Preliminary version
July 26th, 2011

Fiscal Decentralisation, Private School Funding, and Students' Achievements. A Tale From Two Roman Catholic Countries♣

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Abstract

The objective of the paper is to study the disciplining role of both market forces and regional governments own resources in the provision of educational services. The historical evolution of school regulation in Italy and Spain, in particular regarding the funding of private schools run by Roman Catholic Church, and the role of regional governments financing education, created different institutions in terms of both dimensions, private funds and regional governments funds. We take advantage of these institutional diversities to estimate the disciplining role of different sources of funds in the context of educational production function using PISA data. Our results provide support to these accountability drivers. Moreover, we find evidence on the role played by a national standardised test in providing adequate incentives to improve schools' performance.

Keywords: public and private schools, accountability, fiscal federalism

JEL Codes: H75, I22

♣ The paper is funded by the "IEB Research Grant on Fiscal Federalism 2010". Gilberto Turati acknowledges the kind hospitality during his stay at the IEB in November 2010, when this project was initiated. Usual disclaimers apply.

1. Introduction

Historical accounts of the evolution in school regulation all around the world suggest that this is a policy issue subject of bitter confrontations. Two questions emerge as important: on the one hand, what is the role that *private schools* should play in the provision of education. On the other hand, what is the role *regional governments* should play in the provision of education.

In countries where the Roman Catholic Church is still an important actor in social life, the first question is basically centred on the role, if any, private schools run by Catholic Church should play in education, and whether these schools need to be financed with public funds. The institutional answers are different on this point between two countries, like Italy and Spain, where the Roman Catholic Church is still considered a sort of state religion. In Italy, starting from the Unification in the second half of the XIX century, there was a strong push towards a public free-for-all education centrally provided. In Spain, after the success of Franco's *coup d'etat* in 1939, the Catholic Church is still receiving a high share of public funds. As for the second question, Italy and Spain have also followed different paths with regard to decentralization patterns. In the last thirty years Spain has moved from being a unitary state to a much more decentralized one with the regions (*Comunidades Autónomas*) having Parliaments and Governments that can decide on a broad range of public services, among which educational services represent a large share of regional public expenditures. On the other hand, Italian regional governments (*Regioni*) play, in general, a very minor role in deciding public expenditure; with regard to school funding this is consistent with the process of centralization and secularization of education undertaken in Italy.

Given these combinations of private funds (coming from households paying a price for educational services) and public funds (both from regional and central

governments), it is not clear how the "accountability" effect suggested by the literature on private markets and fiscal federalism impact on the production of education. The goal of the paper is to explore this issue. In particular, we study the disciplining role of both market forces and regional governments' own resources in the provision of educational services. We exploit two different sources of variation: on the one hand the difference between private and public schools, suggests that – in the presence of standardised national tests – private schools should be more productive than public schools, given that households pay a price to access the service. On the other hand, the difference between schools funded with regional governments resources and schools centrally funded, suggests that – according to second generation fiscal federalism theories – the former should be more productive than the latter, given the accountability role played by own resources for regional governments. The historical evolution of school regulation in Italy and Spain, in particular regarding the funding of private schools run by Roman Catholic Church and the role of regional governments, created different institutions in terms of both dimensions, private funds and regional governments funds. We take advantage of these institutional diversities to estimate the disciplining role of different sources of funds in the context of educational production function using PISA data.

We build on two papers. On the one hand, Barankay and Lockwood (2007) provide empirical evidence on the claim that fiscal decentralisation promotes - amongst other benefits - the productive efficiency in the delivery of government services. The evidence is based on a data-set of Swiss cantons. The authors first offer careful evidence that expenditure decentralisation is a powerful proxy for factual regional/local autonomy. Further panel regressions of Swiss cantons supply then robust evidence that more decentralisation is associated with higher educational attainment. They also show that these gains lead to no adverse effects across education types, but that male students benefited more from educational decentralisation closing, for the Swiss case, the gender education gap. Finally, they

present evidence of the importance of competence in government and how it can reinforce the gains from decentralisation. Here we add to this paper by considering *tax* decentralisation and not *expenditure* decentralisation in the analysis of efficiency in educational spending, noting that the former should be the real source of accountability for regional governments according to recent literature on fiscal federalism (e.g., Oates, 2005; Weingast, 2009). Our aim is to study whether regions with more tax autonomy are more productive in terms of education attainment.

On the other hand, West and Woessmann (2010) argue that nineteenth-century Catholic doctrine strongly opposed state schooling. The authors show that countries with larger shares of Catholics in 1900 (but without a Catholic state religion like Italy or Spain) tend to have larger shares of privately operated schools even today. They use this historical pattern as a natural experiment to estimate the causal effect of contemporary private competition on student achievement in cross-country student-level analyses. Results show that larger shares of privately operated schools lead to better student achievements in mathematics, science and reading, and to lower total education spending, even after controlling for current Catholic shares. We add to West and Woessmann (2010) by showing that *within countries with Catholic state religion*, there are strong differences in public and private schools depending *both on historical reasons and the degree of fiscal decentralisation*. Indeed, in Italy, private schools are only partially financed by the state and have a minor role. The opposite occurs in Spain, where schools run by the Roman Catholic Church represent a relevant share of total educational supply (about 30% of children attend private schools, the great majority of which are operated by the Roman Catholic Church) and are still now highly financed by the state. Our aim is to study - besides regional funding - the role of public/private funding in increasing school accountability.

Results obtained by estimating an education production function using PISA data for 2003 for Italian and Spanish regions provide support to the two accountability drivers. Moreover, we find evidence on the role played by a national standardised test in providing adequate incentives to improve schools' performance.

The remainder of the paper is structured as follows. Section 2 provides a brief introduction on schooling systems in Italy and Spain, along both an historical and an institutional perspective. Section 3 discusses our empirical strategy, and presents the PISA data and our estimates, adding robustness tests and a brief policy discussion. Section 4 collects short final remarks.

2. Italy and Spain: historical and institutional differences

2.1 Educational systems

While sharing a number of cultural traits characterising the Mediterranean countries, Italy and Spain show large institutional differences rooted in the historical evolution of the two countries. Limiting the analysis to schooling, one can show two important sources of variation: on the one hand, the role of private schools; on the other hand, the role of fiscal decentralisation and regional funding for schools. The present day situation is the result of different historical patterns.

The Italian school system has been heavily influenced after the unification of the country in 1861 by the Coppino Law promulgated in 1877. This law has been introduced by a left-wing government headed by Agostino Depretis, establishing two basic principles: first, free-of-charge elementary schooling for all the citizens, with municipalities responsible of maintaining and funding schools; second, compulsory education for all, with sanctions and fines for all the citizens not attending schools. Catholics strongly criticised this law with a secular taste that

excluded religion from curricula in public schools, and sent their children to private institutions run by the Catholic Church. This compulsory free-for-all public schooling system was further emphasised by the Republican Constitution in 1948. Despite the contribution of different layers of governments, decisions and funding are almost totally centralised in Italy. The Constitution also states that it is possible to establish and run private schools, but without any financial burden for the state. This is a formula that was (and still is) subject to bitter debates in the following years. Italian schooling system was subjected to different reforms, but none of them changed the two fundamental principles of a compulsory and public school centrally managed and financed. Only in the proposed constitutional reform of 2005, schooling has been thought as an exclusive responsibility of Regional government like health care (that in Italy is the most important task devolved to Regions). However, a national referendum rejected this project, so that schooling continues to be highly centralised.

The Spanish schooling system followed a different route, with the Catholic Church playing a more or less prominent role according to the specific historical period. The 1812 Constitution established that schooling was the basic responsibility of the state. However, throughout the nineteenth century, liberals and conservatives engaged in bitter battles over educational issues and the role of the Catholic Church. In particular, the Revolution of 1868 and the subsequent advent of the First Republic pointed to the importance of academic freedom and the separation of church and state in the matters of education, while in the period of the Bourbon Restoration (1874 - 1931) the conservatives sought to re-establish the Catholic Church control in education, supported by a series of *Concordats* with the Vatican that went in the direction of solidifying the relationship between the State and the Catholic Church. The new Constitution promulgated with the advent of the Second Republic in 1931 revoked the 1851 Concordat with the Vatican – which established Catholicism as the official state religion in Spain – and brought new important educational reforms,

including the call for free compulsory primary education and non-religious instruction. All these changes came to an end with the failure of the Republic and the success of the fascist forces of General Franco at the end of the Spanish Civil War in 1939. During subsequent years, education in Spain was converted into the transmission of Franco's views of Spanish Nationalism and Catholic ideology, and the power of the Catholic Church was restored with the approval of the 1952 Concordat. This agreement had important implications for education: Catholic religious instruction was to be mandatory in all schools, even in the public ones; moreover, the Catholic Church was given the right to establish their own universities. With the democratic regime following Franco's death (1975), some laws were issued aiming at reducing the role of state subsidies for education. In particular, in the 1990, there was a profound reform of the educational system (*Law on the General Organization of the Educational System* – LOGSE) that tried to take into account the new reality of Spain, which was no longer a centralized but an increasingly decentralized state, with some regions having competencies to legislate on education from the early eighties. However, the issues surrounding government subsidies for Catholic Church education had not been resolved and, at the end of the twentieth century, the government continued (and still continue) to subsidize private church-affiliated schools.

2.2. Decentralization patterns

As for fiscal decentralisation, Italy and Spain have also followed different patterns. Nowadays, Italy can be considered a centralized country with regard to taxes and revenues decided by regional governments. IMF data show that sub-central

governments in Italy (regions, provinces and municipalities) account in 2007 for around 28% of total revenue and 27% of total spending.[1]

On the contrary, in Spain, the arrival of the democracy brought a Constitution in 1978 that created the *Comunidades Autónomas* (CA) as an intermediate level of government that tried to recognize the internal heterogeneity of the country. This level of government soon took competencies closely related to the Welfare State, such as education or health, that were before in the hands of the central government. In 2005, IMF figures show that in Spain 55,3% of total spending is decided by the central government; 31,6% by regional governments, and 13,1% by local governments.

With respect to decentralization in education, the share of funding coming from regional governments is very different between Italy and Spain.[2] In Italy, only schools belonging to the two Autonomous Provinces of Trento and Bolzano are financed by regional funds,[3] while schools in the other regions are almost totally financed by the Central government. For instance, the Provincial Law n. 5/2006 disciplined the educational system in the province of Trento, by assigning full autonomy (including financial autonomy) to each school. It also introduces additional tools for evaluating at the provincial level the productivity of schools. Notice that fiscal decentralisation results in a higher share of income devoted to public education: the spending-to-GDP ratio was 6.2% in the Autonomous Province of Trento in 2002, while 4.7% in Italy.

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[1] Data from *Government Finances Statistics. Yearbook 2007*, International Monetary Fund. For the Italian case and, as a matter of classification, IMF statistics do not provide disaggregated data for each type of sub-central government.

[2] As explained in more detail in the next section, the regions we use in the empirical estimations are: Bolzano (ITA), Lombardia (ITA), Piemonte (ITA), Toscana (ITA), Trento (ITA), Veneto (ITA), Basque Country (SPA), Catalolina (SPA) and Castilla y León (SPA).

[3] Although the territories of Bolzano and Trento are administratively called Autonomous Provinces they are, *de facto*, regional governements.

In Spain regions such as Andalusia, Basque Country, Canary Islands, Catalonia, Galicia and Comunidad Valenciana received the education legislative competence between 1980 and 1983 for primary and secondary education, and between 1985 and 1987 for higher education. Navarra received both types of competencies in 1990. The remaining regions received the education competences between 1995 and 2000. In 2005, IMF figures show that in Spain 4,5% of total spending devoted to education is decided by the central government; 89,5% by regional governments, and 6,0% by local governments.

In the remainder of the paper, we exploit these institutional differences in terms of the role played by private schools and of fiscal decentralisation in order to identify the "accountability effect" played by both market forces and (regional) tax autonomy.

3. The empirical analysis

3.1. The strategy

According to the institutional differences described in the previous Section, we basically have two important sources of variation as for the impact on school accountability:

a. The first one is the degree of fiscal decentralisation, which is different within Italy, between ordinary statute regions and the Autonomous Provinces of

Trento and Bolzano; and between Italy and Spain. The degree of fiscal decentralisation is important because, as suggested, for instance, by Oates (2005) and Weingast (2009), the higher the share of funding provided by regional governments to finance services to citizens, the higher their accountability, hence the efficiency of public spending. In terms of schooling, we should expect that more decentralisation will lead to improved outcomes.

b. The second source of variation is the public/private dimension, which is different between Spain and Italy as for the role assigned to private providers of education. In particular, private schools in Spain (especially *escuelas concertadas*) are an important actor in the national education system and are consistently financed with public funds (e.g., Calero and Escardíbul, 2007), whereas private schools in Italy (both secular and religious schools) play a minor and residual role, and receive a relatively little financial support from the government. The private nature of schools is important in terms of accountability, especially in the presence of a nationally administered test. As suggested by Woessmann *et al.* (2009), external exams increase schools' accountability along several dimensions, including the enhanced monitoring of teachers and schools. This effect should be stronger the higher the share of educational costs paid by citizens. However, while external exams are available in Spain, similar evaluation exercises have not been systematically introduced so far in Italy.[10]

Starting from these premises, the disciplining effects stemming from both fiscal decentralisation and market incentives provide a ranking of different types of schools in terms of accountability:

[10] In Spain, at the end of secondary (non-complusory) education, there is a unique (global) exam for students aiming at enrolling in a university course (*selectividad*).

i. At one extreme, Italian private schools are those financed mostly with fees paid by households (i.e., they are 'private-independent' schools; e.g., Dronkers and Avram, 2009; Dronkers and Robert, 2008). In principle, then, market forces should strongly discipline them. However, this argument can be displaced by the fact that – in the absence of a national standardised test on attainment in Italy – these schools do not need to be as productive in terms of education as they should be in the presence of an external exam, just providing students with a "certificate" to enter the labour market. That private schools will provide lower quality education than public schools is not only theoretically feasible, but also somewhat consistent with available evidence (e.g., Bertola *et al.*, 2007, and Brunello and Rocco, 2008).

ii. At the other extreme, Italian public schools in ordinary statute regions are financed (almost) completely and staffed completely by the Central government. They are not subject to any evaluation program, and enjoy a very modest degree of autonomy over their budget. According to the theory, they should be the less accountable type of school.

iii. In between, we have Spanish public and private schools and Italian public schools in the Autonomous Provinces of Bolzano and Trento. Their degree of accountability should increase with the share of funding coming from the market (in the presence of nationally administered external exams) and from regional governments. Notice that Spanish private schools are mostly 'private government dependent' schools (Dronkers and Avram, 2009; Dronkers and Robert, 2008), but they receive an important share of regional funding.

Having created a ranking of different types of schools according to their accountability, our strategy is to define a set of dummy variables which basically identify each school type on the basis of the "degree of accountability", measured by both their nature (public or private) and the share of funding by regional governments. In particular, we define the dummy *DECENTR* to identify the schools funded with a high share of *regional* public funds, and the dummy *PUBLIC* to identify the public nature of school institutions. Notice that, in most of the literature on schooling, accountability is defined according to the role of standardised external exams and other devices, but the role of fiscal decentralisation is hardly mentioned. In our exercise, we build a link with the fiscal federalism literature, and control also for this variable in order to provide robust evidence on the accountability role played by the different sources of funding.

As for the econometric specification, we take a very simple route following West and Woessmann (2010) and Barankay and Lockwood (2007). Both papers consider an education production function where the dependent variable is the test score (*SCORE*), and the covariates can be grouped in regional controls, school controls, and (eventually) student controls. The general model to be estimated can be written as follows:

$$SCORE_i = \alpha + \beta_1 DECENTR_i + \beta_2 PUBLIC_i + \sum \beta_j DECENTR \times X_{ji} + \\ + \sum \beta_k PUBLIC \times X_{ki} + \sum \beta_h X_{hi} + \varepsilon_i \qquad [1]$$

where i identifies the different schools, the $\boldsymbol{X_h}$'s are a set of controls deemed to be important determinants of school outcomes (including for instance the total number of students, the share of female students, and the pupils per teacher ratio), while $\boldsymbol{X_k}$ and $\boldsymbol{X_j}$ are variables to be interacted with both *DECENTR* and *PUBLIC* in order to identify the different institutions providing education in Spain and Italy. According

to our "accountability" story, we are particularly interested in the coefficients on *DECENTR* and *PUBLIC*, and their interactions.

3.2. The data

We consider the 2003 data from the OECD Programme for International Student Assessment (PISA), a widely used survey which takes place every three years to collect information on the educational competencies of 15-years-old students in different countries (OECD, 2005a and 2005b). The 2003 wave is particularly interesting for our purposes, since it allows us to identify a number of different regions within each country. To be more precise, while usually conducted at the country level, the 2003 wave makes available for Italy and Spain information on some participating regions. In particular, we are able to identify Lombardia, Piemonte, Toscana and Veneto as ordinary statute regions, and the two Autonomous Provinces of Bolzano and Trento in Italy; the Basque Country, Catalonia and Castilla y León in Spain. In both countries, we also have a residual category of "Other Regions".

According to institutional details discussed above, we set the dummy *DECENTR* equal to one for all the Spanish regions and for the Autonomous Provinces in Italy. Regional funding of schools represents an important share of total funding in all these regions, even though there are institutional differences across regions. To catch this variation we consider both the variable *PUB_FUND*, which measure the percentage of total funding in a typical school year coming from public funding (including local, regional and central governments), and the interaction *DECENTR*×*PUB_FUND*. Notice that *PUB_FUND* allows us also to somewhat differentiate private-dependent schools from private-independent ones, and test the accountability role played by market incentives.

PISA surveys report students' performance through *plausible values*. These need to be thought as random draws from posterior distributions of students' test scores. In other words, instead of obtaining a point estimate of student ability, once collecting the raw score for each student on the number of correct answers, the distribution of student proficiency is computed, and the survey report random values from this (estimated) posterior distribution. Needless to say, this requires appropriate tools for the empirical analysis, even for descriptive statistics. We will take into account the particular nature of the data by considering the PV Stata module discussed in Lauzon (2004) and MacDonald (2008) for all our estimates.

Students' knowledge and ability (our dependent variable score in Equation [1]) is assessed along four main domains: problem solving (*PV_PROB*), mathematical literacy (*PV_MATH*), reading literacy (*PV_READ*), and scientific literacy (*PV_SCIE*). Descriptive statistics for these variables for all the schools in the sample are in Table 1-4, distinguishing also schools along the public/private dimension. Several interesting preliminary insights emerge from these tables. First, Spanish schools perform better than Italian schools along all the four domains. Second, the variance characterising Spanish schools' performance is lower than the variance characterising scores for Italian schools. Third, private schools in Spain perform consistently better than public schools, while in Italy the difference in scores between public and private schools is sizeable only for scientific literacy.

Table 1. Public and private schools performance: problem solving

Schools	Nr. obs.	Mean	SE	t-stat
All sample	789	442.56	31.89	13.87
Spain	383	479.29	3.61	132.73
Spain - public	199	462.62	8.24	56.14
Spain - private	175	498.50	11.69	42.63
Italy	406	413.35	61.41	6.73
Italy – public	380	412.46	67.02	6.15
Italy - private	25	417.74	26.83	15.57

Table 2. Public and private schools performance: mathematical literacy

Schools	Nr. obs.	Mean	SE	t-stat
All sample	789	446.29	26.24	17.01
Spain	383	482.11	3.31	145.44
Spain - public	199	467.33	7.61	61.38
Spain - private	175	499.35	10.91	45.78
Italy	406	417.81	51.70	8.08
Italy – public	380	417.81	55.90	7.47
Italy - private	25	417.37	16.90	24.70

Table 3. Public and private schools performance: reading literacy

Schools	Nr. obs.	Mean	SE	t-stat
All sample	789	448.11	30.79	14.55
Spain	383	475.78	5.64	84.43
Spain - public	199	459.92	10.41	44.19
Spain - private	175	493.84	13.81	35.77
Italy	406	426.09	55.40	7.69
Italy – public	380	424.98	60.20	7.06
Italy - private	25	431.79	27.24	15.85

Table 4. Public and private schools performance: scientific literacy

Schools	Nr. obs.	Mean	SE	t-stat
All sample	789	449.85	38.25	11.76
Spain	383	482.09	6.46	74.66
Spain - public	199	466.71	11.80	39.55
Spain - private	175	499.43	13.53	36.91
Italy	406	424.21	68.39	6.20
Italy – public	380	421.08	76.68	5.49
Italy - private	25	440.65	24.73	17.82

We also preliminary investigate the decentralisation issue, by analysing the means of test scores in the four domains along the centralization/decentralisation dimension (Table 5). Schools in regions where their funding is largely decentralised perform better along the four domains than schools in regions where funding is centralised. This is not simply the reflection of results for Spain and Italy, as we include in the decentralised regions also the two Autonomous Provinces of Trento and Bolzano.

Table 5. Performance of schools in regions where schools' funding is decentralised

Schools	Nr. obs.	Mean	SE	t-stat
	Decentralised			
PV_PROB	459	479.98	3.92	122.47
PV_MATH	459	482.71	3.69	130.69
PV_READ	459	476.63	5.98	79.65
PV_SCIE	459	482.91	6.85	70.47
	Non-decentralised			
PV_PROB	330	411.72	62.38	6.60
PV_MATH	330	416.28	52.49	7.93
PV_READ	330	424.59	56.29	7.54
PV_SCIE	330	422.60	69.46	6.08

The set of covariates include a number of variables at the school level that previous literature deems to be important: *TOT_ENROLL* measures the total number of students enrolled in each institution; *SHARE_FEM* captures the share of female students out of the total number of students; *PUP_TEACH_RATIO* is defined as the number of students per (full time equivalent) teachers (part-time teachers has been considered equivalent to ½ full time ones). We also consider potential difficulties stemming from differences in language among students. In particular, foreigners may find more difficult than natives to understand the questions in the test. The dummy *LANGUAGE* is equal to one if at least 10% of students enrolled in the school have a first language that is not the test language. (As this variable is missing for Catalan schools and Catalonia is an important region in Spain, we will run additional estimate omitting this variable). As for teachers, we also take into account the potential shortage that can hinder the capacity of schools to provide appropriate instruction. In particular, *SHORTAGE_SCIENCE*, *SHORTAGE_MATH*, and *SHORTAGE_READ* are dummy variables equal to one when schools declare that capacity to provide education is hampered 'to some extent' or 'a lot' by scarcity of qualified teachers, respectively for science, mathematics and test language. Controls for schools' location are provided by three dummy variables: *SMALL* is equal to one when the school is located in a village or a small town with less than 15,000 inhabitants; *MEDIUM* is for location in towns from 15,000 up to 100,000 inhabitants; finally, *LARGE* is for cities with more than 100,000 inhabitants. Descriptive statistics for all the variables included in the empirical analysis are collected in Appendix Table A.1.

3.3. The results

We begin our analysis by estimating a very simple model, in which the production of education is a function of 'structural characteristics' of schools only. We consider in

particular *TOT_ENROLL, SHARE_FEM, PUP_TEACH_RATIO, LANGUAGE* and the dummies for schools location. As considering the variable *LANGUAGE* automatically exclude schools in Catalonia, we then drop this variable and estimate an additional model with 'structural' variables only. Table 6 reports our estimates using *PV_MATH* as our dependent variable *SCORE*. Results are pretty much consistent across the two models. Coefficient for *TOT_ENROLL* is positive and statistically significant at the usual confidence levels: an increase of one student at the school raises the test score by about 0.04 points. Coefficient for *PUP_TEACH_RATIO* is also positive, but statistically (marginally) insignificant in Model II: one more pupil per teachers raises the test score by about 4 points. Also the share of female students exerts a positive effect on the score, but coefficient is not statistically significant. Much stronger impacts emerge when considering school location and the shortage of qualified teachers in the subject, but again coefficients are not statistically significant. Coefficient on *SHORTAGE_MATH* (significant at 15% in model II) decreases average school performance by more than 70 points. Finally, coefficient for *LANGUAGE* is not statistically significant, and we decide to drop this variable from the subsequent analysis.

We now augment the 'structural' specification by taking into account (first alternatively, and then together) variables aimed at capturing the two dimension of accountability: the public/private nature of the schools, to consider accountability generated by the 'market', and the importance of regional funding, to consider the accountability due to 'fiscal decentralisation'. We use again *PV_MATH* as an example. Results for the 'market' accountability are in Table 7. Model I augments previous specification by adding the variable *PUBLIC*, while in Model II we interact *PUBLIC* with two country dummies to take into account the institutional differences between Italy and Spain, in particular the absence in Italy of a standardised test. Estimates are substantially similar to those in Table 6: coefficients for new variables are not statistically significant at the usual confidence levels; the

only variables that apparently exert a statistically significant impact on test scores are *PUP_TEACH_RATIO* and *TOT_ENROLL*.

Model III in Table 7 consider accountability due to 'fiscal decentralisation', by adding to specification in Table 6 the variables *PUB_FUND* and the interaction term *DECENTR×PUB_FUND*. Only the coefficient on the first variable is statistically significant: *ceteris paribus*, a one percent increase in the share of public funding reduces school performance by less than one point. However, this is not so in regions where the share of regional funding is high: coefficient on *DECENTR×PUB_FUND* – even though (marginally) insignificant – is positive, meaning that performance improves for schools located in all the Spanish regions and in the Autonomous Provinces of Trento and Bolzano in Italy.

We now pool together the two drivers of accountability, by adding contemporaneously to our specification the variables catching the nature of the schools, and the degree of fiscal decentralisation in schools' financing. Results are in Table 7, Model IV and V, for *PUBLIC*, and *PUBLIC×D_ITA* and *PUBLIC×D_ESP* respectively. Coefficients for *PUP_TEACH_RATIO* and *TOT_ENROLL* are still positive and significant; also the magnitudes of the two coefficients are close to previous estimates. As for the public nature of the schools, coefficient for *PUBLIC* is positive and significant in Model IV; however, when interacting this variable with the two country dummies, we find that this positive effect is entirely due to Italian schools, whereas coefficient on *PUBLIC×D_ESP* is not statistically significant. This is likely to be due to the presence of a standardised national test only in Spain, which impact on 'market' accountability of private schools. Interestingly, coefficient for the share of public funding *PUB_FUND* is negative and significant, but when interacting this variable with the dummy for fiscally decentralised regions, the coefficient turns positive, and is statistically significant: public funding then hampers the performance of schools more when it is

centrally determined. The result provides support to the 'accountability' effect described by fiscal federalism theories.

The last step in our analysis is to further augment the education production function by adding country and region specific dummy variables, to control for common (unobserved) factors across schools in the same region/country. Results are in Table 8 for all the four different performance measures available in PISA data (problem solving *PV_PROB*, mathematical literacy *PV_MATH*, reading literacy *PV_READ*, and scientific literacy *PV_SCIE*). All our estimates tell fairly the same story. First, *PUP_TEACH_RATIO* is consistently positive and statistically significant. Also the magnitudes are similar, ranging from 3.6 additional points every one pupil more per teacher (for both *PV_MATH* and *PV_READ*) to 4.3 additional points (for *PV_SCIE*). As for other structural variables, *TOT_ENROLL* and *SHARE_FEM* are positive and significant only in the *PV_READ* equation. Second, we find consistent evidence that Italian public schools perform better than private ones, whereas performance of Spanish public schools are not statistically different from private ones. As for Italy, our estimates suggest that – *ceteris paribus* – students at public schools obtain between 58 points more (for *PV_READ*) to 76 points more (*PV_PROB*) than students at private schools. Third, the share of public funding impacts negatively on students' performances in all the four domains: a one percent increase in *PUB_FUND* reduces average school performance by about 1 point (from -0.85 for *PV_MATH* to -1.21 for *PV_PROB*). However, the share of public funding improves performances in fiscally decentralised regions, again in all domains (coefficient for *DECENTR×PUB_FUND* being marginally insignificant only in the *PV_MATH* equation). A one percent increase in *PUB_FUND* improves the test score in these regions by less than one point: from + 0.52 for *PV_MATH* to + 0.84 for *PV_PROB*. Hence, controlling for country and region fixed effects, public funding has a negative effect on students' performance, but this is less so the more important is the role of regional governments. This finding supports both the

importance of market incentives, and the accountability effect driven by fiscal decentralisation. This is more so if one looks at country and regional dummies, all statistically significant (but for Catalonia). Spanish schools (where funding of education is decentralised) perform consistently better than Italian schools: difference in coefficient is between 34 points (*PV_READ*) to 60 points (*PV_MATH*). This is evidence in favour of a disciplining role played by a standardised national test. Across Italian regions, the two Autonomous Provinces of Trento and Bolzano score better than most of the other regions. Sole exceptions are schools in Lombardia, Toscana and Veneto, that perform as good as schools in Trento and Bolzano, but only for *PV_SCIE* and *PV_PROB*.

3.4. Discussion and policy implications

Our results discussed in previous Section provide support to both the accountability drivers, market incentives on the one hand (in the presence of a standardised national test), and regional funding on the other hand. There are two possible comments to the robustness of these results. First, we do not take into account different dimensions of schools' autonomy that can be the true drivers of an improved accountability (e.g., Woessmann *et al.*, 2009). Second, previous literature on PISA data confirms the importance of the family background on students' scores (e.g., Oppedisano and Turati, 2011). Hence, our accountability explanation can hide a better family background in more fiscally decentralised regions. We explore each of these alternative explanations in turn.

In order to capture school autonomy, we control for two variables (*AUTCURR* and *AUTRES*) that are thought to increase (indirectly) accountability (Woessmann *et al.*, 2009). In particular, we consider an index of autonomy computed by the OECD to measure school autonomy in defining assessment policies, textbooks, and course contents (*AUTCURR*); and a second index of autonomy computed by the OECD to

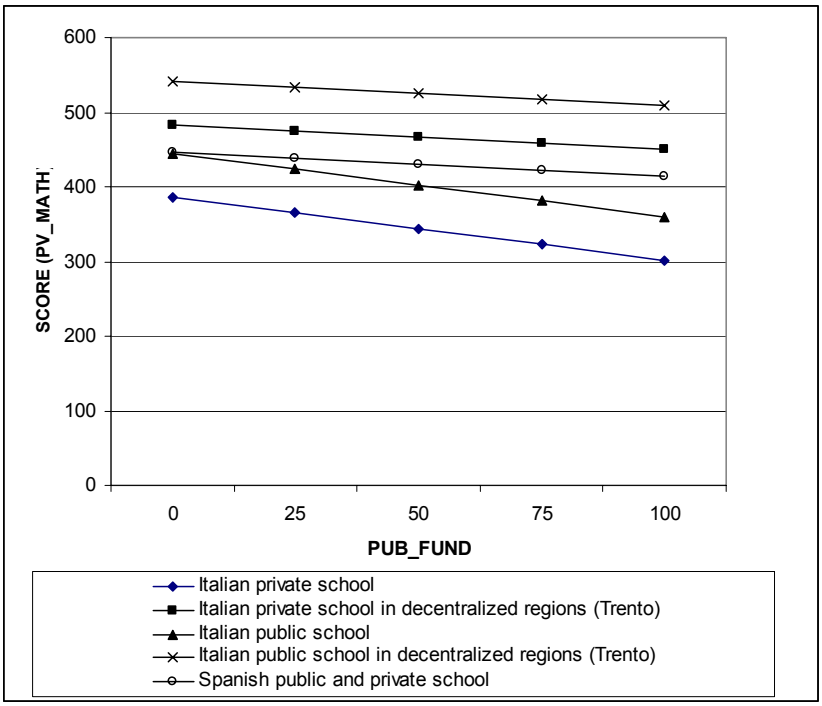
measure school autonomy in managing resources like, for instance, hiring and firing teachers, deciding budget allocations within the school, determining teachers' career (*AUTRES*). Results for models augmented also with these variables are in Table 9. Coefficients for both *AUTCURR* and *AUTRES* are never statistically significant. More importantly, all previous findings are confirmed. One main explanation is that regulation is defined at country/regional level for public as well as private schools. As we already control for fixed effects at country/regional levels, these variables do not add much to the explanatory power of our model.

Finally, in order to capture the impact of the parental background, we define from the student questionnaire two dummy variables, *FATHER_HIGH* and *MOTHER_HIGH*, to identify the students whose parents have a degree or a PhD. At the school level, these variables will identify the percentage of students with highly educated parents. As the two variables are highly collinear, we use just the one for mother education in the empirical models below. We also define an alternative variable *BACKGROUND*, which is the sum of the two variables *FATHER_HIGH* and *MOTHER_HIGH*; as results are coincident, we just include in Table 10 those with *MOTHER_HIGH*. As before, the estimates are substantially unchanged with respect to the full model: coefficient for *MOTHER_HIGH* is positive, but never statistically significant at the usual confidence levels in all the four equation. Most probably, controls for regions and school types soak up also the non random selection of institutions by different categories of students.

Overall, our results – which appear robust to model perturbations – suggest a number of thoughts on important issues in educational policy. First, decentralised schools' funding is consistently associated with a better performance with respect to centralised funding. This is emphasised by country dummies and regional dummies, but also by *PUB_FUND* and the interaction *DECENTR*×*PUB_FUND*. To the best of our knowledge, this is a novel result in the literature. If - starting from our

estimates - we compute predicted scores for different types of schools, those operating in regions where funding is decentralised perform better, as it is apparent from Figure 1. The clear ranking is independent of *PUB_FUND*: public schools in the fiscally decentralised Autonomous Province of Trento perform better than private schools in the same context; in turn, these score better than public and private schools in Spain (that are statistically indistinguishable, given that coefficient on *PUBLIC×D_ESP* is not statistically significant). This finding confirms results by Barankay and Lockwood (2007) and supports theoretical predictions of second generation theories of fiscal federalism (e.g., Oates, 2005, and Weingast, 2009): the higher the share of funding provided by regional governments to finance services to citizens, the higher their accountability, hence the efficiency of public spending. Even though our results cannot be interpreted as causal, still - in terms of policy – one should take into account that students' performance is higher where financing of schools is decentralised.

Figure 1. Predicted scores for different types of schools



Note: predicted scores computed using results in Table 8 Model I

Second, confirming the mixed evidence provided by previous literature (e.g., Dronkers and Avram, 2010a, 2010b, 2009; Dronkers and Robert, 2008), we find that the public/private nature of schools matters, but only in Italy, where public schools outperform private ones. Moreover, given the negative sign on *PUB_FUND*, private-independent schools perform better than private-dependent ones. This evidence brings about two comments: first, the presence of a standardised test at the national level is an important mechanism to improve schools' performances: controlling for the share of public funding, public and private schools are not statistically different in Spain (where such a test exists), whereas they are statistically different in Italy (where such a test does not exist). Second, our evidence that private-independent schools are better than private-dependent ones (given the negative sign for *PUB_FUND*) supports the accountability mechanism provided by the market. *Ceteris paribus*, private schools completely financed with tuition fees paid by households perform better than private schools completely financed with government funds. Again, while we cannot give a causal interpretation to this result, still public funding of private schools should be accompanied with a nationally administered standardised test, especially for this type of schools, if not for all schools as in Spain.

Finally, the importance of regional and country dummies together with other controls for the public nature of the schools suggest that institutional differences are important drivers of performance: public schools in Italy are different institutions from public schools in Spain, because they are not subject to any assessment exercise conducted at the national level, and they are financed and staffed by the national government, with limited autonomy for regional governments to effectively manage schools. At the same time, private schools in Italy are different institutions from private schools in Spain, both when considering private-dependent schools (almost absent in Italy) and when considering private-independent schools (almost absent in

Spain). As such, any generalization on the role of public and private institutions in schooling should be subject to careful scrutiny before any policy recommendations is implemented.

4. Concluding remarks

In this paper we study the disciplining role of both market forces and regional governments own resources in the provision of educational services. We exploit two different sources of variation: on the one hand, the difference between private and public schools, suggests that – in the presence of standardised national tests – private schools should be more productive than public schools, given that households pay a price to access the service. On the other hand, the difference between schools funded with regional governments own resources and schools funded by the Central government, suggests that the former should be more productive than the latter, given the accountability role played by own resources for regional governments. The historical evolution of school regulation in Italy and Spain, in particular regarding the funding of private schools run by Roman Catholic Church and the role of regional governments, created different institutions in terms of both dimensions, private funds and regional governments funds.

We take advantage of these institutional diversities to estimate the disciplining role of different sources of funds in the context of educational production function using PISA data. We provide three main results. First, decentralised schools' funding is consistently associated with a better performance with respect to centralised funding. Second, the public/private nature of schools matters, but only in Italy, where public schools outperform private ones. Moreover, private-independent schools perform better than private-dependent ones. Hence, the presence of a standardised test at the national level (available in Spain, but not in Italy) is an important mechanism to improve schools' performances. In addition, our evidence

that private-independent schools are better than private-dependent ones supports the existence of an accountability mechanism provided by the market: *ceteris paribus*, private schools completely financed with tuition fees paid by households perform better than private schools completely financed with government funds. Third, institutional differences are important drivers of performance: public and private schools in Spain and Italy are different schools. This should be taken into account when designing educational policies aimed at improving students' performance.

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Table 6. Education production function: only structural variables (*PV_MATH*)

Model I

Number of observations: 638
Average R-Squared: .2421139296921341
Plausible Values: pv1math pv2math pv3math pv4math pv5math

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	3.7376625	2.1065573	1.774299	80.352878	.0798016
tot_enrollemnt	.04284558	.01374597	3.1169561	51.693213	.00298217
share_fem	.06715021	.30721526	.21857706	81.195721	.82752799
d_shortage_math	-64.994118	48.438653	-1.3417821	82.498834	.18334822
d_small	8.0155911	15.245419	.52577046	83.577927	.60043998
d_large	5.0889271	11.658501	.43649928	83.967418	.66359487
_cons	389.94535	49.212176	7.9237575	81.343123	1.036e-11

Model II

Number of observations: 581
Average R-Squared: .2442801448424711
Plausible Values: pv1math pv2math pv3math pv4math pv5math

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	3.9951548	2.5084498	1.5926788	80.362727	.11515828
tot_enrollemnt	.03708834	.01510623	2.455169	48.992263	.01767848
share_fem	.22713242	.49129334	.46231527	80.332691	.64510499
d_shortage_math	-72.067962	50.273699	-1.4335122	82.584266	.15548677
d_small	.68638509	16.834321	.04077296	83.878382	.96757379
d_large	.32978277	14.066044	.02344531	83.912043	.98135073
d_language	2.4705935	24.976484	.09891678	82.076373	.92144553
_cons	385.50689	62.793966	6.1392345	80.840951	2.931e-08

Table 7. Education production function: accountability (*PV_MATH*)

Model I

```
Number of observations: 638
Average R-Squared: .2422018243373081
Plausible Values: pv1math pv2math pv3math pv4math pv5math
```

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	3.7730762	2.1127735	1.7858403	80.43986	.07789377
tot_enrollemnt	.04251313	.01361814	3.1218019	59.280945	.00277777
share_fem	.067067	.31070546	.21585396	81.171689	.82964308
d_shortage_math	-65.209807	48.362537	-1.3483537	82.308613	.18124339
d_small	7.9926675	15.255381	.52392447	83.645411	.60171658
d_large	5.2542993	11.518011	.45618112	83.983748	.64943723
.d_public	.97096529	10.284505	.0944105	83.927439	.92500811
_cons	389.04919	49.014929	7.9373611	82.089934	9.237e-12

Model II

```
Number of observations: 638
Average R-Squared: .2640845052784707
Plausible Values: pv1math pv2math pv3math pv4math pv5math
```

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	3.7497721	2.0966637	1.7884471	80.440622	.07746901
tot_enrollemnt	.04151417	.0129877	3.1964205	54.445372	.00231754
share_fem	.05721665	.29546902	.19364687	81.261982	.84693562
d_shortage_math	-59.268159	42.023711	-1.4103504	82.91186	.16217693
d_small	2.3077187	16.150143	.14289154	83.689236	.88671932
d_large	.23361658	14.461037	.0161549	83.511433	.98714935
d_ita_pub	-10.32962	18.336815	-.56332685	82.294902	.57474406
d_esp_pub	22.734036	24.209066	.93907118	81.026848	.35048518
_cons	393.43486	44.034485	8.9346989	82.484295	9.266e-14

Model III

```
Number of observations: 620
Average R-Squared: .2943022079249857
Plausible Values: pv1math pv2math pv3math pv4math pv5math
```

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	2.5435261	1.2092576	2.1033782	80.668453	.03854871
tot_enrollemnt	.03691146	.01343644	2.7471168	48.001159	.00844145
share_fem	-.01277847	.23312091	-.05481477	82.046329	.95641929
d_shortage_math	-39.44943	31.436185	-1.2549051	83.992373	.21299374
d_small	8.3196334	13.330438	.62410805	81.510724	.5342995
d_large	-2.2230386	13.900159	-.15992901	83.975345	.87332106
pub_fund	-.74299344	.23852716	-3.1149218	83.970247	.00251739
d_decentr_pub_fund	.53701387	.3640776	1.4749984	81.12013	.14408375
_cons	449.39884	43.874813	10.242752	81.87768	2.520e-16

Table 7. continued

Model IV

Number of observations: 620
Average R-Squared: .3173534744397504
Plausible Values: pv1math pv2math pv3math pv4math pv5math

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	3.4895943	1.5824124	2.2052369	80.736876	.03028173
tot_enrollemnt	.02787715	.01253241	2.2244045	53.589941	.03035488
share_fem	-.04628395	.23735102	-.1950021	81.915926	.84587415
d_shortage_math	-44.088236	35.093328	-1.2563139	83.633453	.21250014
d_small	8.1775275	13.228509	.61817455	81.385972	.53818643
d_large	3.4636915	10.537479	.32870208	83.999454	.74319895
d_pubblico	35.291829	14.578754	2.4207713	79.77517	.01775901
pub_fund	-1.0077861	.308395	-3.2678419	83.003888	.00157744
d_decentr_pub_fund	.64645952	.40999628	1.5767448	81.54951	.11872582
_cons	435.66652	41.941797	10.387407	82.410839	1.216e-16

Model V

Number of observations: 620
Average R-Squared: .3416477858352708
Plausible Values: pv1math pv2math pv3math pv4math pv5math

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	3.011072	1.371043	2.1961907	80.690205	.0309488
tot_enrollemnt	.02073962	.01299479	1.5959953	67.549055	.11515811
share_fem	-.03905296	.21927795	-.178098	82.239199	.85908399
d_shortage_math	-44.257313	34.484137	-1.2834108	83.682869	.20289091
d_small	7.0763986	13.265319	.53345108	81.874777	.59516658
d_large	7.5500713	10.032005	.75259845	83.741979	.45380165
d_ita_pub	73.625783	16.02734	4.5937618	33.724235	.00005829
d_esp_pub	7.022406	18.932306	.37092185	81.696346	.71165584
pub_fund	-1.3063482	.38322482	-3.4088299	81.577926	.00101613
d_decentr_pub_fund	1.2539626	.28550776	4.3920438	69.635893	.00003923
_cons	431.50937	25.251517	17.088453	83.851861	4.749e-29

Table 8. Education production function: full model

Model I: *PV_MATH*

Number of observations: 620
Average R-Squared: .9841779734024898
Plausible Values: pv1math pv2math pv3math pv4math pv5math

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	3.6020736	1.5629094	2.3047232	80.320595	.02376444
tot_enrollemnt	.01728275	.01539167	1.1228635	82.532832	.2647513
share_fem	-.02452238	.19892909	-.12327195	82.779017	.90219056
d_shortage_math	-36.802592	27.251961	-1.3504566	83.655007	.18051163
d_small	-2.0994078	15.033787	-.13964597	83.707139	.88927517
d_large	3.2710772	10.83859	.30179916	83.174035	.76355849
d_ita_pub	58.979176	25.493766	2.3134745	56.103354	.02438528
d_esp_pub	15.048772	18.775804	.8014981	81.067665	.4251864
pub_fund	-.85565219	.27986716	-3.0573512	51.319527	.00354158
d_decentr_pub_fund	.51772389	.33371392	1.5514004	62.797446	.12583131
d_esp	446.86586	24.393099	18.319356	83.934246	4.551e-31
d_ita	386.08715	22.773831	16.953105	78.931464	4.943e-28
d_veneto	74.039027	15.815895	4.681305	83.585797	.00001089
d_trento	97.926016	34.53334	2.8356949	82.889837	.00574418
d_toscana	62.599533	15.551475	4.0253116	83.998901	.00012409
d_piemonte	53.359573	15.834786	3.369769	83.928564	.00113853
d_lombardia	66.591176	18.004601	3.6985644	82.951289	.00038848
d_bolzano	77.948515	41.501553	1.8782072	81.256278	.06393975
d_castilla	19.399453	6.7504937	2.8737829	82.723349	.00515325
d_catalunya	7.6275895	6.8609394	1.1117413	83.835047	.26942746
d_basque	15.219415	7.7571151	1.9619942	81.761711	.05316557

Model II: *PV_READ*

Number of observations: 620
Average R-Squared: .9838407253958231
Plausible Values: pv1read pv2read pv3read pv4read pv5read

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	3.5823406	1.57979	2.2676056	83.651781	.02593123
tot_enrollemnt	.02728447	.01311119	2.0810065	70.296972	.04107788
share_fem	.75349841	.24492887	3.0763969	83.220452	.00283542
d_shortage_read	-46.130404	37.44863	-1.2318315	82.602546	.22150724
d_small	-1.7390608	15.143937	-.11483545	83.349239	.90885174
d_large	.83453628	18.294108	.04561776	83.988639	.9637232
d_ita_pub	58.386306	26.67395	2.1888886	83.463044	.0313981
d_esp_pub	13.958708	19.946052	.69982311	83.944908	.48597265
pub_fund	-1.0404557	.31680523	-3.2842126	83.765402	.00149381
d_decentr_pub_fund	.63039068	.31795706	1.9826283	81.464169	.05077961
d_esp	406.57774	31.677729	12.834813	79.799429	4.248e-21
d_ita	372.13287	19.709383	18.881001	83.445916	7.261e-32
d_veneto	56.867721	15.663554	3.6305759	69.204522	.00053779
d_trento	62.890436	26.640132	2.3607404	70.927505	.02099112
d_toscana	37.720174	20.194121	1.867879	69.34058	.06600499
d_piemonte	32.845734	12.827983	2.5604754	83.940101	.01224288
d_lombardia	41.688794	22.322657	1.8675552	83.82375	.065319
d_bolzano	68.441385	40.720111	1.680776	82.686519	.09658048
d_castilla	19.397138	8.1076933	2.3924362	71.854937	.01935376
d_catalunya	-3.8348691	7.3407958	-.5224051	77.676673	.60287506
d_basque	14.817734	8.2825366	1.7890333	81.010789	.07734725

Model III: *PV_SCIE*

Number of observations: 619
Average R-Squared: .98091713462349
Plausible Values: pv1scie pv2scie pv3scie pv4scie pv5scie

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	4.360654	2.3543974	1.8521316	82.033786	.06760409
tot_enrollemnt	.01528563	.02709967	.56405238	83.476347	.57423083
share_fem	.23499706	.20896492	1.1245766	83.618856	.26398634
d_shortage_science	-74.944295	53.469601	-1.4016244	83.494548	.16473391
d_small	-5.8724208	20.559621	-.28562884	83.764324	.77586754
d_large	4.6608179	16.170173	.28823551	83.5527	.77388028
d_ita_pub	69.73471	29.799039	2.3401664	24.568667	.02771086
d_esp_pub	27.551164	24.767986	1.11237	82.041999	.26922799
pub_fund	-1.1895013	.41875884	-2.8405401	69.921279	.00589479
d_decentr_pub_fund	.72662313	.41790899	1.7387114	48.118572	.08848074
d_esp	430.57395	28.720624	14.991803	76.011683	2.083e-24
d_ita	394.18814	24.012031	16.416277	74.639604	1.755e-26
d_veneto	72.982803	17.58646	4.1499429	58.820766	.00010865
d_trento	87.347997	31.723439	2.7534214	63.988188	.00766738
d_toscana	77.330893	27.704331	2.7912926	82.284321	.00652443
d_piemonte	61.009904	14.650464	4.1643667	76.150685	.0000815
d_lombardia	78.095729	19.015015	4.1070558	82.714724	.00009368
d_bolzano	71.04005	53.486698	1.3281816	81.716489	.18781584
d_castilla	19.489042	8.7106154	2.2373897	82.871586	.02794508
d_catalunya	14.413035	7.8881564	1.8271742	83.96082	.07122666
d_basque	5.8757343	8.095979	.72575958	83.787021	.47000855

Model IV: *PV_PROB*

Number of observations: 620
Average R-Squared: .9793062216805069
Plausible Values: pv1prob pv2prob pv3prob pv4prob pv5prob

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	3.8872541	1.934395	2.0095452	81.103629	.0478049
tot_enrollemnt	.01487964	.02403126	.61917845	83.009097	.53749449
share_fem	.30112607	.2284911	1.3178897	80.922996	.19125922
d_shortage_math	-50.338427	39.086092	-1.2878859	83.135305	.20135905
d_small	-2.3157905	16.877828	-.13720903	83.953626	.8911941
d_large	1.9381807	15.007723	.12914555	83.649897	.8975525
d_ita_pub	76.775955	25.834882	2.9717943	80.134157	.00390755
d_esp_pub	15.364756	22.172264	.69297193	82.858414	.49026498
sc04q01	-1.2128231	.49093332	-2.4704436	83.995373	.01551704
d_decentr_pub_fund	.84235794	.43435641	1.9393243	82.850619	.05586542
d_esp	428.34196	27.67859	15.47557	79.276491	1.139e-25
d_ita	377.80721	23.5429	16.047607	81.665856	5.643e-27
d_veneto	81.230006	27.060155	3.0018308	83.48279	.00353899
d_trento	71.318122	27.801535	2.5652584	83.301931	.01210178
d_toscana	69.511975	21.053975	3.3016081	77.651484	.00145434
d_piemonte	56.377826	20.303436	2.7767627	83.090124	.00678336
d_lombardia	55.084269	21.678928	2.5409129	83.688006	.01290203
d_bolzano	67.055158	38.409031	1.7458175	83.84509	.08450569
d_castilla	26.254551	7.8289011	3.3535423	82.256801	.00120815
d_catalunya	9.5175175	8.3558026	1.1390309	74.453847	.25834181
d_basque	17.818431	7.3999061	2.4079267	82.857528	.01826333

Table 9. The role of school autonomy

Model I: *PV_MATH*

Number of observations: 618
Average R-Squared: .9842624221624866
Plausible Values: pv1math pv2math pv3math pv4math pv5math

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	3.6970266	1.661031	2.2257421	80.161978	.02883992
tot_enrollemnt	.01620977	.01640534	.98807873	83.142271	.32598092
share_fem	-.03335279	.19331651	-.17252945	82.737588	.86344265
d_shortage_math	-36.41258	27.261268	-1.3356891	83.659269	.18527338
d_small	-2.380971	15.412288	-.15448524	83.825674	.8775985
d_large	3.0431208	10.869196	.27997663	83.206706	.78019029
d_ita_pub	58.344457	23.47324	2.4855733	48.868121	.0164044
d_esp_pub	6.4640256	18.923223	.34159221	82.57068	.73352561
pub_fund	-.90468927	.31631336	-2.8601045	65.294042	.00568128
d_decentr_pub_fund	.54333685	.34211199	1.5881842	65.756887	.11704185
autcurr	-6.32291	7.8022762	-.81039299	82.951715	.42003321
autres	-2.1348383	4.259761	-.50116388	83.463079	.61757504
d_esp	480.09937	31.479482	15.251184	83.465089	7.447e-26
d_ita	417.9137	31.207496	13.391452	78.891003	5.198e-22
d_veneto	71.546755	14.160875	5.0524246	83.758178	2.519e-06
d_trento	95.503309	31.388091	3.0426606	81.454455	.00315558
d_toscana	61.527189	14.748842	4.1716625	83.983714	.00007332
d_piemonte	51.268977	14.667867	3.495326	83.982278	.00075877
d_lombardia	65.369111	18.495958	3.5342376	83.55481	.00066942
d_bolzano	75.956381	38.603203	1.9676186	79.161329	.05261436
d_castilla	17.055003	7.887572	2.1622628	83.794347	.03344877
d_catalunya	4.346496	7.5269742	.57745594	83.949325	.56517704
d_basque	17.113087	7.7444456	2.2097239	81.927799	.02991469

Model II: *PV_READ*

Number of observations: 618
Average R-Squared: .9838813129401345
Plausible Values: pv1read pv2read pv3read pv4read pv5read

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	3.7147059	1.7173724	2.1630172	83.261873	.03340717
tot_enrollemnt	.02662497	.01252797	2.1252423	67.1096	.03725125
share_fem	.74255097	.23742477	3.1275211	83.230295	.00242922
d_shortage_read	-46.294711	37.248264	-1.2428689	82.637212	.21743114
d_small	-1.9804209	15.284446	-.129571	83.297225	.89721822
d_large	.24947692	18.101749	.01378192	83.997815	.98903665
d_ita_pub	54.333768	26.077793	2.0835263	81.928118	.0403203
d_esp_pub	5.689266	21.90621	.2597102	83.757297	.79572464
pub_fund	-1.0955236	.36671052	-2.9874342	83.921779	.00368792
d_decentr_pub_fund	.64868064	.34270411	1.89283	82.428063	.06189024
autcurr	-1.9398755	6.7618265	-.28688632	83.297431	.77491178
autres	-3.5857171	4.451349	-.80553492	83.999999	.42278549
d_esp	430.33893	32.169577	13.377202	80.909328	3.352e-22
d_ita	392.7159	31.761686	12.364454	81.107243	2.375e-20
d_veneto	55.066116	15.191397	3.6248223	67.225985	.0005572
d_trento	62.061781	26.238917	2.365257	71.015849	.02075233
d_toscana	38.407154	20.422269	1.8806506	72.652646	.06402743
d_piemonte	31.259369	13.998395	2.2330682	83.967631	.02820462
d_lombardia	40.020812	23.731482	1.6864017	83.865756	.09543531
d_bolzano	68.695732	38.009254	1.8073423	82.058655	.07437371
d_castilla	18.875245	8.0416401	2.3471885	69.8904	.02175383
d_catalunya	-6.0592248	7.5182807	-.80593223	77.485708	.42274842
d_basque	15.772673	8.3578422	1.8871705	81.883446	.06268083

Model III: *PV_SCIE*

```
Number of observations: 617
Average R-Squared: .9810120731694916
Plausible Values: pv1scie pv2scie pv3scie pv4scie pv5scie
```

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	4.4482998	2.4557142	1.8114078	82.186872	.07373099
tot_enrollemnt	.01418283	.02844705	.49856926	83.298106	.61939686
share_fem	.22618658	.20515424	1.1025196	83.855363	.27339005
d_shortage_science	-74.64353	53.159561	-1.4041412	83.544519	.16398346
d_small	-6.2166143	21.008882	-.2959041	83.714655	.76803609
d_large	4.5658293	15.98509	.2856305	83.239026	.77587072
d_ita_pub	69.888585	30.703526	2.2762398	25.712897	.03140366
d_esp_pub	19.330865	25.081836	.77071173	81.520223	.44310582
pub_fund	-1.236048	.46470471	-2.659857	79.109006	.00946041
d_decentr_pub_fund	.75217065	.44802751	1.6788493	58.353128	.09852926
autcurr	-7.1342428	9.6645401	-.73818751	82.689866	.46249043
autres	-1.7652114	5.1175253	-.34493457	83.431854	.73101162
d_esp	465.04819	38.097344	12.20684	73.63538	2.289e-19
d_ita	427.73148	40.800347	10.483526	73.595077	2.977e-16
d_veneto	70.443118	15.994564	4.4041911	51.544071	.00005381
d_trento	84.784629	29.536493	2.8705042	62.199682	.0055942
d_toscana	75.877852	25.747498	2.946999	82.769488	.00416739
d_piemonte	58.777321	14.825269	3.9646715	71.854186	.00017168
d_lombardia	77.006103	19.347919	3.9800717	82.66695	.00014727
d_bolzano	68.784934	48.818782	1.408985	80.291434	.1627007
d_castilla	16.821677	8.4466592	1.9915183	83.930323	.04967611
d_catalunya	11.15826	7.4273711	1.5023162	83.682265	.13677982
d_basque	7.2442338	8.7982421	.82337287	82.813972	.41266083

Model IV: *PV_PROB*

```
Number of observations: 618
Average R-Squared: .9793343899465329
Plausible Values: pv1prob pv2prob pv3prob pv4prob pv5prob
```

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	3.9257496	1.9650729	1.9977628	81.102698	.04909461
tot_enrollemnt	.01426946	.02472297	.57717415	83.532271	.56537418
share_fem	.2969571	.2260889	1.3134528	81.067512	.19273572
d_shortage_math	-50.054902	39.060089	-1.2814846	83.166742	.20358493
d_small	-2.4852455	17.112375	-.1452309	83.895149	.88487693
d_large	1.7980942	14.856566	.12103027	83.808912	.90395676
d_ita_pub	77.613193	29.701784	2.6130819	83.476623	.01064076
d_esp_pub	10.547408	24.670876	.42752466	83.123092	.67010274
pub_fund	-1.2364597	.52216131	-2.367965	83.998873	.02018297
d_decentr_pub_fund	.85485814	.47139772	1.8134541	83.424605	.07335785
autcurr	-5.0456397	8.1578553	-.61850075	80.400072	.53799364
autres	-.61289889	5.5598231	-.11023712	83.5161	.91248579
d_esp	450.13057	33.32537	13.507144	83.800355	9.628e-23
d_ita	399.22035	36.937194	10.808086	80.635989	2.382e-17
d_veneto	79.653668	25.505739	3.1229704	83.917164	.00245706
d_trento	69.701934	27.351322	2.5483937	83.086219	.0126621
d_toscana	68.288076	19.417654	3.5168036	77.228878	.00073486
d_piemonte	55.041032	19.295698	2.8525028	83.3462	.00546847
d_lombardia	54.59018	21.996252	2.4817946	83.732481	.01507121
d_bolzano	65.501269	35.960586	1.8214739	83.600367	.07211171
d_castilla	24.329194	7.881731	3.0867831	83.386535	.00274656
d_catalunya	6.7427122	8.5623451	.78748428	75.478887	.43346437
d_basque	18.968863	7.8524116	2.4156735	83.383801	.01789081

Table 10. The role of parental background (*PV_MATH*)

Model I: *PV_MATH*

```
Number of observations: 619
Average R-Squared: .9851934074340456
Plausible Values: pv1math pv2math pv3math pv4math pv5math
```

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	3.2490975	1.9663574	1.6523433	80.162932	.10237642
tot_enrollemnt	.01782676	.01221907	1.4589295	76.012522	.14870461
share_fem	-.04736191	.19028478	-.24890014	83.203746	.80405139
d_shortage_math	-36.123221	27.182494	-1.3289149	83.680885	.18748828
d_small	1.8368333	12.507053	.14686381	82.571552	.88359751
d_large	-.53412789	8.4757712	-.0630182	83.574722	.94990248
d_ita_pub	54.956511	32.091215	1.7125095	72.571876	.09107278
d_esp_pub	12.29068	19.01136	.64649134	80.873558	.51979171
pub_fund	-.64472039	.28453005	-2.2659132	45.039327	.02831115
d_decentr_pub_fund	.52886026	.33214714	1.5922469	62.796118	.11635105
mother_high	76.686922	72.621071	1.0559872	82.136709	.2940702
d_esp	415.90998	21.149828	19.664934	82.684938	6.398e-33
d_ita	358.73892	22.458582	15.973356	83.592688	3.980e-27
d_veneto	76.523019	14.426832	5.304215	83.998229	9.025e-07
d_trento	92.510369	38.069128	2.4300627	83.871745	.0172293
d_toscana	66.843129	22.527056	2.9672376	83.196122	.00392248
d_piemonte	45.953658	15.170667	3.0291125	83.611765	.00326227
d_lombardia	62.677575	18.057754	3.4709508	82.022505	.00082983
d_bolzano	78.45955	44.50292	1.7630203	82.564851	.0815972
d_castilla	15.116757	6.6741604	2.2649676	83.967822	.02608986
d_catalunya	8.1003207	6.403814	1.2649213	83.918699	.20940091
d_basque	12.361765	7.495156	1.6493005	81.191328	.10295016

Model II: *PV_READ*

```
Number of observations: 619
Average R-Squared: .9848212796526497
Plausible Values: pv1read pv2read pv3read pv4read pv5read
```

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	3.2516116	1.9996087	1.6261239	82.534394	.10773575
tot_enrollemnt	.02818405	.0143763	1.9604524	77.196677	.05355087
share_fem	.72919866	.24252493	3.0066956	83.460459	.00348861
d_shortage_read	-47.088276	34.463664	-1.3663166	82.868166	.17553578
d_small	2.2617018	12.499492	.1809435	83.851632	.85684856
d_large	-2.8182175	13.417814	-.21003552	83.728063	.83415021
d_ita_pub	54.568028	30.846868	1.7689974	83.941579	.08052664
d_esp_pub	11.664263	20.711763	.56317097	83.973533	.57481915
pub_fund	-.83882059	.34469331	-2.4335273	83.486969	.01708634
d_decentr_pub_fund	.64336684	.27840183	2.3109289	78.03386	.02347816
mother_high	73.793962	84.573264	.8725448	83.143627	.38542413
d_esp	376.30762	26.723719	14.081409	77.013904	5.283e-23
d_ita	346.10908	28.477478	12.153783	83.577795	3.635e-20
d_veneto	59.297965	15.129833	3.9192743	62.004418	.00022435
d_trento	57.553547	27.67903	2.0793195	77.897523	.04087846
d_toscana	41.554531	17.826805	2.331014	53.747724	.02353414
d_piemonte	25.42091	14.228571	1.7866101	82.644433	.07766758
d_lombardia	37.593056	21.864886	1.7193347	83.433851	.08926145
d_bolzano	68.953025	44.210284	1.5596603	83.495724	.12262268
d_castilla	15.256762	10.303315	1.4807625	83.686851	.1424251
d_catalunya	-3.3049064	8.0247404	-.41183967	80.837481	.68154694
d_basque	13.0052	9.2051769	1.4128136	83.879356	.16141042

Model III: *PV_SCIE*

Number of observations: 618
Average R-Squared: .9820961834824218
Plausible Values: pv1scie pv2scie pv3scie pv4scie pv5scie

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	4.0148684	2.8912067	1.388648	81.818544	.16870862
tot_enrollemnt	.01611258	.02206891	.73010311	83.973482	.4673591
share_fem	.20504609	.20003413	1.0250555	83.701633	.30829035
d_shortage_science	-79.457965	59.274993	-1.3404972	82.732381	.18375322
d_small	-1.4477607	17.142595	-.084454	83.705852	.93289714
d_large	.6411809	12.412288	.05165695	82.935821	.95892626
d_ita_pub	66.062795	32.349958	2.0421292	32.500504	.04932254
d_esp_pub	25.216393	26.488983	.95195773	82.111503	.34391226
pub_fund	-.96235535	.42463065	-2.2663351	74.087242	.02635095
d_decentr_pub_fund	.74351174	.36502608	2.0368729	34.256233	.04944961
mother_high	83.171903	81.094583	1.025616	83.983844	.30801765
d_esp	396.20057	25.957757	15.263282	81.422219	1.325e-25
d_ita	365.17691	30.887751	11.82271	77.441871	5.069e-19
d_veneto	75.169434	15.713624	4.7837107	45.407941	.00001853
d_trento	80.205632	33.238974	2.4129996	67.745765	.01853321
d_toscana	81.579677	36.607034	2.2285246	81.053275	.02861511
d_piemonte	51.939338	14.346373	3.6203811	77.184764	.0005238
d_lombardia	73.344278	18.762047	3.9091832	83.522797	.00018762
d_bolzano	71.412839	57.82918	1.2348928	82.991885	.2203552
d_castilla	14.718762	10.616439	1.3864124	83.37017	.16931755
d_catalunya	15.002072	10.643961	1.4094445	83.127818	.16243396
d_basque	3.1572878	14.186763	.22255168	82.685905	.82443327

Model IV: *PV_PROB*

Number of observations: 619
Average R-Squared: .9803061432980272
Plausible Values: pv1prob pv2prob pv3prob pv4prob pv5prob

	Coef	Std Err	t	t Param	P>|t|
pup_teach_ratio	3.5465117	2.4583663	1.4426295	80.874276	.15298675
tot_enrollemnt	.01537778	.01945058	.79060799	78.648581	.43155034
share_fem	.27925724	.22113387	1.2628424	80.784132	.2102788
d_shortage_math	-49.699023	39.99742	-1.2425557	83.024914	.21752963
d_small	1.5135498	14.316635	.10571966	83.863458	.91605724
d_large	-1.7179989	11.06853	-.15521474	83.417929	.87702699
d_ita_pub	72.912467	23.069224	3.1605947	71.896492	.00230468
d_esp_pub	12.767683	23.274274	.5485749	82.849007	.58477251
pub_fund	-1.0096347	.54285883	-1.8598475	83.269164	.06643819
d_decentr_pub_fund	.85288581	.32943237	2.5889557	74.690782	.01156549
mother_high	73.919855	98.480975	.75060036	83.956946	.45499176
d_esp	398.50043	29.855436	13.347667	79.081407	5.937e-22
d_ita	351.4499	31.692735	11.089289	83.186186	4.524e-18
d_veneto	83.614129	24.263286	3.4461173	83.994869	.00089043
d_trento	66.101629	28.697964	2.303356	83.97781	.02373059
d_toscana	73.595437	29.03609	2.5346194	82.989943	.013135
d_piemonte	49.231363	19.72824	2.4954767	83.773593	.01454072
d_lombardia	51.301523	21.304745	2.4079858	83.943119	.01823125
d_bolzano	67.558579	40.990398	1.6481562	83.984964	.10305693
d_castilla	22.115689	10.061677	2.1980123	83.46719	.03071735
d_catalunya	9.9727911	8.6056365	1.1588673	75.93565	.25014167
d_basque	15.407697	11.737787	1.3126577	83.453985	.19289681

Appendix Table A.1. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
pup_teach_ra	648	11.01765	5.685349	1.37931	70
tot_enrollmt	745	643.9638	404.5179	26	2819
share_fem	745	50.1802	20.48196	0	100
d_shortage_m	767	.1694915	.3754303	0	1
d_small	779	.2439024	.4297105	0	1
d_large	779	.322208	.4676224	0	1
d_pubblico	779	.7432606	.437115	0	1
d_ita_pub	779	.4878049	.5001724	0	1
d_esp_pub	779	.2554557	.4363973	0	1
pub_fun	750	78.71044	23.859	0	100
d_decentr_fu	750	48.9528	44.4882	0	100
d_esp	789	.4854246	.5001045	0	1
d_ita	789	.5145754	.5001045	0	1
d_veneto	789	.0659062	.2482755	0	1
d_trento	789	.0418251	.2003163	0	1
d_toscana	789	.0659062	.2482755	0	1
d_piemonte	789	.0722433	.2590546	0	1
d_lombardia	789	.0659062	.2482755	0	1
d_bolzano	789	.0544994	.2271444	0	1
d_castilla	789	.0646388	.2460434	0	1
d_catalunya	789	.0633714	.2437842	0	1
d_basque	789	.1787072	.38335	0	1
autcurr	773	3.483829	.7524122	1	4
autres	773	2.165589	1.491255	0	6