Italy and PISA 2006: A Transformation Disease? A comparison with Finland and Portugal

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Abstract

This essay analyzes the determinants of the PISA score in reading skills at an individual level, using the most recent (2006) database. We compare Italy to Finland (the European top performer in PISA tests) and to Portugal, a country whose performance in PISA tests looks similar to Italy's. Following Ammermuller (2004) we then decompose the differences in test scores between Italy and the other two countries into a component attributable to the differential characteristics of the national systems and a component related to the system's capability of transforming favourable characteristics into high scores. We find that the second component plays s relevant role in explaining the low Italian score. The causes of this "transformation disease" are open to further investigation.

1 Introduction

Italy has recently witnessed a debate on its alleged decline. "Decline" is a rather imprecise notion, but some specific economic facts provide some background for the alarm, namely, the long term decline in productivity, the low propensity to innovate of Italian firms, the decline in the world market share for Italian commodities (Daveri-Jona-Lasinio (2005)). The sluggish growth of the economy as a whole brings with itself the obvious diseases of low wages and low social mobility . It would be pointless to review here the many explanations provided for these trends, in many of which the malfunctioning of the politica l system plays a relevant role. However, it is fairly accepted that the Italian education system as a whole (from primary school up to the system of higher education) represents one of the most important weaknesses of the country. Over the years, the outcomes of the PISA tests provided new pieces of evidence to support this view. To cite the most recent edition of PISA (on which this paper is based) , on average the Italian sample students ranked 31st on 57 countries participating, as regards reading skills. In mathematics the rank position was 38th, while in science the ranking was 35th. In all subjects, the average Italian score was 16% lower than the score of the best performing country and below the OECD average to a statistically significant extent. Although crude scores and rankings must be properly evaluated and interpreted, nevertheless these outcomes suggest that concerns over the school system are not overrated.

This essay analyzes the determinants of the PISA score in reading skills at an individual level, using the most recent (2006) database. We shall compare Italy to Finland (the European top performer in PISA tests) and to Portugal, a country whose performance in PISA tests looks similar to Italy's. By this comparison we shall try to decompose the gap between Finland and Italy into a component attributable to the differential characteristics of the two systems and a component related to the school system's capability of transforming favourable characteristics into high scores. Although there is no significant gap in test scores between Italy and Portugal, we shall apply the same decomposition: the practical absence of a gap in the test scores in fact may be the consequence of a close similarity between the two countries as well as the outcome of various compensating combinations of differences in characteristics and in "returns" to these characteristics. We shall try to understand which of the two possibilities applies. Following Ammermuller (2004) we shall use Oaxaca-Blinder and Juhn-Murphy-Pierce techniques. Moreover, we also apply the Machado-Mata decomposition to a quantile regression. The paper is organized as follows. In paragraph 2 we shall briefly review the PISA-related literature. In paragraph 3 we describe the data, provide some crude evidence on the score test distributions in the three countries and introduce the model to be estimated. Paragraph 4. contains the estimates. Paragraph 5. discusses the decomposition exercise. Paragraph 6. contains the conclusions.

2 The PISA related literature

Previous editions of the PISA survey (in 2000 and 2003) aroused a wide interest in the economics of education profession, given the size of the sample at the overall and the national level, the international comparability of data, the multidisciplinary scope of the test and the rich assortment of pupil- and school-related variables. An obvious limitations in the data is their purely cross-sectional nature, in the absence of a time dimension.

The literature has tried to answer two related sets of questions. First, and quite obviously, what explains the differences among individual scores? Second, since comparisons of crude test scores across countries show that variations are large: what makes countries so different?

In answering both questions, the common tool is the notion of an education production function. The "inputs" to an education production function are divided into four groups

a) Purely individual characteristics

b) "Social" inputs

c) Family inputs

d) School inputs

Strictly individual characteristics, except gender and few more, are in general unobserved in the PISA sample. Studies in behavioural genetics (Thompson et. al (1991)) stress the interplay between genetic factors and inputs of the b), c) and d) types. To some surprise, a common finding in this literature is that b)-type inputs, which behavioural genetists call nonfamily (or nonshared) environment, turn out to be more relevant than c)-type inputs.

"Social" inputs, i.e. influences directly coming from the social environment at large are not particularly present in the PISA-related literature; the lack of a territorial dimension reduces the opportunities to supplement the survey data with information concerning the general milieu in which pupils live. It is true, however, that most social influences are mediated either by the family or the school: for example, living in a poor neighbourhood may affect school achievement through the corresponding poor quality of schools. Prejudice against immigrants as such is not directly measured; however, the fact that the language spoken home affects school achievement may be the result of a simple difficulty in understanding the test language or the consequence of living under prejudices against immigrants. Fertig-Schmidt (2002) and Fertig (2003) included language spoken home and the immigrant or immigrant's child condition as explanatory variables which are partly non-family inputs. As we shall show, in the Italian case being native or not represents an important circumstance affecting the test outcome.

Family inputs are largely present in all the literature cited, and the present paper will include a wide choice of these variables. There are two fundamental channels through which the family environment is thought to affect the children's school achievement: one is the parents' level of education; the other is the provision of tangible and intangible resources (a peaceful family atmosphere; an acceptable standard of living; an appropriate place to study when at home; access to "cultural" goods and services, etc.). Some of these are correlated with purely economic indicators such as family income or wealth, but not necessarily (see for instance the distinction between families with one parent and "intact" families which some authors employ as a background factor, as well as the number of siblings (Wolter 2003)).

Inputs of the d) type are obviously the most interesting to the policy maker , as they are more directly controlled over the short run than others, which are less dependent on political decisions, and anyway over longer horizons. Unfortunately, it is a rather frequent finding in the literature that inputs of the d) type have a limited influence (see for instance Hanushek-Kim (1995)- a less pessimistic approach is Barro-Lee (1997)). It would be wrong, however, to conclude that such inputs are irrelevant . First (see Hanushek-Woessman (2007)) it is possible that the indicators we use for these inputs are not appropriate. Another possible interpretation has to do with efficiency. Variation in test scores would be explained not only by the input flows, but by efficiency in the use thereof . There are contributions which point to this direction. Afonso -St. Aubyn (2006) follow an efficiency frontier approach. Using as output the country average across the four scores and as inputs the intended school hours and the teachers/pupil ratio in secondary (average 2000-2002), the authors compute an efficiency score for each country. The variation across countries is remarkable. One of the authors of the present paper (Vaglio (2008)) performed a simpler exercise using analogous measures of inputs, allowing for multiple processes in education production. He also found wide variations in efficiency across countries.

Some papers explored the factors influencing efficiency. Robin-Sprietsma (2003) and Sprietsma (2006) investigate the role of autonomy in teacher hiring, type of funding, student's freedom in school choice and examination features, in influencing the performance. Hiring autonomy turns out to be beneficial, while examination features matter, although in an unclear direction. Public funding is found to have a negative effect, but there is a likely correlation with low autonomy in hiring teachers.

Ammermuller (2004) follows a parallel inspiration. He first estimates the education production function for Finland and Germany; then he decomposes the differences in test scores into components attributable to differences in inputs and components attributable to differences in coefficients. The point is that here the inputs are not only school inputs, but the whole set of explanatory variables considered. Then in this case what it is estimated is at the same time something more and something less than the efficiency of the school system. For example, there might be a substantial inter-country difference in the coefficient of parents' education: this is not exactly a difference in efficiency, and further analysis should be applied to find a convincing (an policy-relevant) interpretation of the results.

3 Italy, Finland and Portugal: differences and similarities in PISA performance

3.1 Data

The Programme for International Student Assessment (PISA) is an OECD survey for educational attainment which testes 15 year-old students in the subjects of mathematics, science and reading proficiency. We use the 2006 cross-section, which includes data about the 24 OECD countries plus other 33 countries.

Along with test scores in reading, math and science, information is collected about many characteristics in a student and in a school questionnaire.

The student questionnaire contains information about family background, socio-economic status in terms of ownership of durable goods, a specific focus on science issues.

The school questionnaire contains information about number of students enrolled, number of teachers part-time and full-time, quality of infrastructure, type of funds which.

The two data sources can be merged at the student level and then the complete dataset is used to conduct econometric analysis.

For a detailed description of PISA project, see OECD (2006).

Looking at data used for this analysis, the Italian sample consists of 21773 students and 799 school; Finland is present in the dataset with 4714 students and 155 schools, while Portugal dataset includes 5109 students and173 schools.

3.2 Distribution of Test Scores

Historically, Finland stands as a case of excellence in PISA test performances. Italy, instead, is traditionally one of the worst achievers among industrialised countries. OECD 2006 is no exception. In this paragraph, the distributions of test scores for Finland, Italy and Portugal will be presented graphically. For each subject, non-parametric kernel density estimates describe the score distribution of the two countries.

Figure 1 displays the test score distributions for the three subjects that have been tested for both Finland (FIN) and Italy (ITA). Italian students clearly perform worse than Finnish in all subjects: the Finnish distributions of scores are all shifted to the right relative to Italy. The mode of the Finnish distribution too lies to the right of the modal value for Italy. Figure 2 instead compares Italy with Portugal, a country whose overall test score is very close to the Italian value: in this case the distributions almost overlap. After this descriptive analysis, in the next few sections we proceed to econometric analysis. Figures from 3 and 4 show how the score gap across varies across deciles. In the higher percentiles differences are smaller (with an exception in the last 95th percentile).

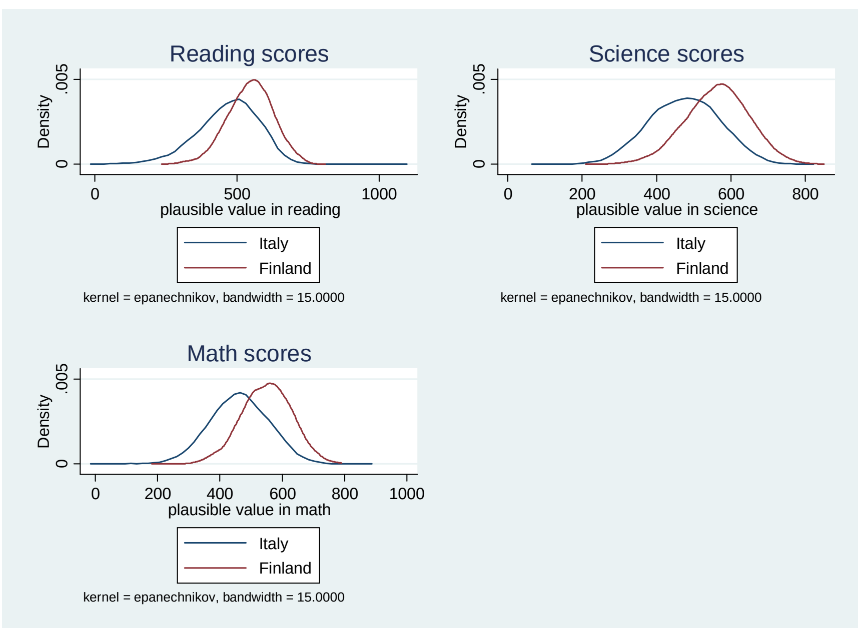

Figure 1

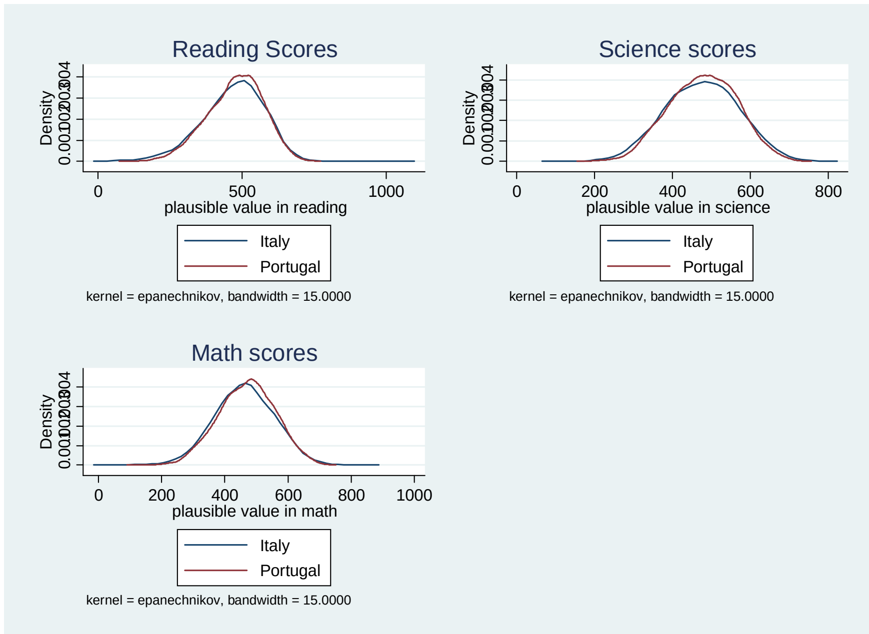
Reading Scores
Density
plausible value in reading
0
500
1000
Italy
Portugal
kernel = epanechnikov, bandwidth = 15.0000
Science scores
Density
plausible value in science
0
200
400
600
800
Italy
Portugal
kernel = epanechnikov, bandwidth = 15.0000
Math scores
Density
plausible value in math
0
200
400
600
800
1000
Italy
Portugal
kernel = epanechnikov, bandwidth = 15.0000

Figure 2

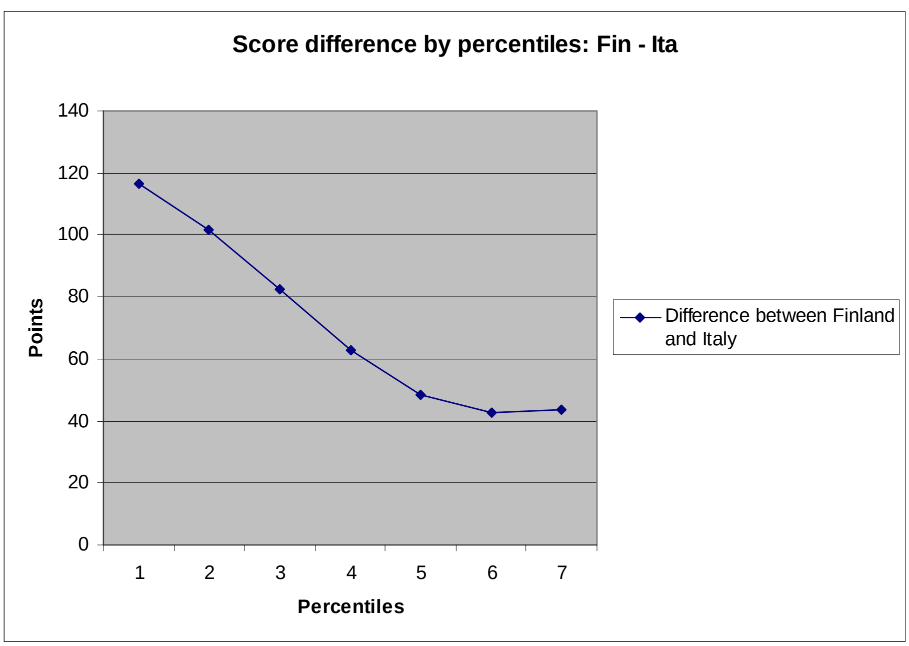
Score difference by percentiles: Fin - Ita
Points
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
Percentiles
Difference between Finland and Italy

Figure 3

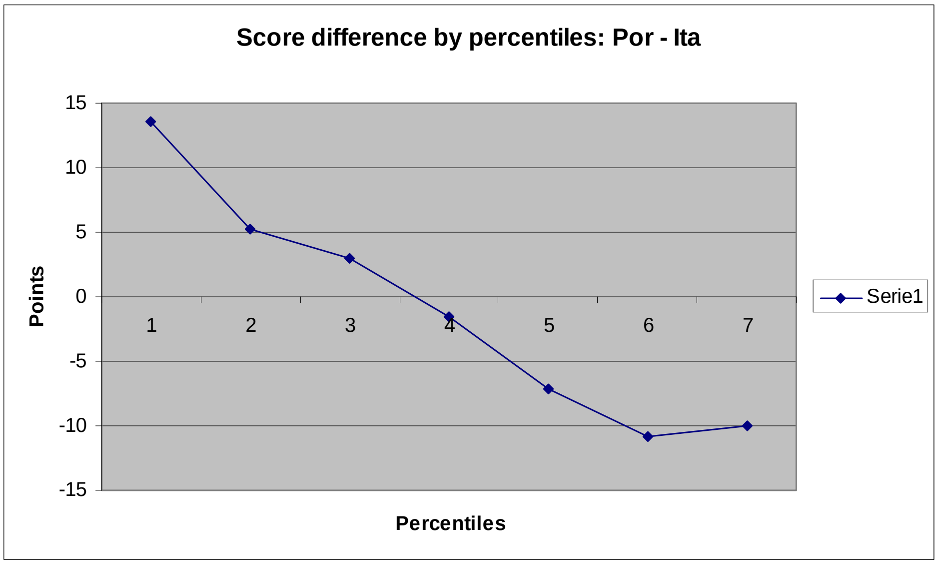

Figure 4

	Italy	Finland	Portugal
Percentiles	Score value	Score value	Score value
1	194.067	234.251	234.011
5	291.07	411.273	305.317
10	336.518	443.597	343.504
25	410.792	494.45	412.304
50	486.983	550.698	483.328
75	553.564	602.491	545.772
90	606.671	647.78	596.141
95	633.877	676.381	624.148
99	687.513	723.253	672.273
Obs	21773	4714	5109
Mean	477.365	547.223	476.63
Std. Dev.	106.253	80.558	97.289

Table 1

3.3 The production function approach

In this paper we follow the approach suggested by Ammermuller (2004), who compared Germany to Finland. The comparison with Finland is a natural one in this context, being Finland the best PISA performer. In a very rough synthesis, one might say that, were we able to say what makes the difference between Italy and Finland, we would be able to say what "went wrong" in the Italian education system. We compare Italy not only with Finland, but also with Portugal. As we have, both the average and the distribution of test scores look very similar in Italy and Portugal. In this case it is possible to check whether similar outcomes share the same causes or not. In other (and again rough) words, things can go wrong in more than one way and it is interesting to understand which one has been been followed by a given country.

We estimate an education production function by investigating the determinants of reading scores in the three countries exploiting the quantity of information contained in the dataset, expecially for family background and demographic variables. As mentioned in paragraph 2., two characteristics of the PISA dataset represent important limits for this analysis : firstly, there is not information about past school experience of students, as marked by Todd and Wolpin (2003), which definitely contributes to explain school proficiency. On the other hand, from a study by Bertschy et al. (2008) on Swiss PISA participants it seems that PISA test scores predict to some extent the subsequent performance in education or in career.

Secondly, samples in PISA dataset are not taking into account the across-regions difference of school quality within a country, which is a relevant issue for such a fragmented country as Italy (a study by Bratti-Checchi-Filippin (2007) which integrates PISA data for Italy with territorial data from other sources shows the potential advantages from such an enlargement of the data set). Therefore, results from the estimation of educational production functions must be taken with extreme caution. We shall estimate the coefficients of the following equation:

$$T_{is} = \beta_0 + X_{is}\beta_1 + R_s\beta_2 + E_s\beta_3 + \nu_s + \varepsilon_{is} \quad (1)$$

Where T_{is} is the student test score , X_{is} is a set of variables defining student's characteristics, R_s describes the resources available to the school, E_s represents the environmental and institutional variables and the last two terms are the error terms at the school and student level.

X_{is} is the core set of variables, corresponding to the the individual determinants of school proficiency: although the inner ability of students is not observable, a set of personal characteristics may be used as a proxy of it . We use also information about family characteristics, both in terms of educational level of father and mother and of their occupational status.

R_s catches the school resources. We expect the fact of receiving public funds to be statistically not significant for countries which do have a public-based school system. We then construct the student-teacher ratio given the available information about the numbers of student enrolled and of teachers (part-time and full-time) employed. There is strong consensus in literature about the substantial irrelevance (or at best, ambiguity) of this variable. To identify the role played by efficiency in the use of resources, like in Ammermuller (2007) we insert a variable for class size. The paper addresses an important issue of selection bias: as a matter of fact, there could be a problem of selection within classes, because less performing students could be put in smaller classes in order to speed up their learning. We try to control for this potential bias by adding a dummy variable about the existence of differential classes within the school system.

E_s refers to city size, which may have an impact on student's performance and indirectly catches the within country variability of scores in the absence of regional data *(ma è vero?)*.

4 Estimation

Table 2 and 3 show the ordinary least square estimates of equation (1).

Table 2

	ITA		**FIN**	
	Coef.	p-value	Coef.	p-value
gender	36.36***	0.000	39.033***	0.000
father edu med	55.391***	0.000	29.09***	0.003
father edu uni	62.622***	0.000	34.549***	0.000
father white collar	6.953***	0.000	6.205***	0.000
mother edu med	38.16***	0.009	-16.732	0.581
mother edu uni	45.954***	0.002	-6.463	0.812
native student	72.573***	0.000	-22.436	0.519
edu mother med x nat stud	-20.727	0.224	30.456	0.391
edu mother uni x nat stud	-20.065	0.243	60.672	0.347
mother_wc	16.529***	0.000	12.99***	0.000
recent migration	-13.389**	0.032	15.474	0.259
cultposs index	6.733***	0.000	13.17***	0.000
homeposs index	-5.641***	0.000	-11.753***	0.000
nr of books 2	19.669***	0.000	8.161	0.169
nr of books 3	37.673***	0.000	23.483***	0.000
nr of books 4	53.603***	0.000	46.918***	0.000
nr of books 5	59.026***	0.000	53.22***	0.000
nr of books 6	61.049***	0.000	72.21***	0.000
nr of televisions	-7.834***	0.000	-2.015	0.229
link to internet	22.69***	0.000	17.98	21.286
str	7.764***	0.000	-4.125***	0.000
diff classes	0.427	0.737	0.934***	0.000
class size	-0.038	0.613	-0.364*	0.076
city size 2	26.176***	0.000	6.405*	0.053
city size 3	36.74***	0.000	4.436*	0.061
city size 4	33.722***	0.000	5.937	0.124
city size 5	31.751***	0.000	(no)	
private school	21.81***	0.000	17.004***	0.01
school in the north	42.096***	0.000	(no)	
N.Observations	19307		4215	
Adj R squared	0.2802		0.2471	

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%

Table 2

	ITA		POR	
	Coef.	p-value	Coef.	p-value
gender	36.36***	0.000	31.328***	0.000
father edu med	55.391***	0.000	2.746	0.396
father edu uni	62.622***	0.000	3.863	0.392
father white collar	6.953***	0.000	19.208***	0.000
mother edu med	38.16***	0.009	18.803	0.112
mother edu uni	45.954***	0.002	34.656***	0.004
native student	72.573***	0.000	7.800	0.501
edu mother med x nat stud	-20.727	0.224	-0.916	0.391
edu mother uni x nat stud	-20.065	0.243	-5.391	0.940
mother_wc	16.529***	0.000	12.99***	0.663
recent migration	-13.389**	0.032	13.725	0.068
cultposs index	6.733***	0.000	9.368***	0.000
homeposs index	-5.641***	0.000	0.109	0.963
nr of books 2	19.669***	0.000	20.934***	0.000
nr of books 3	37.673***	0.000	40.196***	0.000
nr of books 4	53.603***	0.000	40.905***	0.000
nr of books 5	59.026***	0.000	46.802***	0.000
nr of books 6	61.049***	0.000	37.454***	0.000
nr of televisions	-7.834***	0.000	1.088	0.652
link to internet	22.69***	0.000	19.331***	0.000
str	7.764***	0.000	4.706***	0.000
diff classes	0.427	0.737	-10.505	0.000
class size	-0.038	0.613	0.389	0.120
city size 2	26.176***	0.000	17.347***	0.001
city size 3	36.74***	0.000	21.317***	0.000
city size 4	33.722***	0.000	41.362***	0.000
city size 5	31.751***	0.000	35.621***	0.000
private school	21.81***	0.000	0.264	0.957
school in the north	42.096***	0.000	(no)	
N.Observations	19307		4543	
Adj R squared	0.2802		0.278	

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%

Table 3

Regressors include: age and sex of student; his/her nationality; education of both mother and father; occupational status of both mother and father; nationality of parents; a composite index for home possessions at family level; a composite index for the level of cultural possessions of a family (going to museums, expenditures for theatre or other cultural activities); the number of books owned at home; the number of books of literature available at home; student-teacher ratio; the lack of qualified math teachers; the presence of differential classes; class size; city size; availability of computers at school; school type (private or public); percentage of funding coming from the central government.

Empirical results seem robust and the signs and magnitudes of the coefficients are those expected. Going deeper into an analysis of covariates, sex is not surprisingly significant: being female increases the average test score in Italy, Finland and Portugal of approximately 40 points, in line with Ammermuller (2004). The psychological literature confirms that female usually perform better than males in reading tests, and males better than females in mathematics, although it is far from clear the role played by biological factors vis-à-vis environmental ones.

The fact of being a native student is particularly relevant in Italy, where the average score increases of 38 points, while in Finland it increases of 21 points. This may be due, rather than to a more multi-ethnic environment in Finland, to a less efficient school in Italy for people who do not talk Italian or have not an Italian origin. Being native is an advantage for Portoguese students too, with an average increase of 27 points.

Having a foreign parent has a comparable impact in the three countries, which is another confirmation of the fact that the problem is not to be found in the social context, but rather at school.

The variables related to educational level of parents have the expected sign, with an increasing positive effect for an increasing level of parental education, which again is in line with results from Ammermuller (2004). The effect is stronger and more significant for Italy, both for father and mother, which may be due to the important role still played by education in a static labour market. The size of the father effect is particularly remarkable, with an average increase of around 100 points with respect to students who have fathers with no education. It could be possible to investigate further the issue by considering intra-regional differences, but lack of information in PISA creates the need to find for other data to match with, which is beyond the scope of this paper.

Another interesting result is the conflicting role played by the indicators of cultural possession and home possessions.

PISA dataset contains a composite indicator of wealth, which comprises both cultural possessions and durables possessions. Regressions with the composite indicator show a negative impact of the variable on the outcome, while splitting the two categories of wealth in two independent covariates gives us a positive impact of cultural possessions (with an average increase of around 10 points of reading score for the three countries) and a negative value of the same size for durables ownership both for Finland and Italy (while in Portugal durables ownership increases the outcome of 6.5 points). What at a first glance seems counter-intuitive can maybe be explained by the fact that students assessed with PISA are completing compulsory education. Evidently, both for our country and Finland, educational system is such that socio-economic status does not constitute a relative advantage in this phase of the school cycle. A case study on Denmark gets the same results (Rangvid, 2007) . It should be interesting to investigate if this effect is robust and confirmed even for later grades.

Not surprisingly again, the score in reading skills increases with the number of books owned by the student.

The lack of qualified teachers in math seems to be an issue in Italy, where it determines a sort of substitution effect increasing the score of students by 11 points.

The fact of receiving public funds does not seem a significant variable, which is not astonishing for two countries where public schools constitute the core of the educational system.

The increasing size of cities has a relevant effect for Italy and Portugal (with a stronger impact in our country and 50 points more on average with respect to really small villages) but not for Finland, where actually population density is quite low. What is important to notice is that even the fact of being in the capital does not seem to affect results of students.

The last variable to comment is the student-teacher ratio: literature (reference) agrees on the low statistical significance of this covariate in determining educational performance. And the regression confirms the result, with Italian students who improve when student-teacher ratio increases.

5 Decomposing the gap

In this section we apply two different techniques in order to analyze the difference between the test scores across countries. The Oaxaca-Blinder technique (1973) (OB) decomposes the difference between national average test scores into three components: the first component (C_1) is attributable to differences in (average) observable characteristics of two countries ("characteristics"); the second one (C_2) depends on the differences in estimated national coefficients ("returns"); the third one (C_3) is a residual and corresponds to the interactions between the first and second components.

Formally, the three components are, respectively:

$$\begin{aligned} C_1 &= \widehat{\beta}_1^I \left(\overline{X}^j - \overline{X}^I\right) + \widehat{\beta}_2^I \left(\overline{R}^j - \overline{R}^I\right) + \widehat{\beta}_3^I \left(\overline{E}^j - \overline{E}^I\right) \\ C_2 &= \left(\widehat{\beta}_0^j - \widehat{\beta}_0^I\right) + \left(\widehat{\beta}_1^j - \widehat{\beta}_1^I\right)\overline{B}^I + \left(\widehat{\beta}_2^j - \widehat{\beta}_2^I\right)\overline{R}^I + \left(\widehat{\beta}_3^j - \widehat{\beta}_3^I\right)\overline{E}^I \\ C_3 &= \left(\widehat{\beta}_1^j - \widehat{\beta}_1^I\right)\left(\overline{X}^j - \overline{X}^I\right) + \left(\widehat{\beta}_2^j - \widehat{\beta}_2^I\right)\left(\overline{R}^j - \overline{R}^I\right) + \left(\widehat{\beta}_3^j - \widehat{\beta}_3^I\right)\left(\overline{E}^j - \overline{E}^I\right) \end{aligned} \tag{2}$$

where $\widehat{\beta}_i^j$ is the vector of the estimated coefficients of the variable group i ($i = 1,2,3$) for country j ($j = I, P, F$), while $\overline{X}^j, \overline{R}^j, \overline{E}^j$ are respectively the mean values for country j of the explanatory variables of the three groups. Then, if we define the mean total score gap as:

$$\Delta T = \overline{T}^j - \overline{T}^I \tag{3}$$

Where $\overline{T}^j$ is the average test score for country j, we have:

$$\Delta T = C_1 + C_2 + C_3$$

Whereas the OB decomposition applies to average values, the Juhn-Murphy-Pierce (1993) (JMP) technique can be applied at different points of the distribution. Let us define Z^j as the composite vector containing the three vectors X^j, R^j and E^j for country j. Let

$$F\left(\varepsilon_i^j \middle| Z_i^j\right)$$

be the distribution function for the residuals of regression (1), conditional on the vector of explanatory variables Z_i^j in country j, for individual i. Then, if the i-th individual lies in quantile θ_i^j of the country j residual distribution function, we can also write:

$$\varepsilon_i^j = F^{j(-1)}\left(\theta_i^j \middle| Z_i^j\right) \tag{4}$$

Where $F^{j(-1)}$ is by definition the inverse cumulative residual distribution function. The test score for individual i country k is then by definition

$$T_i^k = \widehat{\beta}^k Z_i^k + F^{k(-1)}\left(\theta_i^k \middle| Z_i^k\right) \tag{5}$$

where $\widehat{\beta}^j$ is the vector of estimated coefficients for country j. Now consider the two students, one in Italy and the other one in country j (j=F, P) corresponding to the same quantile θ_i in their country distributions of residuals. We can then decompose the total score gap $T_i^j - T_i^I$ between the two students into four components

a. the *characteristics effect*

$$CHAR_{j,I} = \widehat{\beta}^I \left(Z_i^j - Z_i^I\right) + F^{I(-1)}\left(\theta_i^j \middle| Z_i^j\right) - F^{I(-1)}\left(\theta_i^I \middle| Z_i^I\right) \tag{6}$$

b. the *return effect*

$$RET_{j,I} = \left(\widehat{\beta}^j - \widehat{\beta}^I\right) Z_i^I \tag{7}$$

c. the *residual effect*

$$RES_{j,I} = F^{j(-1)}\left(\theta_i^I \middle| Z_i^I\right) - F^{I(-1)}\left(\theta_i^I \middle| Z_i^I\right) \tag{8}$$

d. the *interaction effect*

$$INT_{j,I} = \left(\widehat{\beta}^j - \widehat{\beta}^I\right)\left(Z_i^j - Z_i^I\right) + \left[F^{I(-1)}\left(\theta_i^I \middle| Z_i^I\right) - F^{j(-1)}\left(\theta_i^I \middle| Z_i^I\right)\right] + \left[F^{j(-1)}\left(\theta_i^j \middle| Z_i^j\right) - F^{I(-1)}\left(\theta_i^j \middle| Z_i^j\right)\right]$$

$T_i^j - T_i^I = CHAR_{j,I} + RET_{j,I} + RES_{j,I} + INT_{j,I}$. In our estimates, $RES_{j,I}$ and $INT_{j,I}$ are grouped together, thus yielding $T_i^j - T_i^I = CHAR_{j,I} + RET_{j,I} + UNEX_{j,I}$, where:

$$UNEX_{j,I} = \left(\widehat{\beta}^j - \widehat{\beta}^I\right)\left(Z_i^j - Z_i^I\right) + \left[F^{j(-1)}\left(\theta_i^j \middle| Z_i^j\right) - F^{I(-1)}\left(\theta_i^j \middle| Z_i^j\right)\right]$$

Finally, the Machado and Mata (MM) decomposition (2005) allows us to estimate more precisely the unconditional distribution of the reading scores by using again the information contained int he regressors. This technique operates through the estimation of counterfactual unconditional distributions. When we take, for example, the characteristics distribution for the group of Italian student and the coefficients estimated using the observations of Finnish students, we estimate the counterfactual distribution that we would observe if the Italian sample had the same output function as the Finnish one.

Comparison of Italy and Finland using the OB technique yields a total difference of 68 points: that is to say, with the same characteristics and returns as those of the Finnish school system, Italian students would attain on average a score 68 points larger than it is. Table 4 shows that this difference is explained mainly by differences in parameters since, as far as characteristics are concerned, the performance of Italian students is still worse than that of Finnish, but to a lesser extent. By comparing the Italian average score with the Portuguese one finds that the difference is instead negligible: Italian students would get the same score if they faced the Portuguese combination of characteristics and returns. This is not surprising given the density functions for Italy and Portugal shown in Paragraph 3.2. The interesting fact is that the advantage of Italian students is mainly driven by characteristics rather than by returns: in other words, had the Portuguese average student the same resources available to the average Italian student, the former would get better results than the latter. Then the transformation disease appears to be relevant also in comparison to an apparently "similar" country.

	FIN-ITA	POR-ITA
Total gap	68.315	-0.84
Characteristics effect	25.112	-24.8
Return effect	49.405	22.609
Interaction Effect	-6.202	1.347

Table 4

If we now turn to the JMP decomposition, we get a similar picture, although with more interesting details. Let us consider the comparison with Finland first. The Finnish total score is larger than the Italian one at all percentiles; however, the size of the gap decreases as one considers higher percentiles. At the same time, the gap is explained to a larger extent by differences in returns when lower percentiles are considered, rather than at higher percentiles. Finally, at higher percentiles, the residual effect is favourable to Italy, that is, Italian students in the highest percentiles would perform worse had they the same residuals as Finnish ones; or, in other words, the characteristics and the return gaps overpredict the gap in total scores in these regions of the distribution. In the Italy-Portugal case, the picture is similar. Again, returns are sizeably lower for Italy relative to Portugal. Italians students in the highest percentiles perform better than Portuguese, but worse in the lowest ones. Across percentiles, the ratio of the return gap to the characteristics gap shows little variation.

	Total	Characteristics	Coefficients	Unexplained
p5	116.291	17.379	69.668	29.242
p10	101.865	16.086	63.985	21.793
p25	82.409	11.214	63.128	8.067
p50	62.761	7.248	58.276	-2.762
p75	48.435	4.934	54.773	-11.272
p90	42.556	7.833	54.597	-19.873
p95	43.695	13.948	51.67	-21.923

Table 5

	Total	Characteristics	Coefficients	Unexplained
p5	13.623	-68.724	69.547	12.8
p10	5.293	-69.6	65.083	9.81
p25	2.964	-60.613	58.985	4.592
p50	-1.588	-53.397	51.434	0.374
p75	-7.175	-47.716	45.137	-4.597
p90	-10.804	-41.906	42.211	-11.11
p95	-10.01	-34.71	36.135	-11.434

Table 6

Interestingly, the role of differences in characteristics becomes larger in the higher percentiles (see figures 5 and 6)

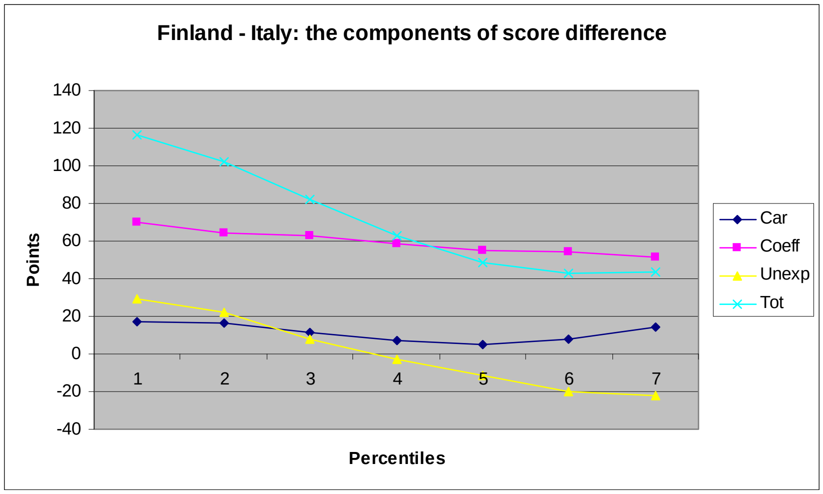

Figure 5

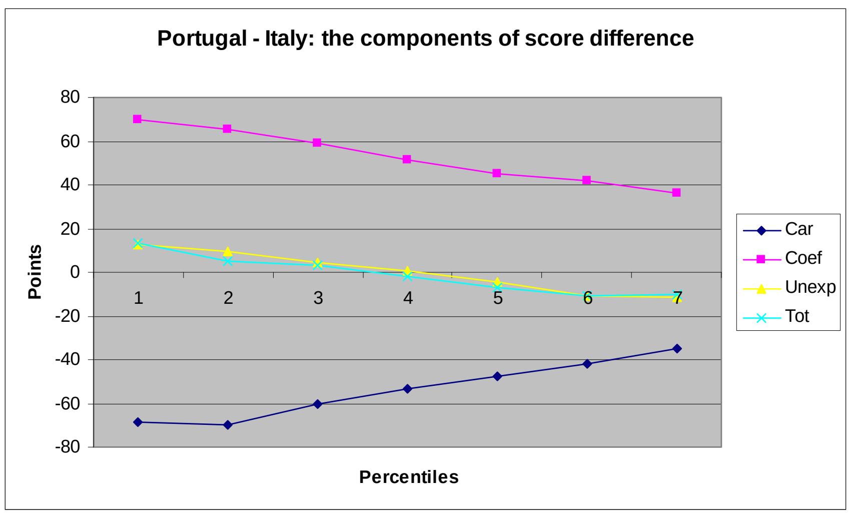

Figure 6

Table 7 shows finally the results of MM decomposition, which again confirms the picture enlightened by the previous analysis. Italian students exhibit a large inefficiency in terms of transformation of resources into output, if compared with both Finnish and Portuguese students. High performing students seem to substitute the lack of an efficient context with their own skills.

	FIN - ITA	POR - ITA
Quantile 1		
Tot diff	102.748	8.92
Characteristics	14.552	-37.137
Coefficients	88.196	46.058
Quantile 2		
Tot diff	87.87	1.868
Characteristics	14.816	-35.779
Coefficients	73.054	37.647
Quantile 3		
Tot diff	78.325	-1.917
Characteristics	14.85	-34.2
Coefficients	63.475	32.283
Quantile 4		
Tot diff	70.556	-4.671
Characteristics	14.296	-32.808
Coefficients	56.26	28.137
Quantile 5		
Tot diff	63.882	-6.691
Characteristics	13.599	-31.105
Coefficients	50.283	24.414
Quantile 6		
Tot diff	57.88	-8.156
Characteristics	13.215	-28.794
Coefficients	44.665	20.637
Quantile 7		
Tot diff	52.403	-8.83
Characteristics	13.073	-26.256
Coefficients	39.329	17.425
Quantile 8		
Tot diff	47.356	-9.679
Characteristics	13.376	-24.118
Coefficients	33.98	14.439
Quantile 9		
Tot diff	42.971	-10.329
Characteristics	14.55	-22.506
Coefficients	28.42	12.177

Table 7

6 Conclusions

Why is the average score of Italian students in PISA 2006 so low as compared ? The answer that we provide, on the basis of the estimates above presented, is that Italy suffers from a "transformation disease" : the value of the inputs to the education production function being equal, Italy performs worse than other countries, independently of whether Italy is compared to an extremely successful performer such as Finland or to a country such as Portugal, whose overall performance is not better than Italy's.

This transformation disease must be properly understood. Interpreting it as an indication of low efficiency might be intuitively appealing but it also misleading if the interpretation is pushed too far. Just to make an example, the coefficient attached to mother higher education in Italy is larger than in Finland: do we gain a better understanding of the situation if we say that Finnish mothers are less efficient than their Italian counterparts in transforming their human capital into better school performances of their children ? Similarly, the coefficient attached to being a recent immigrants is negative in Italy and positive (although not significant) in Finland: does this mean that Italy is inefficient in making recent immigrants successful students?

Our conclusions must be maybe less clear cut, but more sensible.

The first main conclusion is in the negative, i.e. what the results say is that Italian outcomes are not entirely explained by a lack of "endowments" , at least of the endowments that we are able to observe in the

The estimates presented in the previous paragraph show that Italy did experience The determinants of PISA test scores have been largely investigated in the literature related to previous edition of the survey. We found in this paper that a set of variables reasonably similar to the ones already experimented keeps a comparable explanatory power when applied to the 2006 dataset. What or who then is to blame for the low performance of the Italian participants? Our finding is that, at least prima facie, insufficient resources are not the immediate answer. Were it only a matter of resources, we should predict test scores for Italian students closer to the Finnish ones, and farther from the Portuguese than they are. Italy then seems to suffer from a "transformation disease", a difficulty in converting its favorable characteristics into a good performance of the school system. However, concluding that the teachers or headmasters are the sole or main responsible for the current state of affairs would mean to choose the most convenient scapegoat. Our analysis points out an overall "inefficiency" in producing education, which should probably be explained by a range a social, cultural and local factors which call for further analysis.

References

[1] Ammermuller , A. (2007) "PISA: What Makes the Difference ? Explaining the Gap in PISA Test Scores Between Finland and Germany" *Empirical Economics* vol.33, n. 2 :263-287

[2] Andrabi, T. - Das, J. - Khwaja, A.I. (2009) "What Did You Do all Day ? Maternal Education and Child Outcomes" *World Bank Policy Research Paper n. 5143*, November

[3] Becker,G.S.-Tomes, N. (1986) "Human Capital and the Rise and Fall of Families" *Journal of Labour Economics*, July, n. 4:S1-39

[4] Bratti,M.-Checchi,D.-Filippin, A. (2007) "Geographical Differences in Italian Students' Mathematical Competencies: Evidence from PISA 2003", *Giornale degli Economisti*, vol. 66, n.3 November: 299-333

[5] Bound, J. -Solon,G. (1999): Double Trouble: On the Value of Twin-Based Estimation of the Return to Schooling. *Economics of Education Review*, 18, 169-182.

[6] DeFries, J.C.- McClearn, G.E-McGuffin, P.- Plomin, R. (2001) *Behavioural Genetics* Worth Publications,New York

[7] Fertig, M. – Schmidt C.M. (2002) "The Role of Background Factors for Reading Literacy: Straight National Scores in the PISA 2000 Study", *IZA Discussion Papers*, n. 545

[8] Fertig, M. (2003) "Who's to Blame? The Determinants of German Students' Achievement in the PISA 2000 Study", *RWI Discussion Papers*, n. 4

[9] Fuchs, .-Woessman, L. (2007) "What Accounts for International Differences in Student Performance?A Re-examination Using PISA Data", *Empirical Economics*, vol.32, n. 2-3 :433-464

[10] Hanushek, E.A (2008) "Education Production Function" *The New Palgrave Dictionary of Economics*, 2nd Edition, MacMillan.

[11] Hanushek E.A. – Woessman, L. (2008) "The Role of Cognitive Skills in Economic Development" Journal of Economic Literature, 46(3): 607-668

[12] Harris, J.R. (1998) *The Nurture Assumption* The Free Press, New York

[13] Herrnstein, R.J. -Murray C. (1994) *The Bell Curve:Intelligence and Class Structure in America*, Free Press,NY

[14] Holmlund, H., M. Lindahl and E. Plug (2008): Estimating Intergenerational Schooling Effect: A Comparison of Methods. IZA Discussion Paper, no 3630

[15] Haveman, R. - Wolfe, B. (1995), "The Determinants of Children Attainments: A Review of Methods and Findings", *Journal of Economic Literature* 33:4, pp. 1829-1878.

[16] Jensen, A. (1969) "How Much Can we Boost I.Q.and Scholastic Achievement", *Harvard Educational Review* , February

[17] Kamin, L.J. (1974) *The Science and Politics of IQ*,LEA, Potomac.

[18] Patacchini, E - Zenou, Y. (2004) "Intergenerational Education Transmission:Neighborhood Quality and/or Parents' Involvement?" The Reserach Institute for Industrial Economics, Working Paper No. 631.

[19] Chiara Pronzato,C. (2008) Why Educated Mothers don't make Educated Children? A Statistical Study in the Intergenerational Transmission of Schooling, Statistics Norway, Discussion Papers No. 563, October

[20] Sprietsma, M. (2006) "Regional School Comparison and School Choice: How do They Relate to Student Performance" *European Journal of Comparative Economics,* vol.5 , n.2 :155-178.

[21] Thompson, L.A.-Detterman, D.K.-Plomin, R. (1991) Association between Cognitive Abilities and Scholastic Achievement: Genetic Overlap but Environmental Differences, *Psychological Science* , 2: 158-165

[22] Wolter S.C. (2003) "Sibling Rivalry: a Six Country Comparison" , *IZA Discussion Papers*, n. 734

[23] Afonso , A.-St. Aubyn M. (2006) "Cross Country Efficiency of Secondary Education Provision: A Semi-Parametric Analysis with Non-discretionary Inputs" *Economic Modelling*, vol.23, n.3, May: 476-491

[24] Bertschy,K. – Cattaneo, M.A – Wolter, S.C. (2008) What Happened to the PISA 2000 Participants Five Years Later? , IZA Discussion Papers, n. 3323

[25] Daveri, F.-Iona-Lasinio,C. (2005) "Italy's Decline: Getting the Facts Right" *Giornale degli Economisti e Annali di Economia*, vol. 64, n.4 Settembre: 365-410

[26] Juhn, C., K.- Murphy -P.B(1993)," Wage Inequality and the Rise in Returns to Skill", *Journal of Political Economy* Vol. 101(3), 410-442.

[27] Lee J. – Barro R.J. (1997) "Schooling quality in a Cross-Section of Countries" NBER Working Paper n. 6198

[28] Mincer, J. (1974), School, experience and earnings, National Bureau of Economic Research; distributed by Columbia University Press New York

[29] Oaxaca, R. (1973), Male-Female Wage Differentials in Urban Labor Markets, International Economic Review Vol. 14 (3), 693-709.

[30] OECD (2006), Science competencies for tomorrow's world: Vol.1, OECD, Paris

[31] Rangvid B.S. (2007), School composition effects in Denmark: quantile regression evidence from PISA 2000, Empirical Economics 33:359-388

[32] Robin S.R.- Sprietsma, M. (2003) Characteristics of Teaching Institutions and Student's Performance: New Empirical Evidence from OECD Data, mimeo

[33] Todd, P. and K. Wolpin (2003), On The Specification and Estimation of The Production Function for Cognitive Achievement, The Economic Journal Vol. 113(485).

[34] Vaglio, A. (2008) The Efficient Frontier with Multiple Processes in Education Production: a Note, mimeo.

[35] Wolter S.C. (2003) Sibling Rivalry: a Six Country Comparison , IZA Discussion Papers, n. 734