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# ***Standard needs of the Italian primary schools***

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# Motivation of the paper

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- ❑ The education sector in Italy is mainly **public** and **highly centralized** as concerns both **financial** and regulatory **aspects** (e.g., teachers' salaries, recruitment, school funding, etc.). However, there are significant **disparities in school spending across regions**.
- ❑ This heterogeneity is relevant also in relation to the **ongoing fiscal decentralization** process ([L. 42/2009](#)) → to lead to assignment of **responsibility for education** to **Regions** or even more directly to **schools**.

# Motivation of the paper

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- ❑ Additionally, hints from **international** and **national studies** suggest that **better** results in **education** can be achieved through a combination of **greater autonomy** and **accountability of schools** (OECD 2004; Technical Commission of Public Finance 2008; G. Agnelli Foundation 2010; Bordignon and Fontana 2010).
- ❑ Both the decentralization process and the wide gap in per capita education spending across regions seem to justify a general interest in the identification of the **specific financial requirement for each school**.
- ❑ **Schools** have a **greater knowledge** on the local context and specific needs of their catchment area → they should be in a better position to **decide** on important school items such as the **combination of input factors** and the **supply** of education **services**.

# Aim of the paper

- ❑ To obtain a better allocation of the available resources, we **estimate** the **financial standard requirement for each school** (*about 1,000 primary schools for the 2009/2010 school year*) based on the **demand of service** (i.e. number of students served and the type of school), and **comparing** it with the **current endowment**.
- ❑ We combine information on the **physical inputs** (teachers, administrative staff), **major outputs** (number and specific features of students) and **school expenditures for ordinary running tasks** from the school budgets. Some **exogenous factors** that can influence the school needs are also included.
- ❑ The **novelty** of the paper lies in considering the **needs of individual schools** rather than some form of regional requirements as in the existing Italian literature (Biagi and Fontana 2009; Bordignon and Fontana 2010; IRPET 2012) attempting a **bottom-up approach**, in accordance with the Italian legislator's purpose.

# The related literature

- ❑ There is a wide literature on **educational production functions** and **educational cost functions**, mostly referring to the US.
  - **a)** The **cost function** is the **most common** in the international literature (Riew 1966, 1986; Kumar 1983; Downes and Pogue 1994; Duncombe et al. 1995; Reschovsky and Imazeki 2001; Duncombe and Yinger 2005; Golebiewski 2011) → it refers to the estimation of the minimum amount of resources required to obtain a **given** level of **students' performance** → *more similar to our approach*
  - **b)** The goal of the production function is to identify the impact of various exogenous variables on endogenous ones, especially students' learning.
  
- ❑ In turn, the **literature on the needs of standards** (e.g., for the Italian local governments) is essentially based on two distinct approaches:
  - **a)** models estimating expenditure functions according to the Regression-based Cost Approach (**RCA**) → *more similar to our approach*
  - **b)** models estimating a production function (IFEL 2010).

# The Italian education financing system

- ❑ The role of the *central government* in education spending basically concerns **teachers** and **staff's salaries** and their **recruitment**. *Sub-central* governments support costs for **school buildings**, functioning and routine services; define **school network** planning, lessons and class timetable.
- ❑ In **2009** (*latest data from MIUR 2011*): total resources spent in education was about **54.6 billions of euro** (6.8% of total public expenditure):
  - 82.6% paid by the State;
  - 14.2% by Municipalities and Provinces (highest by the former);
  - 3.2% by Regions.
- ❑ **Per capita education** total spending is, on average, **6,635 euro** in **2009**.
- ❑ **Regional differences** are likely to be due to:
  - *size and type of classes* (e.g., full/long time) and **schools**;
  - **students with special education needs**;
  - *age* (seniority) and *type of contract* (i.e. fixed-term or permanent) for **school personnel**.

# The empirical analysis

- ❑ Our research question: how many resources should be given to each school to *deliver ordinary services*? Two scenarios:
  - The **current scenario** → schools are responsible *only* for **operation spending** but not for teachers and administrative staff expenses, which are directly handled by the State.
  - The **decentralized scenario** → school perform *all education functions* coming from their budget and those previously administrated and provided by the State (*including personnel expenditure and recruitment*).
  
- ❑ In both cases: the type of school (*specialized/comprehensive*) and its size (*the total n. of students and its inverse*); the n. of service delivery points; the % of full-time classes; the % of disabled students; environmental features (*urbanization degree, municipalities altitude*) are considered as determinants of **per student spending** of current and decentralized scenario.

# The current scenario

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❑ The current scenario → (1) 
$$\left(\frac{schoolEXP}{n^{\circ}student}\right)_i = \alpha + \sum_{i=1}^n \beta_i x_i + \varepsilon_i$$

- ❑ The **dependent variable**: total current expenditure of the school budget net of both EU structural funds and family or private sector contributions

<i>Descriptive statistics of dependent variables (in euro)</i>				
	<i>Mean</i>	<i>Sta. Dev</i>	<i>Min</i>	<i>Max</i>
School_EXP per student	631	261	103	1731

- ❑ **Variability across regions is substantial.** There may be room for a more evenly balanced allocation of resources...
- ❑ **Covariates**: total number of students and its inverse; the percentage of disabled students; a dummy variable for the type of school; number of service delivery points and the share of full-time classes; dummies for urbanization and altitude.



# The current scenario

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## Estimation results – OLS with robust standard errors

<i>Dependent variable</i>	<b>School_EXP per student</b>	
<i>Independent variables</i>	<i>Coefficient</i>	<i>Significance Level</i>
N° students	-0.214	(**)
N° students_inverse	79093.05	(***)
Share of full-time students	0.692	(**)
Share of disabled students	29.328	(***)
Type of school	-75.132	(***)
N° service delivery points	12.359	(**)
Constant	533.845	(***)
<i>Number of observations</i>	1083	
<i>F-test</i>	45.4	(***)
<i>R-squared</i>	0.19	

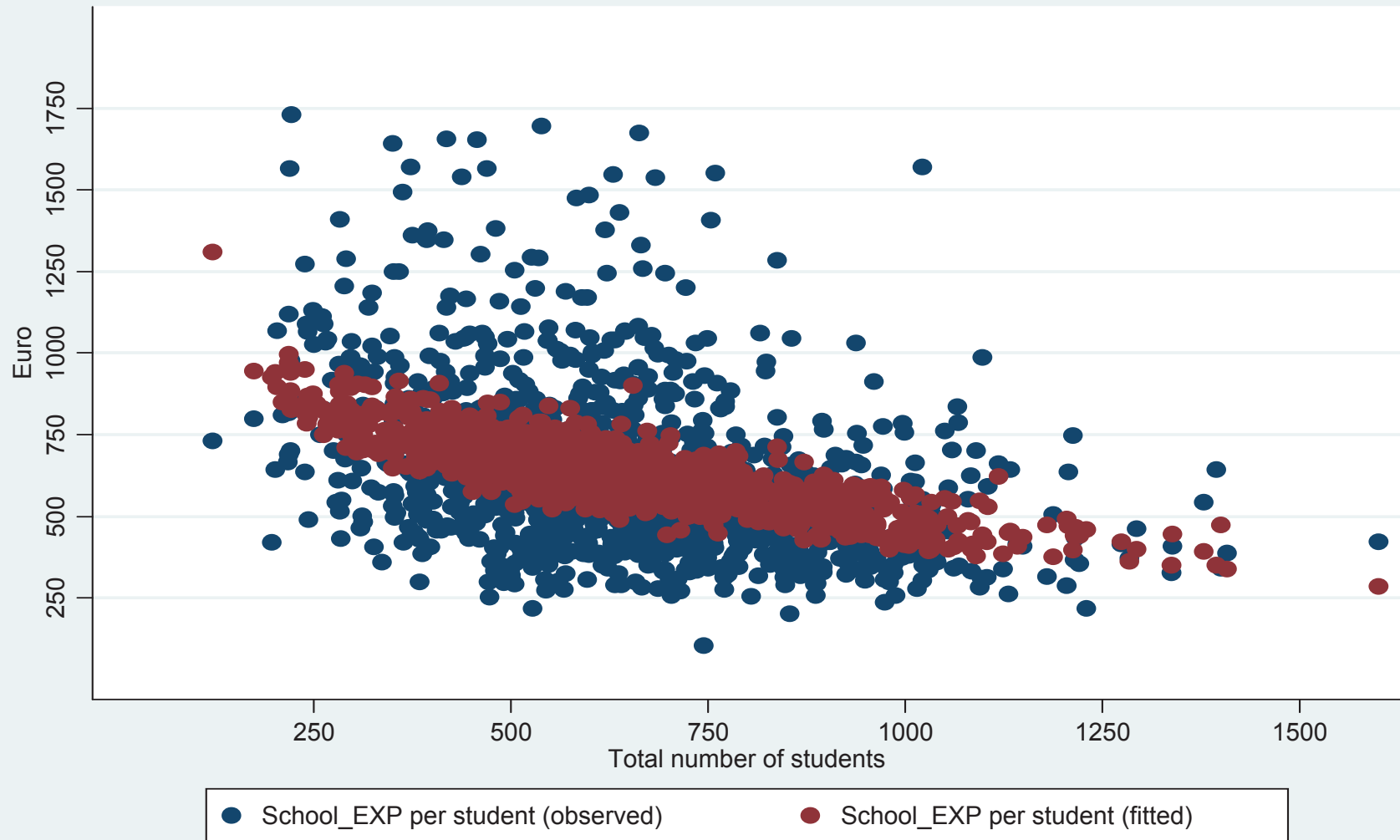
Note: OLS with robust standard errors. Significance level: (\*\*\*) 1%; (\*\*) 5%; (\*) 10%

- ❑ **Scale economies** linked to the size of schools (e.g., the number of students served) exist; **full-time** students and those **with special needs** and require **more spending**; the increasing **number of service delivery points** also imply a **higher per pupil spending**. Being a **comprehensive** school leads to some kind of **savings**.

# The current scenario

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Figure 1: *Observed* and *fitted* values of per student spending under the *current scenario*.



# The decentralized scenario

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□ The decentralized scenario → 
$$\left( \frac{\text{schoolEXP} + \text{staffEXP}}{n^{\circ} \text{student}} \right)_i = \alpha + \sum_{i=1}^n \beta_i x_i + \mu_i$$

- The **dependent variable**: includes **school personnel expenses**; it is always measured in per pupil term

<i>Descriptive statistics of dependent variables (in euro)</i>				
	<i>Mean</i>	<i>Sta. Dev</i>	<i>Min</i>	<i>Max</i>
(School_EXP + Staff_EXP) per student	3948	726	2389	7006

- **Differences are somewhat flattened** as a consequence of the predominant weight of the salary component, but **variability is still substantial** as total expenditure ranges from just under 2.4 thousand per pupil to over 7 thousand...
- **Covariates**: as before...

# The decentralized scenario

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## Estimation results – OLS with robust standard errors

<i>Dependent variable</i>	<b>(School_EXP + Staff_EXP) per student</b>	
<i>Independent variables</i>	<i>Coefficient</i>	<i>Significance Level</i>
N° students	-1.03	(***)
N° students_inverse	395963.30	(***)
Share of full-time students	8.32	(***)
Share of disabled students	121.49	(***)
Type of school	452.62	(***)
N° service delivery points	170.21	(***)
Constant	2625.60	(***)
<i>Number of observations</i>	1083	
<i>F-test</i>	301.9	(***)
<i>R-squared</i>	0.69	

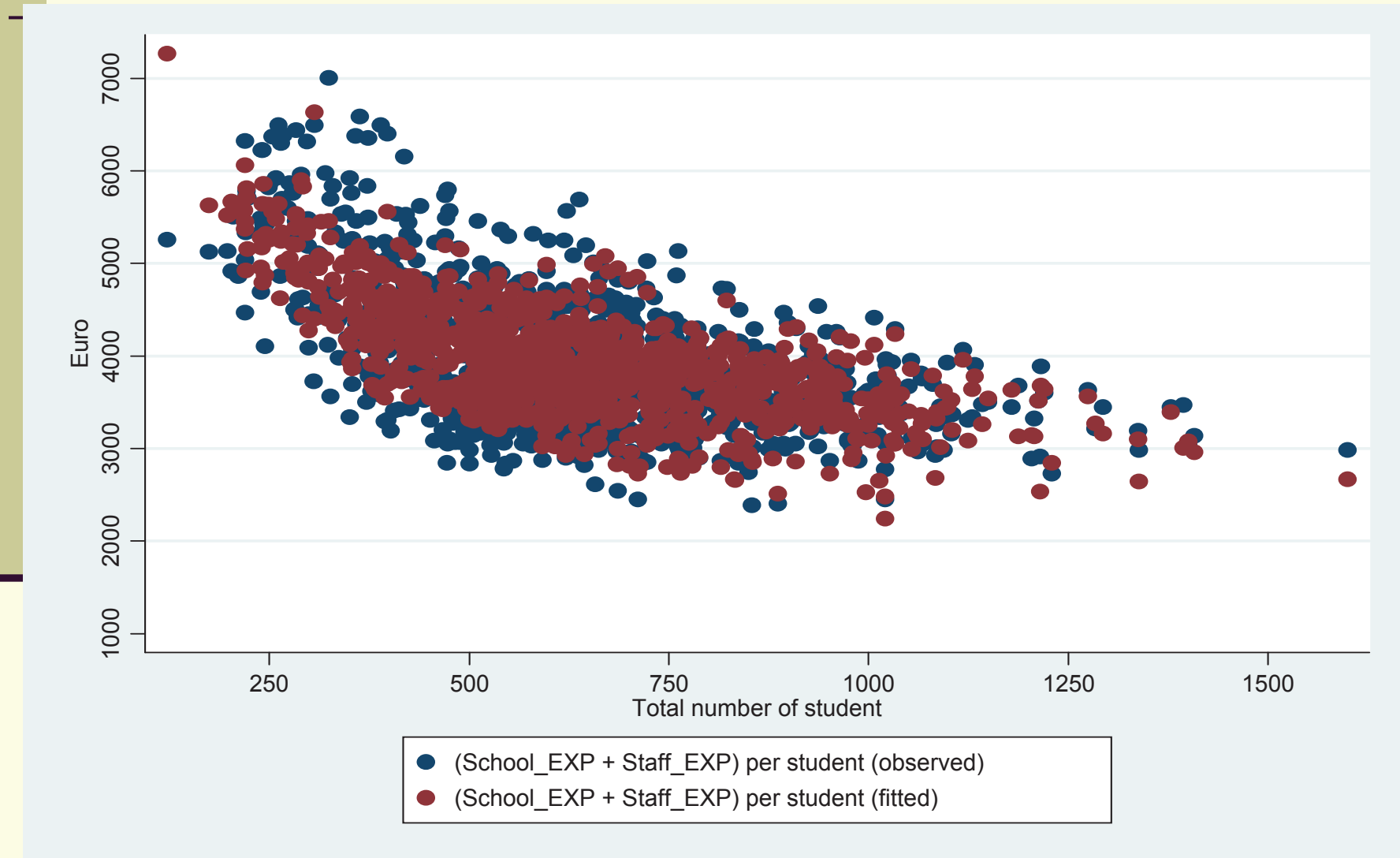
Note: OLS with robust standard errors. Significance level: (\*\*\*) 1%; (\*\*) 5%; (\*) 10%

- **Scale economies** linked to the size of schools (e.g., *the number of students served*) exist; **full-time** students and those **with special needs** and require **more spending**; the increasing **number of service delivery points** and being a **specialized school** (i.e. *organizational aspects*) also imply a **higher** per pupil **spending**.

# The decentralized scenario

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Figure 2: *Observed* and *fitted* values of per student spending under the *federalist* scenario.



# The standard need

Grey color: POSITIVE GAP → schools should receive LESS resources to meet their standard (in euro)

## Observed *minus* fitted dependent variable

Regions	Mean	Sta. Dev	Min	Max
Piedmont	-129	308	-901	672
Liguria	-164	297	-734	542
Lombardy	-106	303	-734	689
Veneto	-175	300	-920	548
Friuli Venezia-Giulia	→ 9	303	-645	1028
Emilia Romagna	-12	373	-736	1371
Tuscany	-59	270	-673	812
Umbria	-96	377	-2005	347
Marche	-210	323	-1149	692
Lazio	→ 59	378	-682	893
Abruzzo	→ 4	425	-529	1550
Molise	-199	505	-764	1398
Campania	→ 162	387	-639	1337
Apulia	→ 196	419	-627	1557
Basilicata	→ 32	421	-909	846
Calabria	→ 287	528	-510	1669
Sicily	→ 56	436	-772	1341
Sardinia	→ 256	452	-783	1490

# Underfunded vs overfunded schools

The distribution of frequency and percentage of the index =  $(\text{observed} - \text{fitted})/\text{observed}$

<i>Class definition</i>	<i>Class number</i>	<i>Frequency</i>	<i>Percent</i>	<i>Cum.</i>
From -40% to -30%	1	2	0.2	0.2
From -30% to -10%	2	174	16.1	16.3
From -10% to 0%	3	413	38.1	54.4
From 0% to 10%	4	357	33.0	87.4
From 10% to 20%	5	112	10.3	97.7
Over 20%	6	25	2.3	100
	<i>Total</i>	<i>1,083</i>	<i>100</i>	

- Values of the index are grouped into six classes: from the most positive 1 (**most underfunded**) to the most negative 6 (**most overfunded**).
- Classes **1, 2 3** = schools should be **receiving** a **higher** percentage of **resources** to meet the standard (**underfunded**).
- Classes **4, 5, 6** = schools should be **receiving** a **lower** percentage of **resources** to meet the standard (**overfunded**).

# At the regional level

The distribution of frequency and percentage of *the index* =  $(\text{observed} - \text{fitted})/\text{observed}$

Class definition		From -40% to -30%	From -30% to -10%	From -10% to 0%	From 0% to 10%	From 10% to 20%	Over 20%	
Class number		1	2	3	4	5	6	
Regions	N° schools	<b>Most underfunded</b>	Percentage values				<b>Most overfunded</b>	Total
Piedmont	69		20.3	46.4	30.4	2.9		100
Liguria	52		23.1	51.9	23.1	1.9		100
Lombardy	67		20.9	41.8	32.8	3.0	1.5	100
Veneto	76		26.3	48.7	22.4	2.6		100
Friuli V. G.	50		12.0	36.0	42.0	8.0	2.0	100
Emilia Romagna	71		15.5	38.0	35.2	8.5	2.8	100
Tuscany	73		13.7	45.2	35.6	5.5		100
Umbria	45	→ 2.2	13.3	33.3	51.1			100
Marche	62	→ 1.6	33.9	35.5	27.4	1.6		100
Lazio	65		12.3	38.5	30.8	18.5		100
Abruzzo	54		13.0	46.3	31.5	5.6	3.7	100
Molise	29		48.3	24.1	17.2	6.9	3.5	100
Campania	61		4.9	27.9	44.3	19.7	3.3	100
Apulia	68		8.8	20.6	42.7	20.6	7.4	100
Basilicata	46		13.0	43.5	28.3	15.2		100
Calabria	60		3.3	31.7	35.0	20.0	→ 10.0	100
Sicily	74		17.6	37.8	21.6	21.6	1.4	100
Sardinia	61		1.6	31.2	41.0	19.7	6.6	100



# Any role for quality-efficiency issues?

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- ❑ The results discussed up to now **do not take into account efficiency or quality issues**. In other words, the estimated models do not consider that spending over or under the standard may be due to **differences in quality of the services provided and educational results obtained**.
- ❑ We try to perform a **second step** of the analysis, where **students' performance levels and school context factors** (such as the average social and economic background) are used to **explain the residuals** emerging from the estimation of equation (2), i.e. *the decentralized scenario*.

## Any role for quality-efficiency issues? 2/4

$$(3a) \quad \hat{\mu}_i = \lambda + \gamma_1(AVE\_SCORES_i) + \gamma_2 ESCS_i + \theta_i \quad \text{with } \hat{\mu}_i > 0$$

$$(3b) \quad \hat{\mu}_i = \lambda + \gamma_1(AVE\_SCORES_i) + \gamma_2 ESCS_i + \theta_i \quad \text{with } \hat{\mu}_i < 0$$

- $\hat{\mu}_i$  = is the **fitted value of the error-term from equation (2)**, i.e. *the difference between observed and fitted values*.
- ***AVE\_SCORES*** = variable representing **average scores in reading and math** of students participating in the INVALSI national student assessment for grade **II** and **V** (by applying the *Principal Component Analysis (PCA)*).
- ***ESCS*** = the **average socio-economic and cultural intake** of each school, based on **students' family background**.

# Any role for quality-efficiency issues?

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<i>Dependent variable</i>	<b>(a) Positive residuals from equation (2)</b>	
<i>Independent variables</i>	<i>Coefficient</i>	<i>Significance Level</i>
AVE_SCORES	-14.325	(***)
ESCS	-57.788	(***)
Constant	317.860	(***)
<i>Number of observations</i>	494	
<i>Wald chi2</i>	2236.1	(***)
<i>Dependent variable</i>	<b>(b) Negative residuals from equation (2)</b>	
<i>Independent variables</i>	<i>Coefficient</i>	<i>Significance Level</i>
AVE_SCORES	-1.685	
ESCS	20.641	(***)
Constant	-277.587	(***)
<i>Number of observations</i>	589	
<i>Wald chi2</i>	226.1	(***)

Note: FGLS with robust standard errors. Significance level: (\*\*\*) 1%; (\*\*) 5%; (\*) 10%

# Any role for quality-efficiency issues? 4/4

- ❑ As the **social and economic background** becomes more favorable, **observed expenditure is closer to the standard benchmark** (*positive residuals case: overfunded schools*).
- ❑ **Students' performance is statistically significant only for overfunded schools**  
→ we may infer that, all other factors being equal, the lower students' performance, the higher expenditure schools are experimenting respect to their standard requirement. In other words, **quality issues suggest that increasing students' performance brings school expenditure closer to what it would be expected as their actual need.**
- ❑ Policy implication: to **enhance the capacity of schools** in using the resources to **implement relevant projects** and to **choose or attract better staff**. **Incentive mechanisms** based on providing schools, which prove a good track in terms of improving students' performance with a small sum of additional resources on top of the estimated standard, could be a viable proposal in such direction.

# Concluding remarks

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- ❑ The **decentralized scenario** appears to fit **better** the data rather than the current one, wherein the demand-side variables do not seem to properly explain school funding.
- ❑ The main results highlight that the **current endowment** is **quite far** from the **benchmark** for all schools → **most** of them should **receive more** resources as they are below the standard. Moreover, **schools above the standard** - which should thus receive less - are highly **concentrated in a few regions** (e.g., [Sardinia](#), [Calabria](#), [Campania](#), and [Apulia](#)).
- ❑ For **implementation purposes**, the standard school requirement should be **firstly referred to the quantity and characteristics of the service provided** rather than to students' outcomes, which could indirectly penalize weaker school backgrounds without providing solutions for their improvement.

# Concluding remarks

2/2

- ❑ Overfunded and underfunded schools are **similar in terms of social and economic backgrounds**, but **the former** tend to be characterized by **lower** values of **students' performance** than their counterparts.
- ❑ **Students' performance** plays a role in explaining only those cases wherein **observed expenditure is higher than the standard** requirement (**overfunded**). Although the direction of the casual relationship is unknown, a funding mechanism **strictly based on structural demand factors may not be sustainable if students' performance is too low**.
- ❑ In order to gradually drive low performing schools to better results and reduced expenditure, **it may be envisaged to allow them** - at least in the short run - **to spend more than their benchmark**, subject to improvements in students' national assessment scores.

# Future research

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- ❑ This empirical exercise is made **only on a sample of schools**; it should be actually **extended to the whole** of schools in order to be **operative and effective** and also used for more practical purposes.
- ❑ **Future research** should analyze more **detailed** breakdowns for the **school budget** as the aggregate data could be actually affected by **lack of homogeneity** and **consistency in recording** practices.

# Some descriptive statistics

## *Explanatory variables*

	<i>Mean</i>	<i>Sta. Dev</i>	<i>Min</i>	<i>Max</i>
N° students	640.13	220.38	122	1599
N° students_inverse	0.0018	0.0007	0.0006	0.0082
Share of full-time students	24.79	28.15	0	100
Share of disabled students	2.75	1.30	0	10
Type of school	0.54	0.50	0	1
N° service delivery points	2.88	1.43	1	9
Urban municipalities	0.34	0.47	0	1
Mountain municipalities	0.02	0.14	0	1



# Some descriptive statistics

## *Dependent variables by regions (in euro)*

<b>Regions</b>	<b>School_EXP per student</b>				<b>(School_EXP + Staff_EXP) per student</b>			
	<i>Mean</i>	<i>Sta. Dev</i>	<i>Min</i>	<i>Max</i>	<i>Mean</i>	<i>Sta. Dev</i>	<i>Min</i>	<i>Max</i>
Piedmont	613	162	324	1078	4039	492	3063	5293
Liguria	545	162	297	994	4047	563	3096	6492
Lombardy	467	137	237	859	3732	436	2972	4695
Veneto	430	152	217	980	3555	391	2733	4520
Friuli V.G.	570	168	270	909	3968	562	2893	5255
Emilia Romagna	561	182	275	1250	3750	588	2877	6382
Tuscany	552	156	307	1048	3808	554	3019	6367
Umbria	605	196	333	1255	3988	527	2991	5315
Marche	508	190	103	1293	3758	547	2869	5494
Lazio	830	290	330	1697	4074	644	2875	5696
Abruzzo	728	262	313	1538	3999	886	2748	7006
Molise	652	304	273	1495	4309	1070	2838	6587
Campania	765	335	257	1674	3764	668	2402	5427
Puglia	693	276	216	1565	3645	706	2541	6386
Basilicata	614	194	252	1131	4331	943	2837	6493
Calabria	820	352	291	1731	4456	947	2898	6358
Sicily	639	255	201	1411	3932	889	2389	6440
Sardinia	828	276	306	1655	4430	795	2852	6495