Woessmann, 2007), this may be due to what Hanusek (1997) called "productivity collapse in schools" in the case of the United States. 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 is presented as a factor that exercises negative effect on student performance as well as the intensive use of computers (Fuchs and Woessmann, 2004). As regards the scope of teachers, the educational level of those is presented as a factor that positively affects sudent performance as wee 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 academic performance (Woessmann et al, 2009). Another aspect discussed in the literature is the autonomy of the 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, concluding that the effect is positive. There si consensus that schools with autonomy stock up on supplies and power to decide on issues such as recruitment of teachers achieve better results on academic performance. The literature regarding the effect of institutional characteristics on academic achivement is quite scare. This institutional or constitutional features are not specific to the school but the education system. For example, the effect of the introduction of external curriculum tests. These show a positive impact on student achivement (Bishop, 1997 and Bishop, 2006).

With respect to area of our study, decentralization and education, the literature is also quite scarce. For instance, 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 does not reach students with less resources, so that their distribution is uneven. In the same line as the previous author, Barankay and Lockwood (2006) show

for the Swiss case that expenditure decentralization allows to reach higher levels of academic achievement. Falch and Fischer (2010), using a panel of international student achivement for 23 OECD countries find that goberment expenditure decentralization is conductive to student performance. Behrman et al (2002) shows that there is little evidence that the effect of decentralization improves academic outcomes in developing countries, probably because many of these countries have no adequate 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, concluding that the effect is positive. Merrouche (2007), in an analysis for the Spanish case, argues that there is no improvement in human capital with the introduction of decentralization of education spending in the 80's, instead, Sole-Olle Salinas (2009) find that relationship is positive. For the U.S. case, Akai et al (2007) reach the same conclusion for high school students only. Often the worsening or not improving academic performance through fiscal decentralization may be evident due to inefficient spending on education as evidenced by Clements (1999) for the case of Portugal.

4 – Empirical framework and data

4.1 – Empirical model

Educational Production Function (hereafter, EPF) is presented to us as a way to understand the production processes by estimating the effects of various inputs on academic performance. In order to obtain unbiased estimators should be included in the EPF all inputs (current and past) that may determine the student's academic performance. It includes background information on each student, school characteristics and country characteristics, but there is no information about student performance in another period, thus our estimate is limited by the lack of these inputs (Todd and Wolpin , 2003). Our EPF can be represented by the following linear relationship:

$$A_{isct} = \alpha + \beta X_{isct} + \gamma Z_{sct} + \mu Y_{ct} + \varepsilon_{istc} \qquad (1)$$

Where A_{istc} for each country c the score of a given student i who attends a school s in year t, represent the academic results: X_{isct} is a set of variables that characterize the student; a series of variables that describe the school, Z_{sct}; and whose values are equal for all students in the same school, a series of country characteristics, Y_{ct}, whose values are equal for all students to share country. In this last variable rates are also included political and fiscal decentralization. In the latter set of variables political and fiscal decentralization indices are also included. The term ε_{istc} is a random error term, and $\alpha, \beta, \gamma, \mu$ are the set of parameters to be estimated.

In addition to the model (1) we can also consider the specific time effects, δ_t, and country-specific effects, λ_c, so that equation (1) now would be expressed as follows:

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

The specific time effects, δ_t, are introduced to control for any unobserved temporary shock that can alter the response variable and do not reflect any of the other variables. On the other hand, since the data are grouped by country, which are territorial units of its own, country-specific effects, λ_c, are included to control for idiosyncratic unobserved country characteristics. Furthermore, the inclusion of λ_c is also necessary to identify the effects of the variables of country, among which include decentralization indexes.

The estimation method selected to estimate equation (2) is the pooled linear model, where the temporary effects δ_t are introduced through dummy variables for each year. On the other hand, the country-specific effects λ_c can be considered by a fixed-effects model. Each country has its own specific characteristics that might influence the outcomes. If we assume that there is some unobserved heterogeneity across the countries, this implies that there may be correlation between country-specific effects and the covariates. If this is so, the random effects estimator would be inconsistent, since this model imposes as a restriction that the this correlation is zero. Consequently, the method chosen in our case, the fixed effects model, which eliminates the impact of

these time-invariant characteristics to assess effect of the estimator. Finally, to obtain efficient estimators, the estimated standard errors of the parameters is performed by controlling the correlation between groups, in our case countries.

4.2 – Data

The empirical work is focused on analyzing how the political and fiscal decentralization affects academic achievement in PISA tests for math, reading and science skills for the years 2000, 2003, 2006 and 2009 for 22 countries.

The data used in this study are part of the Programme for International Student Assessment (PISA)[2]. The PISA report is a international standardized study in the areas of math, science and reading skills eliciting the academic results of them. The study also collects information regarding the student and their family environment and the characteristics of their. There are four available waves conducted in a total of 43 countries in 2000, in 41 countries in 2003 in 57 countries in 2006 and in 65 countries in the last edition of 2009.

For the study it was necessary to match the PISA database and decentralization data. To do so, based on PISA data, are assigned to the individuals belonging to a country the corresponding value for both indices of fiscal and political decentralization to the different variables that have characterized the country. In this matching we have not only taken into consideration the spatial but also the appropriate time horizon. To each country is assigned the average of the last ten years of the index, decentralization variables or characteristics of the country. More specifically, the decentralization indexes are comprised between 1965 and 2006, so we have found the restriction that was not available rates for the year 2009 and we imputed the 2006 value

Since our decentralization data covers a limited number of countries that appear in both, PISA waves and decentralization indexes is 22. In Table 1 (see Appendix) are represented the available observations disaggregated by year.

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[2] Data retrieved from http://www.pisa.oecd.org/pages/0,3417,en_32252351_32236130_1_1_1_1_1,00.html

4.2.1 – Dependent variables

Results on tests of math and science are presented in the form of five plausible values for each student and subject. The plausible values are imputed values to students that are similar to the individual test scores and have approximately the same distribution as the measured latent feature. These were used for the first time in the National Assessment of Educational Progress (NAEP) in 1983-1984. The PV have continued being used in the following evaluations of education for both NAEP, TIMSS or PISA. 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. So the PV are random samples from a distribution derived from their fitness values subject to certain observed values used as evaluation elements (Wu, 2005 and von Davier et al., 2009).

In the PISA study, each student has five plausible values per subject. To construct our dependent variable we have made the logarithm of the average of these five. So each student has assigned three scores that will be used as dependent variables.

We decided to use the three dependent variables although the correlation between them is high. All of them above 0.8.

The statistics concerning the agregated academic results by country are shown in Table 1 (see Appendix). We can see that the five best performing countries in mathematics are Finland, Holland, Switzerland, New Zealand and Belgium. As respect to Finland, it repeated reading skills in first position followed by New Zealand, Holland, Ireland and Australia. Finally, the countries with the highest ranking in science are Finland, Netherlands, Czech Republic, New Zealand and Australia. It should be noted that Finland is maintained in the three tests in the first position and the Netherlands, New Zealand are always among the five countries with the best results. The worst results are obtained by Greece who appears on the last position in the three achivements. 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

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

Student characteristics comprises a set of individual's variables and the family environment. These are gender, age variables, birth place of the student and their parents, the number of books they have at home, and the cultural level of the father and mother[3]. 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 to the type of urban area in which the school is located, it can take 5 values based on the size of it. *T*he type of school (public school, private school independent of government and government-dependent private school).

It has been added a number of country-level variables to identify the effects of the decentralization key variables. This variables include the GDP per capita at constant 2000 prices data are from the catalog data from the World Development Indicators, The World Bank[4]. The data concerning the annual expenditure on educational institutions per student, teacher salaries (both the primary and the secondary) and total education the expenditure as a percentage of GDP comes from the annual publication *Education at a Glance: OECD Indicators*[5] corresponding to a series of studies that provide a rich source of indicators for different countries, allowing comparisons between them. The data unemployment youth rate are from the *Labour Force Statistics, OECD*[6]. Finally, we also include the index of corruption perception in the public sector collected by the organization Transparency International Corruption Perceptions Index[7].

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[3] 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.
[4] Can be downloaded from http://data.worldbank.org/indicator
[5] From 2001 to 2010 edition can be found here
http://www.oecd.org/document/52/0,3746,en_2649_39263238_45897844_1_1_1_1,00.html
[6] Can be downloaded from http://www.oecd.org/document/46/0,3746,en_2649_34251_2023214_1_1_1_1,00.html
[7] Can be downloaded from http://www.transparency.org/policy_research/surveys_indices/cpi/2010

The principal study variables are the variables of decentralization. They are arranged in two types: political and fiscal decentralization. Political decentralization variables were developed by Hooghe et al. (2008) and are known as Regional Authority Index (RAI)[8]. These correspond to a total of eight indicators for a total of 42 countries and cover the period between 1950 and 2006. The RAI was validated in a study (Schakel, 2008) as a good index to study decentralization to be evaluated along with others seven. These decentralization variables are Self rule and Shared rule. The first one represents the authority exerciced by a regional goberment over those who live in the region and the second one shows the authority exerciced by a regional government or its representatives in the country as a whole.

Fiscal decentralization indexes are from the Government Finance Statistics of the International Monetary Fund[9] for the period between 1972 and 2005. These are the ratio between central and sub-general. For the case of spending, current expenditure (*current expenditure*), capital expenditure (*capital expenditure*), revenue and grants (*revenue / grants*) and revenue from taxes (*tax revenue*). In Table 7 (see Appendix) are detailed the two types of indexes.

In Table 6 (see Appendix) is represented the ranking of countries according to their level of political and fiscal decentralization. In the case of fiscal decentralization, this is calculated as the average of the five indexes used in the analysis. For the political decentralization indexes, countries with higher rates of political decentralization are Germany, Belgium and the United States instead Iceland, Czech Republic and Portugal occupy the last places. Taking as reference indices of fiscal decentralization, Switzerland, Germany and Denmark are in the top three positions, however Portugal, Iceland and the UK are in the last positions of this ranking.

Finally, to check the effect of decentralization indices on the typology of school we have included a variable representing the interaction between them and the typology of the school..

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[8] Can be downloaded from http://www.unc.edu/~gwmarks/data_ra.php

[9] Can be downloaded from http://www.imf.org/external/pubs/ft/gfs/manual/gfs.htm

5 – Econometric results

Table 7 (see Appendix) reports the results obtained in the estimation of equation (2).

We observe that individual characteristics, are statistically significant in all academic equations (math, reading and science skills). More specifically we see that being a woman has a negative effect on the results obtained in tests of math and science, but a positive effect on reading ability, while age exerts a positive effect in all outcomes. Regarding family context, we observe that the fact of having books at home has a positive effect on academic performance, which becomes more evident as the student own more books. This positive relationship is also observed for the education level of father and the mother. If we look at the effect of the origin of father and the mother, we see that being born outside the country where their child has completed the test adversely affects the outcome of the three subjects. It produces the same negative effect if the student is also foreign born.

School variables have also turned-out to be statistically significant for student's performance. The location and the school environment have a positive and significant effect that increases with increasing the number of inhabitants of the municipality where the school is located. Therefore, the location of the school in an environment with high density of population has a greater effect on academic performance than if it is located in a small town. Studying in public school has a significant negative effect on academic achievement by respect to studying in private subsidized school. In contrast, the effect of attending a private school independent of the government is not significant, based on belonging to a private school subsidizedt. It also notes that the proportion of girls in school has a positive effect, although not significantly. The ratio of students / teachers has a positive impact but not significant in any of the three subjects.

Regarding the specific country controls, we observe that GDP per capita exerts a negative and statistically significant impact. Education expenditure per student only shows significant performance in math by exercising a positive effect. Total expenditure as a percentage of GDP shows a significant negative effect but only for performance in math. The variables measuring teachers' salaries show mixed results although none is

significant. The unemployment youth rate (between 15 and 24) has a positive effect on performance. This result can be explained by the existence of incentives to improve school performance and to continue studying in a context of high youth unemployment. Finally, we observe that the corruption index has a positive and significant effect, wich again is in line with a poorer performance in more developed countries.

Once analyzed the effect of student characteristics, school characteristics and the country characteristics on academic performance, we focus now on the impact of decentralization indices on the dependent variables.

The results show that political decentralization adversely affects the performance of the three subjects tested. With respect to academic achievement in math, reading skills and science, the authority exercised by the regional government on those who live in the region (*self rule*) exerts a negative and significant effect. However, the effect of the authority exercised by the regional government on national politics (*shared rule*) is only significant, and also negative in the achievement in mathematics.

One plausible explanation for the negative impact of sel rule on academic performance be attributed to the difficulty that subnational governments found to articulate policies that allow the efficient allocation of public resources (in our case educational resources). Another posibility is that political autonomy does not improve in subnational goberments because they are not endowe with the financial resources to implement public policies.

Regarding the fiscal decentralization variables, we observe that the index that represents the capacity of the subnational government to collect (*Subnational Revenue*) has stronger (positive) effect on academic performance in math and reading. The fiscal decentralization rate regarding current expenditure (Current Subnational Expenditure), which correspond to the human resources recruitment and the purchase of goods and services, has a positive and significant effect in all the subjects studied. On the other hand, capital expenditure (Subnational Capital Expenditure) and subnational income taxes (Subnational Tax Revenue) only appear as a significant achievement in mathematics.

However, thus all the significant fiscal decentralization variables related to both, expenditure and revenues have a positive impact on academic performance in all the three subjects tested. Results also suggest that math achivements are the most sensitive to decentralization policies.

The combination of the negative effect of political decentralization and the positive effect of fiscal decentralization show interesting results. Thus, it follows the fact that if the subnational government has decentralized the fiscal parcel, it represents an important factor in improving academic outcomes. In this way sub-national governments with power to control expenditure and revenues can provide better services to its citizens as far as education refers, translating them, in better academic results.

If we focus on the interactions between the decentralization variables and the type of school we see some interesting results. On the one hand if we observe the interactions of political decentralization variables they are all negative for all the three type of subjects. The only significant interaction is the one between the variable that represents the authority exerciced by a regional goberment over those who live in the region and the private schools and as we said this effect has negative sign and is similar in the three discussed subjects. So private schools located in regions where the government have political autonomy tend to get worse academic results.

Finally the effect of the interaction between fiscal decentralization and school type variables show ambigous results. On one side the interactions between subnational government expenditure and the type of school show a positive but not significant impact. The interactions concerning subnational current expenditure and subnational capital expenditure affect negatively with both types of school but only significant for the interaction between subnational capital expenditure and private school. In the other hand, subnational revenue and subnational tax revenue interactions show both positive effect with public schools and negative effect with private schools but only significant for the case of the interaction between subnational tax revenue and private school.

6 – Conclusions

This paper has analyzed the effect exercised by fiscal and political decentralization on students academic performance. With this aim we resort to the four available PISA waves with micro-data. Our outcome variables are the political and fiscal decentralization indexes. We restrict the sample to 22 countries since our decentralization covers a limited number of countries.

After controlling for a number of individual, school and country characteristics our results show that only fiscal decentralization exert an unequivocal effect on academic performance. So the sub-national governments with power to execute their investments in their region and those with the capacity to revenue will positively affect academic outcomes. This may be caused due to local goberments are knowledgeable about their local reality and this allows them to allocate more efficiently their expenditures. We understand that in these investments, a part is intended to improve education.

On the contrary, political decentralization exert also a negative effect on academic achivement. However, the efect is only statistically significant for self rule. Our results cast some doubt on the hypothesis that local governments on gaining autonomy to articulate its own policies are able to run with greater efficiency. This may be due to sub-national governments found often difficulties in the absence of instruments available to the central government such as economies of scale or the use of spillovers that can allow efficiency on the allocation of public reourses. Another posibility is that political autonomy does not improve in subnational goberments because they are not endowe with the financial resources to implement public policies.

Finally we introduce interactions between the decentralization indexes and the type of school. The interaction between self rule and private school show negative effect on academic achivement. On the other hand the interaction between subnational capital expenditure and public school and the interaction between subnational tax revenue and private school indicate a negative impact on academic achivement.

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Annex

Table 1: Observations by contry 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
Sweden	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 achivement		
	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
Sweeden	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 goberment Private: If the school is private and independent of government Private government-dependent
Percentage of girls at school	Proportion of girls in school
School size/teachers ratio	Ratio between number of students and teachers

Table 5: Description of the variables at the country level

Variable	Descripción
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 contry

	Self Rule		Shared Rule		Subnational Fiscal Descentralization	
	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	10	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
Sweeden	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

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

	Math achivement		Reading achivement		Science achivement	
	Coeficient	t-stat	Coeficient	t-stat	Coeficient	t-stat
Constant	-11.7240	-1.75*	-18.3806	-2.62**	-9.4993	-1.12
Individual characteristics						
Female	-0.0319	-11.54***	0.0695	25.27***	-0.1362	-6.73**
Age	0.0290	12.18***	0.0304	10.91***	0.0303	14.09***
Student born in foreign country	-0.0250	-4.50***	-0.0324	-5.45***	-0.0262	-4.38***
Mother born in foreign country	-0.0195	-3.62***	-0.0196	-4.01***	-0.0241	-4.32***
Father born in foreign	-0.0268	-5.11***	-0.0258	-5.41***	-0.0320	-5.94***
Books at home (Base: None)						
1 – 10 Books	0.0471	13.99***	0.0598	15.51***	0.0563	21.86***
11 – 50 Books	0.1100	19.50***	0.1218	21.94***	0.1199	28.33***
51 – 100 Books	0.1491	22.75***	0.1604	24.66***	0.1617	29.94***
101 – 250 Books	0.1893	27.69***	0.1960	25.66***	0.2021	31.30***
251 – 500 Books	0.1943	26.22***	0.1978	23.26***	0.2073	28.54***
More than 500	0.2250	23.48***	0.2323	20.24***	0.2366	26.78***
Father isced qualification	0.0092	10.36***	0.0098	12.48***	0.0097	9.89***
Mother isced qualification	0.0088	8.41***	0.0090	10.15***	0.0096	11.72***
School characteristics						
Location (Base: village, less 3.000)						
Small town (3.000 to 15.000)	0.0136	2.74**	0.0154	3.15***	0.0101	2.03*
Town (15.000 to 100.000)	0.0199	2.84***	0.0277	4.01***	0.0161	2.36**
City (100.000 to 1.000.000)	0.0201	3.31***	0.0313	4.81***	0.0178	2.82***
Large city (more 1.000.000)	0.0212	2.29**	0.0370	4.57***	0.0165	1.86*
Shool type (Base: private goverment dependent)						
Public	-0.0177	-2.10**	-0.0200	-2.22**	-0.0142	-1.69
Private, goverment independent	0.0110	0.96	0.0133	1.21	0.0187	1.70
School size / number of theachers ratio	0.0017	1.44	0.0023	1.58	0.0020	1.60
Country characteristics						
Log GDP per capita constant prices 2000	-2.1395	-2.65**	-2.6963	-3.33***	-1.6478	-1.80*
Log GDP per capita constant prices 2000, squared	12.1229	2.6**	16.0686	3.38***	9.7211	1.84*
Log expenditure per student	0.0651	3.07***	0.0084	0.40	-0.156	-0.51
Teacher salary at primary education	-1.62e-06	-0.32	2.42e-06	0.47	-3.67e-06	-0.66
Teacher salary at low secondary education	6.10e-06	1.60	-8.84e-07	-0.29	8.63e-07	0.20
Teacher salary at upper secondary education	-3.19-06	-1.19	-1.20e-07	-0.03	4.08e-06	1.55
Total expenditure in education as % of GDP	-0.0263	-2.61**	-0.0031	-0.30	-0.0030	-0.33
Unemployment rate 15 – 24 years	0.0012	1.32	0.0008	1.06*	0.0098	0.71
Corruption index	0.0022	3.52***	0.0023	4.20***	0.0002	2.00*
Year (Base: 2009)						
2000	-0.0402	-1.64	-0.0027	-0.10	-0.0522	-1.85*
2003	0.0262	1.46	0.0461	1.67	0.0174	0.74
2006	0.0203	1.61	0.0414	1.62	0.0320	2.00*

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

Tabla 9 (continuation)

	Math achivement		Reading achivement		Science achivement	
	Coeficient	t-stat	Coeficient	t-stat	Coeficient	t-stat
Decentralization indexes						
Political descentralization						
Self-rule (SR) ID+PS+FA+RP	-0.0133	-3.84***	-0.0175	-5.07***	-0.0140	-2.66**
Shared rule (SHR) LM+EC+FC+CR	-0.0236	-2.60**	-0.0086	-0.69	-0.0075	-0.59
R^2 within		0.1965		0.2149		0.1992
R^2 between		0.0631		0.0195		0.0315
R^2 overall		0.0242		0.0723		0.1124
Fraction of variance due to u_{ct}		0.5059		0.3842		0.2375
Sample size		377.490		373.371		377.489
Fiscal descentralization						
Sub-national Government Expenditure	0.7045	3.89***	0.3558	2.22**	0.4895	2.42**
Sub-national Current Expenditure	0.4511	2.82**	0.3491	3.84***	0.3142	1.96*
Sub-national Capital Expenditure	0.4406	1.98*	0.0762	0.29	0.3252	1.25
Sub-national Revenue	0.7248	3.22***	0.5710	2.92***	0.4541	2.00*
Sub-national Tax Revenue	0.3648	1.26	-0.1925	-0.64	0.1987	0.56
R^2 within		0.1989		0.2150		0.2004
R^2 between		0.1399		0.1494		0.2275
R^2 overall		0.1101		0.1119		0.1470
Fraction of variance due to u_{ct}		0.1999		0.1887		0.1132
Sample size		343.851		339.732		260.733
Political decentralization Interactions						
Self-rule * public	-0.0010	-0.74	-0.0010	-0.70	-0.0004	-0.35
Self-rule * private	-0.0053	-2.48**	-0.0047	-2.47**	-0.0050	-2.13**
Shared-rule * public	-0.0045	-1.54	-0.0042	-1.46	-0.0040	-1.49
Shared-rule * private	-0.0043	-0.80	-0.0029	-0.54	-0.0039	-0.75
Fiscal decentralization Interactions						
Sub-national Government Expenditure * public	0.0372	0.99	0.0296	0.66	0.3325	0.84
Sub-national Government Expenditure * private	0.3725	-0.93	-0.8603	-0.79	-0.0904	-0.78
Sub-national Current Expenditure * public	-0.0217	-0.43	-0.0246	-0.49	-0.0119	-0.26
Sub-national Current Expenditure * private	-0.1117	-1.34	-0.0885	-1.19	-0.0848	-1.09
Sub-national Capital Expenditure * public	-0.1856	2.96***	-0.1780	-2.86**	-0.1806	3.65***
Sub-national Capital Expenditure * private	-0.1057	-0.67	-0.0881	-0.54	-0.1372	-0.86
Sub-national Revenue * public	0.4413	1.22	0.0371	0.87	0.0413	1.04
Sub-national Revenue * private	-0.1181	-0.95	-0.0879	-0.88	-0.0871	-0.80
Sub-national Tax Revenue * public	0.0761	1.49	0.0692	1.37	0.0784	1.64
Sub-national Tax Revenue * private	-0.1378	-1.76*	-0.1238	-2.00*	-0.1153	-1.53

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