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EFFICIENCY OF JUNIOR HIGH SCHOOLS AND THE ROLE OF PROPRIETARY STRUCTURE[#]

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Abstract *In this paper we deal with the measurement of efficiency in the Italian school industry. We analyze a sample of 497 schools located in Piemonte, a region in the North-Western part of the country, distinguishing between public, private for-profit and private non-profit schools. We provide robust estimates of efficiency scores, using the two most widely known techniques in applied works, namely Data Envelopment Analysis (DEA) and Stochastic Frontiers (SF). Our second stage analysis suggests that proprietary structure matters in explaining efficiency. Nonprofit schools are more efficient than public ones, whereas for-profit counterparts are outperformed by public producers. Foreign and disabled students affects negatively efficiency, raising concerns for cream-skimming practices among private producers. Finally, school size is another important determinant of efficiency; in particular, the higher the number of students, the higher the level of efficiency. Policy implications call for a revision of the actual system of public funding in Italy.*

J.E.L. Codes: I20, D24, L31

Keywords: public and private schools; efficiency estimation; nonprofit organizations

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1. Introduction

The organization of the compulsory school system in western countries has been the subject of a widespread policy discussion over the last years. In Italy, recent reforms have been undertaken to increase the effectiveness and the efficiency of the – mostly public – system of compulsory education. Critics of the Italian reform process – both scholars and politicians - emphasized that higher benefits (in terms of efficiency and effectiveness of the school system) could be gained getting rid of the *de facto* state monopoly of education. State monopoly could be dismantled allowing students (and their parents) freedom to choose the school they prefer (public or private) and introducing real competition between public and private schools thanks to public subsidies (a voucher system) to students attending private schools. In Italy, private provision of education is free but only a limited number of students attend private schools because of their cost, compared with public education provided free of charge.

While the debate over "freedom of choice" and competition in the school system is now becoming a crucial political issue, very little research has been undertaken in Italy to measure the impact on students performance of alternative systems of education provision. With this paper we try to fill, at least partially, this gap. The aim of the paper is twofold. First of all we want to measure technical efficiency of junior high schools located in the Italian northern region of Piemonte, a large and highly populated area where about six million people live. To the best of our knowledge, this is the first attempt to estimate technical efficiency of schools using Italian data. Our results are quite interesting: in fact, efficiency estimates are robust to different techniques and model specifications. Secondly, we want to explain what lies behind differences in technical efficiency. According to classic results in the literature, these differences could be determined by the proprietary structure (public, nonprofit or for profit) of the school and by the number and the characteristics of the students enrolled. For instance, we expect an inverse correlation between efficiency and the number of foreign and disadvantaged students attending schools because of possible lower performance of the foreign students and higher need of teachers for the disadvantaged ones. As far as the number of students is concerned, we may expect a direct correlation between efficiency and the size of schools because of the decreasing impact of fixed costs. Nonetheless, the literature shows mixed results in this respect. We do not have any *a priori* hypothesis concerning the impact of the proprietary structures on technical efficiency. In fact, several reasons may explain the superiority of public, nonprofit or for profit organizations in this respect. For example, theoretical results emphasize the role of the non-distribution-of-profit constraint (NDC) in generating incentives in nonprofit organizations. On the one hand, it is often assumed that the NDC reduces the incentive to exploit under-informed consumers providing services of lower quality to increase profits; of course, this increases efficiency. On the other hand, the NDC may reduce the incentive for managers to exercise effort and control costs; hence, it reduces efficiency. Our empirical analysis could therefore be useful to verify the hypothesis (implicit in the Italian political debate) that private (both for-profit and not-for-profit) schools are more efficient than public ones.

In fact, our findings show that proprietary structures do matter. Private nonprofit schools appear to be more efficient than public ones; on the contrary, private for-profit schools are less efficient that their public counterparts.

The structure of the paper is the following. In section 2 we briefly describe the Italian system of compulsory education. Our sample is described in section 3.1, while in section 3.2 we specify the different models and techniques (DEA and stochastic frontiers) used to estimate technical efficiency. Section 3.3 reports our findings on efficiency scores of junior high schools in Piemonte. We analyze the impact of different proprietary structures on technical efficiency of schools in section 4. Finally, section 5 provides some first interpretations of our results and suggests some policy implications.

2. The Italian school industry

Following recent reforms that have been target of much criticism, the Italian system of compulsory education is now undergoing major changes that will most likely influence its performance and efficiency in the near future. Nonetheless, since data used in this paper refer to 1998, it is useful to describe the characteristic of the Italian system of education in the late nineties. In 1998, education was compulsory for all Italian children from age 6 to 14. During their 8 years long career of compulsory education, students were required to attend primary (elementary) schools from age 6 to 10 (grades 1 to 5) and junior high schools from age 11 to 14 (grades 6 to 8). In 1999 a new law extended compulsory education to the age of 15.

As far as provision of educational services is concerned, state-run schools played a major role. In fact, in 1996 (latest figure available), 92% of the Italian students from age 6 to 10 attended a state run primary school while, in 1997, 96% of students from age 11 to 14 attended a state run junior high school[1]. Therefore, private schools, most of them nonprofit institutions run by religious orders, played a modest and marginal role in the Italian system of education. The only exception is represented by nursery schools (pupils from age 3 to 5) where public schools were in short supply and private schools enrolled about 65% of all students; about two third of them attended a school run by a religious order.

In 1998, public schools were still considered as local branches of the central administration; therefore, they did not enjoy any degree of autonomy or self-government as far as budget or management was concerned. Public schools were funded by a complex mixture of funds coming from both the central and local governments. While the central government took care of running costs and the cost of teaching personnel, local governments bear the expenses for building maintenance; non teaching personnel was funded by a complex blend of central and local public funds. In 1999, a new law recognized some degree of autonomy to the Italian public schools; according to the new law, each school will get legal personality and higher freedom to organize its supply of services and to innovate teaching techniques and curricula. Nonetheless, public schools will not be free to hire teachers and non teaching personnel. In fact, teachers working in public schools are public employees hired in nationwide contests; their wages - established at the national level and directly disbursed to individuals by the central administration – do not differ in relation with individual skills or effort, but only with "seniority". Moreover, regulation allows for the minimum and maximum ratio between teaching personnel and students. As a consequence, one would not expect great

[1] Data referring to senior high schools are not very different, given that in 1997 about 93% of the Italian students attended a senior high school run by the state.

variations in the cost structure of public schools. However, within the system of public compulsory education, students and their families enjoy some degree of choice. In fact, the Italian system of public compulsory education is quite close to what Cohn (1997) called a "public schools choice model" were students are allowed to attend any public school, regardless of attendance zone or district lines. Compulsory education is free for all students attending public schools.

Students and their families can also opt out for private schools. However, while public schools are free of charge, attendance of a private school requires direct payment of fees and charges with (limited) fiscal deductibility. In fact, although private education is guaranteed by the Italian constitution, private school get very little funding either from the state or local authorities, both directly and indirectly. High direct cost is, most likely, the primary reason explaining the limited attendance of private schools in Italy. Private schools are free to organize as they like as far as curricula and teachers are concerned. Nonetheless, only schools following strict national regulations (including number, skills and wages of teachers, availability of building, free access of students, democratic governing structure) can be considered as part of the national system of education and have their degrees certified and recognized by the state. A certified degree is a necessary condition to enter higher levels of public education and to gain access to public jobs. As a consequence of this strict system of regulation one may expect that differences in cost and efficiency between public and private schools should not be very relevant. In the remaining of the paper we concentrate on technical efficiency, and we compare public and private schools (both for-profit and not-for-profit) to understand how proprietary structure affects schools efficiency.

3. The estimation of efficiency

In his widely quoted survey of the literature on school efficiency, Hanushek (1986) suggests a somewhat negative result, observing that "there appears to be no strong or systematic relationship between school expenditures and student performance", whereas "family background is clearly very important in explaining differences in achievement"; intuitively, better educated and wealthier parents have children that perform better on average. Of course, as parental background cannot be managed by schools, there appear to be no easy policy recommendations in order to improve efficiency. However, when one compare public and private schools, Hanushek notes that private schools outperform public ones. Two basic criticism relate to this finding. First, as family background is important in determining efficiency, one can argue that private schools superior efficiency simply reflect a bias in student composition: better educated and wealthier parents prefer to enroll their children in private schools. Second, it might well be that the distinction between public and private schools (i.e. the difference in terms of proprietary structure) hides other most important and structural differences (e.g. a systematic diversity in teaching staff). As Hanushek puts it, "in this area, the evidence is very incomplete".

Theoretical literature often argues that public schools are not provided with incentives toward efficiency, whereas profit maximization constitute the primary reason why for-profit private schools should pursue efficiency. As nonprofit producers are concerned, the non-distribution-of-profit constraint (NDC) constitute a rationale for both higher and lower efficiency with respect to for-profit counterparts. On the one hand, in the market of educational services, where informational asymmetries play a crucial role, the NDC might increase efficiency by increasing trust between producers and consumers. On the other hand, the NDC attenuates property rights and leaves managers room to increase opportunistic behavior. Unfortunately, empirical papers do not seem to distinguish between private for-profit and private nonprofit schools, so that the question remain unsolved.

3.1. Data description

In this paper we contribute to the public versus private school efficiency debate by considering a sample of Italian schools. In particular, our full sample consists of 663 junior high schools (grades 6 to 8) in Piemonte, an Italian region located in the north-western part of the country. Sample year is 1998 and data are cross-section, aggregated at the school level. We consider public and private schools, distinguishing between private for-profit and private nonprofit ones. This allows us to fully account for the effect of proprietary structure on schools' efficiency.

No data is available neither about the "quality" of the educational services (the output) provided by the schools belonging to our sample nor about the "quality" of inputs used in the production process. As a consequence, we model the production technology using a simple multi-input–single-output production function without controlling for quality. In this framework, schools are viewed as producers that seek to maximize the number of graduate students using the minimum required amount of resources. This objective function can be thought as a minimum condition for all the different schools and can encompass profit maximization for for-profit schools and welfare maximization for both nonprofit and public schools. Our general model can be represented by equation (1):

(1) $G = f(T, TD, A, S, Z)$

where G represents the number of graduates in the final examination; T the number of teachers, TD the number of teachers taking care specifically of disabled and disadvantaged students, A the number of employees with administrative duties, S the number of other non-teaching personnel and Z a vector of environmental variables that might influence schools production, e.g. cultural background and income (defined later in this paragraph).

As far as the output variable is concerned, one should notice that in Italy all students take the same final graduation exam, regardless of the school - public or private - attended; failures are negligible. Even if individuals passing their final graduation exam get scored, score results are not available. Score results can be interpreted as a proxy for the "quality" of educational services produced. Therefore, we could not measure scores on a continuos scale, but only on a "fail" or "pass" basis. In this respect, our model is quite different from those (e.g. Deller and Rudnicki, 1993; Ruggiero, 1996; Grosskopf et al., 1997) considering students' scores obtained in standardized tests as output variables. Nonetheless it is very close to the model used by Kirjavainen and Loikkanen (1998), who consider both the number of student who pass their grade and the number of graduates in matriculation examination as output variables in their analysis of Finnish senior secondary schools. Of course, both measures are imperfect proxies of individual students' achievements. However, considering the sample of Italian junior high schools, our output measure can be interpreted as a reliable proxy of students' attainments. In fact, the junior high school degree represents a *minimum* requirement to access the unskilled labor market, that in Italy accounts for more than half of total jobs available.

As far as input variables are concerned, our inputs closely mirrors those normally used in empirical analysis of educational services production functions. In this study we consider teachers as an essential input. Therefore, following economic theory, we removed from our sample all schools that didn't employ at least one teacher. As a consequence, the sample we used to run estimate consists of 497 schools out of the total 663.

Table 1 provides some descriptive statistics, distinguishing between public producers and private ones. Public schools represent the vast majority of the sample (423 producers). Among private providers, 61 are nonprofit schools, while just 13 are for-profit firms. Nonprofit schools are mainly run by religious orders, whereas for-profit schools are represented by secular organizations. On average, public schools enroll more students than private ones. The number of disabled and foreign students is larger for public schools than for private nonprofit ones, whereas private for-profit producers provide their services to more foreign students than their public counterparts. Data seem to suggest the existence of "cream skimming": private nonprofit producers enroll only the least problematic students. Nonprofit providers also show more students per teacher than public and private for-profit schools; this may suggests a better use of resources compared with their competitors or, at the opposite, lower quality of the education process.

Table 1. Descriptive statistics

	All sample (497)		Public (423)		Nonprofit (61)		For-profit (13)	
Variables	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*
Students	174.2	114.2	190.4	114.1	89.9	57.6	42.6	22.2
Disabled	4.5	4.7	5.3	4.7	0.04	0.2	0.2	0.5
Foreign	3.8	5.8	4.3	5.8	0.3	0.7	4.9	11.7
Graduates	59.5	40.1	65.0	40.2	31.6	20.1	12.9	6.9
Teachers	27.4	15.9	30.2	15.5	11.4	3.4	9.8	2.4
Teach. for disabled	2.7	2.9	3.2	2.9	0.03	0.1	0.0	0.0
Administ. staff	2.3	1.6	2.4	1.6	1.7	1.8	1.7	1.0
Non-teach staff	5.3	3.1	5.9	2.8	1.5	1.6	0.9	1.3
Stu/teach ratio	6.56	2.58	6.53	2.50	7.2	3.0	4.2	1.7

3.2 Model specification

In order to obtain robust estimates of efficiency scores, we use two different methodologies of estimation and specify two different models. The environmental variables Z define the only difference between the two models. Model 1 includes a proxy variable for parental educational background, represented by the share of persons with a BA degree out of the total population living in the school neighborhood . We do expect a positive influence of this variable on educational attainments. Model 2 considers the total number of bank branches active in the school neighborhood as a proxy of population income and wealth. Again, we expect income and wealth to have a positive impact on the output of the education process. We decided to consider parental background and population income separately because of the possible correlation between the two variables. However, it is still debated whether the causality goes from growth (i.e. income) to schooling (i.e. parental background) or the other way round (e.g. Bils and Klenow, 2000).

We used the two most common methodologies applied in the literature to estimate our models. In particular, we first estimated our production functions using the Data Envelopment Analysis (DEA) methodology introduced by Banker et al. (1984). DEA is a linear programming technique that does not require the specification of the function f(.) in equation (1) and it is usually labeled as a non-parametric methodology. However, classic DEA models do not allow researchers to distinguish between statistical noise and inefficiency; in this sense, DEA estimate a *deterministic* frontier. Of course, this implies that DEA is very sensitive to the presence of outliers in the data. Banker (1993) provided DEA with a statistical foundation, by showing that it offers maximum likelihood and consistent estimators under very mild conditions, when modeling multi-input-single-output production functions. As we do not have any a priori assumption, we specify the production function either with constant returns to scale (CRS) or with variable returns to scale (VRS). From equation (1), DEA frontier estimators accounting for VRS can be written as (e.g. Banker, 1993):

$$(2)\ G^* = f^*(T, TD, A, S, Z) = \max\left\{ G \,\middle|\, G = \sum_j \lambda_j G_j,\ \sum_j \lambda_j X_j \le X_0,\ \sum_j \lambda_j = 1,\ \lambda_j \ge 0 \right\}$$

where **X**=(T, TD, A, S, Z) represents the input vector and the λ's are the optimal weights to be determined to define the "best practice" deterministic DEA frontier. The linear programming model that accounts for CRS can be obtained from equation (2) by simply dropping the constraint $\sum_j \lambda_j = 1$.

We then estimated our models following the methodology introduced by Aigner et al. (1977). Differently from DEA, the stochastic frontier (SF) technique requires the specification of function f(.) in equation (1); in this respect, SF represents a parametric methodology for efficiency estimation. In particular, we specify our production functions as Cobb-Douglas stochastic production frontiers:

$$(3)\ G = C * T^{\beta 1} * TD^{\beta 2} * A^{\beta 3} * S^{\beta 4} * Z^{\beta 5} * E$$

where C measures the level of technology in the industry; E is a composed error term that takes into account both white noise (v) and economic inefficiency of firms (u); the remaining variables are defined as earlier. The specification of the composed error term E clearly identifies another striking difference between DEA and SF, since SF estimate a *stochastic* frontier. Starting from equation (3) and taking logs, we get the following specification:

$$(4)\ g = c + \beta_1 t + \beta_2 td + \beta_3 a + \beta_4 s + \beta_5 z + e$$

where lower case letters represent logs. MLE estimators of the model are presented in table 2. We assume that inefficiency is distributed as a half-normal random variable. As usual in stochastic frontier models, λ represents the ratio between standard deviation of the two random variables collected in the error term, respectively inefficiency and statistical noise.

Table 2. Regression results

Variables	Model 1	Model 2
Constant	1.167 (6.358) ***	1.652 (16.458) ***
Teachers	0.734 (15.817) ***	0.708 (16.366) ***
Teachers for disabled	0.077 (1.935) *	0.102 (2.732) ***
Administrative staff	0.058 (1.377)	0.054 (1.390)
Other non teaching staff	0.079 (2.091) **	0.068 (1.822) *
% population holding a B.A.	0.106 (3.498) ***	-
Nr. bank branches	-	0.064 (5.732) ***
Nr. Observations	497	497
Log-L	-297.5	-284.4
λ	3.127 (7.520) ***	3.512 (7.832) ***
LR-test (§)	1.704	0.0046

Asymptotic t-ratios in parentheses; lev. of significance: 1% ***, 5% **, 10% *.
(§) Test the hypothesis of CRS in educational services production function; critical values $\chi^2(1)$.

Almost all of the coefficients show the expected sign and are statistically significant. Teachers represent the input that gives the highest contribution to the production of educational services, whereas administrative staff seems not to affect the provision of education. Both environmental variables (parental background and income) affect the production process positively. Unfortunately, we have no further data to analyze the relationship between growth and education more in depth. However, our findings strongly suggest that the two variables play the same role and are somewhat correlated. Estimated coefficients in table 2 evidence the hypothesis of constant returns to scale in both models. Hence, we test the null hypothesis H_0: $\sum_{j=1,\dots,5} \beta_j = 1$ against the alternative H_1: $\sum_{j=1,\ldots,5} \beta_j \neq 1$ using a Likelihood Ratio test. As reported in table 2, we found no evidence to reject H_0 at conventional significance levels.

3.3. Empirical findings on efficiency scores

DEA and SF provides estimates of efficiency scores for each school in the sample. Estimates of technical efficiency for the two models and the two different methodologies are reported in table 3. As expected, mean efficiency is higher in the case of SF estimators than DEA estimators. In fact, stochastic frontier models distinguish inefficiency from statistical noise, while deterministic frontier models do not. SF estimators are defined as in Jondrow et al. (1982); they represent the conditional expectation of inefficiency u given the observed error term e. As shown by Waldman (1984), E[u|e] provides unbiased but inconsistent estimators of inefficiency. DEA mean efficiency ranges from 0.34 in the case of CRS to 0.42 when considering VRS with model 1 and 0.51 with model 2. Mean efficiency determined with SF methodology is 0.63 in both models. Interestingly, different types of proprietary structure show different results. On the one hand, mean efficiency for the sub-sample of public schools closely mirrors the results obtained for the whole sample. On the other hand, mean efficiency is systematically higher with respect to the entire sample when considering the sub-sample of not-for-profit schools, while it is generally lower looking at the sub-sample of for-profit schools.

Table 3. Efficiency estimators

Models	**All sample (497)**		**Public (423)**		**Nonprofit (61)**		**For-profit (13)**	
	Mean	*Std. Dev.*	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*
DEA 1 CRS	0.34	0.17	0.34	0.16	0.35	0.23	0.17	0.08
DEA 1 VRS	0.42	0.19	0.41	0.18	0.52	0.26	0.50	0.25
DEA 2 CRS	0.34	0.17	0.34	0.15	0.37	0.24	0.18	0.10
DEA 2 VRS	0.51	0.26	0.50	0.26	0.54	0.27	0.52	0.29
SF 1	0.63	0.18	0.63	0.17	0.65	0.20	0.40	0.18
SF 2	0.63	0.18	0.64	0.17	0.64	0.20	0.39	0.19

Table 4 shows the correlation coefficients between different estimators calculated considering different model specifications. Correlation between estimators obtained with the same methodology range from 0.982 (SF) to 0.549 (DEA VRS). The results suggest that the ranking of schools in terms of efficiency seems not to be affected by small changes in model specification (e.g. the environmental variables). Even the nature of returns to scale does not seem to affect the results in DEA frontiers. In fact, correlation between CRS and VRS DEA estimators is 0.742 in the case of model 1 and 0.615 in the case of model 2. Considering the nature of returns to scale, efficiency estimators obtained using either SF or DEA appear to be fairly robust as well.[2] In particular, correlation range from 0.702 (model 1 DEA CRS and model 1 SF) to 0.611 (model 2 DEA CRS and model 1 SF). As should be expected, correlation between estimators obtained with different methodologies are much lower when one considers DEA models with variable returns to scale.

Table 4. Correlation among different estimators

	DEA 1 CRS	DEA 1 VRS	DEA 2 CRS	DEA 2 VRS	SF 1	SF 2
DEA 1 CRS	1	0.742	0.624	0.314	0.702	0.693
DEA 1 VRS		1	0.468	0.549	0.470	0.447
DEA 2 CRS			1	0.615	0.611	0.673
DEA 2 VRS				1	0.202	0.261
SF 1					1	0.982
SF 2						1

4. What causes efficiency: a second stage analysis

Robustness of our efficiency scores estimators encourages a second stage analysis on the determinants of efficiency. Since we want to analyze the impact of proprietary structure of schools on technical efficiency (EFF), we start our analysis by defining the dummy variable PRIVATE, that takes value 1 when the i-th school is private (either nonprofit or for-profit) and value 0 otherwise. Previous empirical papers show mixed evidence on the role played by a private proprietary structure on efficiency. For instance, Kirjavainen and Loikkanen (1998) find that “somewhat surprisingly, private schools are less efficient than public schools”, whereas Hanushek (1986) seems to suggest that private schools perform better than public schools. In order to control for

[2] When we estimate our models with MLE, we found no evidence to reject the hypothesis of constant returns to scale.

other determinants of schools' efficiency, we consider in our second stage analysis also school size (as measured by the number of students N) and the number of disabled (D) and foreign (F) students. We do not have any clear *a priori* expectation on the school size variable: Kirjavainen and Loikkanen (1998) find that school size is insignificant in explaining efficiency; Deller and Rudnicki (1993) show that "increasing school size may be a hindrance to student performance"; finally, standard microeconomic arguments would suggest a positive effect of increasing size (at least up to a certain point) in the presence of fixed costs. In this respect, school size could influence efficiency in a non linear fashion; hence, we test for a quadratic relation including the number of students squared (N^2) among our regressors. On the other hand, the number of disabled and foreign students should negatively affect efficiency, as it should be more difficult for a disabled (or a foreign) to get her degree. Our general model estimating the causes of efficiency can be represented as follows:

(5)

$$EFF_j = \gamma_0 + \gamma_1 PRIVATE + \gamma_2 N + \gamma_3 N^2 + \gamma_4 D + \gamma_5 F + \varepsilon; \quad j = DEA1, DEA2, SF1, SF2$$

Efficiency scores estimators derived using either DEA CRS or SF represent our dependent variables. We estimate the four separate models using O.L.S.[3] Regression estimates are in table 5.

Empirical findings suggest that the proprietary structure does not affect efficiency. In this sense, public and private schools do not seem to perform differently. However, when (only in one case) the coefficient γ_1 is statistically significant, the dummy variable PRIVATE shows a positive effect on efficiency scores. School's size does matter: the higher the number of students, the more efficient is the school. Interestingly, this relationship is nonlinear: efficiency rises with school size, but at a decreasing rate. As expected, the number of disabled and foreign students affects efficiency negatively.

[3] Tobit estimates produced fairly similar results and are not included.

Table 5. Second stage analysis (eq. 5)

Variables	Mod. 1 DEA	Mod. 2 DEA	Mod. 1 SF	Mod. 2 SF
Constant	0.191 (7.963) ***	0.302 (12.781)***	0.420 (18.355) ***	0.428 (18.492) ***
PRIVATE	0.034 (1.274)	-0.022 (-0.762)	0.059 (2.607) ***	0.035 (1.490)
N	0.001 (6.138) ***	0.0009 (4.092) ***	0.001 (10.009) ***	0.002 (10.055) ***
N^2	-0.000001 (-2.972)***	-0.000001 (-3.649) ***	-0.000002 (-6.124) ***	-0.000002 (-6.419) ***
D	-0.007 (-4.386) ***	-0.008 (-5.550) ***	-0.007 (-4.789) ***	-0.008 (-4.822) ***
F	-0.003 (-3.967) ***	-0.004 (-5.218) ***	-0.003 (-2.659) ***	-0.004 (-3.439)***
Nr. Observations	497	497	497	497
Adj. R^2	0.18	0.07	0.30	0.28
F-test	23.53	8.84	43.62	39.55

Source: our calculations. OLS. SE corrected for heteroskedasticity using the White procedure. T-test in parentheses; lev. of significance: 1% ***, 5% **, 10% *.

We further explore the issue of proprietary structure by splitting our variable PRIVATE in two different dummies, namely NPO and FPO, that takes value 1 respectively when the i-th school is a nonprofit organization or a for-profit firm and value 0 otherwise. In fact, simply opposing private schools to public schools could veil very different behaviors within private producers. Hence, we estimate the new model in (6) by O.L.S.:

(6)

$$EFF_j = \delta_0 + \delta_1 NPO + \delta_2 FPO + \delta_3 N + \delta_4 N^2 + \delta_5 D + \delta_6 F + \varepsilon; \quad j = DEA1, DEA2, SF1, SF2$$

Results reported in table 6 are robust among the four regressions. Estimated coefficients are statistically significant and signs are fairly stable to variations in the dependent variable. Differently from estimates of model in (5) - where we considered one single dummy variable (PRIVATE) - proprietary structure now does matter. Efficiency seems to be affected in two opposite directions: nonprofit schools seem to be more efficient than public ones, while for-profit schools are more inefficient.

One possible interpretation of these results relies on the different roles the two kinds of schools might play in the market for educational services. Suppose we have high talented and low talented students, with the former interested in school’s selectivity and the latter preferring a less challenging environment. Public educational services should then be designed so as to account for both types of students. Nonprofit schools could compete with public schools to attract the most talented students, offering better quality services or increasing selectivity. Indeed, the "cream skimming" approach of nonprofit schools that was observed earlier in the paper could be interpreted as the result of this competition between private nonprofit and public schools. On the other hand, for-profit schools could deliberately attract *less* talented students, by offering a less competitive environment. This behavior implies a sort of monopoly for less talented students and could explain the lack of efficiency that characterizes for-profit schools. However, since we cannot control for output quality, we cannot reject a very different interpretation. Nonprofit schools may simply use a lower amount of inputs (when compared to public schools) and therefore produce output of different (lower) quality. Given the nature of our final score tests (that does not allow to measure scores on a continuous scale) this lower quality may be mistaken as higher efficiency.

As for other determinants of efficiency, results does not change. The size of school still matters: in fact efficiency rises, even at a decreasing rate, as the number of students increases. As expected, the presence of disadvantaged students, either disabled or foreign, reduces schools efficiency and shows a clear efficiency–equity trade-off.

Table 6. Second stage analysis (eq. 6)

Variables	**Mod. 1 DEA**	**Mod. 2 DEA**	**Mod. 1 MLE**	**Mod. 2 MLE**
Constant	0.196 (8.184)***	0.308 (13.168)***	0.428 (18.766)***	0.436 (18.902)***
NPO	0.053 (1.805)*	0.0006 (0.020)	0.088 (3.859)***	0.062 (2.636)***
FPO	-0.064 (-2.296)**	-0.138 (-4.320)***	-0.088 (-1.885)*	-0.106 (-2.148)**
N	0.001 (5.773)***	0.0008 (3.737)***	0.001 (9.432)***	0.001 (9.542)***
N^2	-0.000001 (-2.663)***	-0.000001 (-3.324)***	-0.000001 (-4.705)***	-0.000001 (-5.958)***
D	-0.0069 (-4.335)***	-0.008 (-5.514)***	-0.007 (-4.705)***	-0.007 (-4.756)***
F	-0.003 (-3.426)***	-0.003 (-4.598)***	-0.001 (-2.039)***	-0.002 (-2.814)***
Nr. Observations	497	497	497	497
Adj. R^2	0.19	0.08	0.32	0.29
F-test	20.80	8.77	39.98	35.94

Source: our calculations. OLS. SE corrected for heteroskedasticity using the White procedure. T-test in parentheses; lev. of significance: 1% ***, 5% **, 10% *.

5. Some policy conclusions

In this paper we provide a first attempt to measure the efficiency of the Italian school system. We also investigate the role of private producers in the market for educational services. The results of our analyses may shed some light on the policy debate about the future of the Italian school system.

First of all, it is worth separating the issue of *funding* the educational system from the one – related but different – of *providing* educational services. From a theoretical point of view, at least three reasons justify public funding of the school system. A primary rationale to support public funding is that education produces positive externalities in several respect (e.g. Barr, 1998). In fact, education could increase one's productivity and therefore her future wages and tax payments; moreover, education could increase not only someone's productivity, but also contributes to the productivity of others. Furthermore, schools could create family as well as cultural benefits external to the recipients. On this ground one could expect less than optimal market production of educational services; public funding could therefore be justified as a matter of efficiency. Secondly, public funding of the school system could be justified in terms of equity. The argument is that we should allow every citizen – regardless of her own wealth and income – to have access to a reasonable amount of education. Finally, education could be considered a merit good, so that the public authorities could find it worthy providing the population with a minimum amount. None of these arguments is put under discussion by our paper. What we discuss here is whether public funded educational services should be also publicly provided.

On the issue of service provision, one strand of the literature (e.g. Gradstein and Justman, 2000) argues that education should be publicly provided because it shapes social capital and it defines social norms; this in turn increases economic growth, because it reduces rent seeking behavior from different groups of the population. While this is probably true, it is worth noting that the goals (efficiency, equity, production of merit goods) of a public system of education could probably be pursued either through public or private provision of services. In particular, differences in efficiency between private and public schools could back the idea of introducing competition in the school system. Public support to private institutions (through voucher mechanism or any other institutional device) could be one of the possible way to induce competition and increase efficiency.

As showed by Hoxby in several papers, competition *among* public schools and competition *between* public and private schools increases productivity of public producers. Hence, private provision of education could be justified basically through a yardstick competition argument: private schools stimulate efficiency. It is worth noting that, in order to increase competition and productivity, an incentive compatible funding mechanism should be devised. For instance, competition (and efficiency) may increase when private (and public) schools are funded according to the number of students they serve. On the contrary, lump sum contributions not related to the amount of services provided - a mechanism used for Italian public schools that some private schools would like to extend to the private sector as well – clearly do not provide schools incentives to pursue efficiency. Of course, given the clear negative impact on efficiency, the funding mechanism of schools should be corrected to account for the higher cost of providing education to disabled and foreign students so as to prevent private producers from undertaking cream-skimming and segregation policies.

On a different ground, our findings indicate that size matters. From a policy point of view this would mean that schools with a limited number of students should be closed in order to increase the overall efficiency of the school system. However, such a measure raises an efficiency-equity trade-off. In fact, smaller schools are more likely to be located in areas (such as mountain or rural villages) where income and wealth are lower than average. The funding system should then account also for students living in these disadvantaged areas.

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