

The Economic, Social, and Cultural Background: a continuous index for the Italian Students of the fifth grade

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Abstract Starting from the school year 2008/2009 standardized tests of Italian (reading comprehension and grammar) and Mathematics are yearly administered to the pupils of the primary and low secondary school. The tests are administered to the pupils attending the second, fifth, sixth, and eighth grade. In this work the results of the tests of the fifth grade are taken into account, because at this school level social, economic, and cultural covariates are collected, as well. This paper describes the methods for the calculation of a continuous social, economic, cultural index (ESCS) based on discrete indicators like the parents occupational status and their education, but on a continuous index of the family economic milieu, as well.

1 Introduction

The social, economic, and cultural background of the pupils and their families exerts a very important influence on knowledge and skills that pupils acquire in their school career, even in the primary school. It is well known in the specialized literature that the student background has a big predictive power of the school results (INVALSI, (2008); OECD (2007)). Therefore, it is crucial to define and to calculate an index that is able to measure the economic, social, and cultural status of the considered pupils.

The definition and the calculation of a background index imply methodological and technical problems that have to be faced. This work take into account methods that are

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used in the comparative international studies in the education field, like OECD-PISA¹, IEA-TIMSS², and IEA-PIRLS³.

The index considered in this work is based on the data of the school sample which is stratified at regional level. The sample has been drawn by INVALSI from the primary school population. It consists of 1052 primary schools and within each school a sample of pupils is selected.

The Italian National Evaluation Service (SNV) is based on a test of Italian (reading comprehension and grammar) and Mathematics and on a questionnaire, as well. The questionnaire is designed in order to collect several information about the pupil background and other motivational and metacognitive aspects. Furthermore, for each pupil the school has collected other data about his/her families, such as the parent occupational status and the parent education in terms of years of formal schooling.

In the following parts of this work each variable used for the calculation of the economic, social, and cultural status (ESCS⁴) is briefly described. The problem of the missing data is briefly faced, as well.

2 The Economic, Social, and Cultural Status (ESCS)

The aim of this work is to define and to calculate for the Italian pupils of the last year of the primary school an index able to depict pupil background. This index is well known in the specialized literature and it is usually called ESCS or SES.

In the last decades the important international surveys OECD-PISA, IEA-TIMSS, and IEA-PIRLS have clearly showed the relevance of the family background and its influence on the results obtained by the pupils. The above mentioned surveys show also that the social background is important in order to evaluate the effects of the policy decisions in the educational field. In this work the index ESCS is calculated by using the PISA technique, because it seems to be interesting and fruitful both in terms of the variable number of considered variables and the elementary indices construction.

The index ESCS based on the SNV data of the school year 2008/2009 is defined by using three indicators: the parent occupational status (HISEI), the parent education measured in terms of years of formal schooling (PARED), and the household possession as an indicator (proxy) of family wealth (HOMEPOS). Indeed, recent international studies in the field of education show that data about household assets are able to capture wealth better than income because they reflect a more stable source of wealth.

¹ Programme for International Student Assessment.

² Trends in International Mathematics and Science Study

³ Progress in International Reading Literacy Study

⁴ The background index is internationally known as *Economic, Social and Cultural Status* (ESCS).

2.1 *The parent occupational status*

It is quite clear and accepted that the parental occupational status exert a certain influence on the social and cultural milieu of the pupils. The latter aspects are specially relevant for pupils that attend the last years of the primary school, even more than for older students for which the concept of extra scholastic environment has a broader meaning, although it is strongly influenced by the social status of the family.

Occupational data for both the student's father and student's mother are obtained by the data collected by the school administration. This choice was necessary because it is unthinkable to ask to 11-year old pupils so detailed information. Although the collection of these data was surely not easy for the administration of each school the rate of missing data is quite low and more of 80% of valid answers was collected.

The responses were coded to four-digit ISCO codes and then mapped to the international socio-economic index of occupational status (ISEI). Three indices were obtained from these scores: father's occupational status (BFMJ); mother's occupational status (BMMJ); and the highest occupational status of parents (HISEI) which corresponds to the higher ISEI score of either parent or to the only available parent's ISEI score. For all three indices, higher ISEI scores indicate higher levels of occupational status.

2.2 *The parent education*

Parental education is a second family background variable that is usually considered in the analysis of educational outcomes. Indeed, for the specialized literature the parent educational level is even more relevant than the occupational status in terms of influence on the school results.

Like occupation, the collection of internationally comparable data on parental education poses significant challenges, and less work has been done on internationally comparable measures of educational outcomes than has been done on occupational status.

Like in OECD-PISA survey, parental education is classified using ISCED¹ (OECD, (1999)). Indices on parental education are constructed by recoding educational qualifications into the following categories: (0) None; (1) ISCED 1 (primary education); (2) ISCED 2 (lower secondary); (3) ISCED Level 3B or 3C (vocational/pre-vocational upper secondary); (4) ISCED 3A (upper secondary) and/or ISCED 4 (non-tertiary post-secondary); (5) ISCED 5B (vocational tertiary); and (6) ISCED 5A, 6 (theoretically oriented tertiary and post-graduate). Indices with these categories were provided for the students' mother (MISCED) and the students' father (FISCED) of the student. In addition, the index on the highest educational level of parents (HISCED) corresponds to the higher ISCED level of either parent. The index scores for highest educational level of parents were also recoded into estimated years of schooling (PARED).

¹ International Standard Classification of Education.

2.3 Household possessions

In the last decades, using data about household possessions as an indicator of family wealth has received much attention in recent international studies in the field of education. Data about household assets are believed to capture wealth better than income because they reflect a more stable source of wealth.

The data used to determine the household possession index are obtained by several items from the student questionnaire. In order to verify the unidimensionality of the considered trait several confirmative factor analyses are conducted. On the basis of the obtained results and the calculated indices (RMSEA=0.061; CFI=0.93; NNFI=0.92) the best item pool is selected.

As in several international studies in the field of education the scaling procedure is based on the Rasch method, so that it is possible to locate on the same scale items and individual estimation of the investigated latent trait (Bond and Fox, (2007)).

In this case the latent trait is the family wealth and the scaling aim is the definition of an index that is able to express through a continuous measure (HOMEPOS) the individual level of family wealth.

Some items used for the index definition are politomous items, but through several comparative factor analyses it was possible to reduce all items to a dichotomous scoring schema because the information reduction is negligible. This simplification allows the use of the simplest Rasch model for dichotomous items. The Rasch method is particularly fruitful in this kind of research. It permits to locate on the same scale the individual level of family wealth and the single items. That is, the item location allows to understand the information value of each item in relation with the studied latent trait.

Table 1: WLE (*Weighted Likelihood Estimates*) estimation of the parameter b_i (location of the item i on the latent trait) for each item on which the HOMEPOS is built.

In your home, do you have:	Estimation of b_i
a) A quiet place to study	-2.196
b) Your own desk for homework	-2.157
c) Encyclopedia (books, on CD, or on DVD)	-1.125
d) A link to internet	-1.102
e) A security alarm	0.850
f) Your own room	-0.137
g) More than a bathroom	-0.570
h) More than a car	-0.998
i) More than 100 books (recoded)	1.061

The second column of table 1 shows the estimations of the location parameter by using the Warm method (Warm, (1989)). All estimates are theoretically based on a model with mean 0 and standard deviation 1. Therefore, an item with a low value of b_i depicts a low level of family wealth, so that an item with a high value of b_i represents a high level of family wealth. Furthermore, for each item the fit between theoretical model and real data through the *weighted mean-square statistic (infit)* is evaluated. The latter statistic assumes for each item values smaller than 1, therefore within the interval of acceptability (Wu *et al.*, (1997)).

3 Missing values

In all large scale survey missing values are an important issue that has to be faced carefully in order to reduce the estimation bias. Missing values are more relevant when the collected information is related to personal sphere, as for the family wealth or the educational level of parents.

The collection of covariates for the SNV 2008/2009 is not an exception, although the missing value rates are smaller than as usual. In this work different imputation methods are used. Missing values for students with one missing response and two valid responses were imputed with the school or region most frequent value. In other cases missing responses were imputed with predicted values plus a random component based on a regression of the variable with missing responses on the other two variables. Variables with imputed values were then transformed to a national metric with averages of 0 and standard deviations of 1.

4 The calculation of the ESCS index

Several researches show a strong relation between educational outcomes and family background (Brunello e Checchi, (2006); Carneiro e Heckman (2003); Marks *et al.*, (2006)). International surveys like IEA-TIMSS and OECD-PISA and national studies confirm this relation (INVALSI, 2008; Martini e Ricci, 2007; 2010).

The ESCS index described in this work is calculated by using OECD-PISA methods with adaptations to the Italian specific situation. The index is based on the three above described indexes: HISEI, PARED, and HOMEPOS.

The ESCS individual values are obtained by a principal component analysis and they are the scores for the first principal component that is able to explain more than of 56% of the total variance. By construction, the average of the ESCS index is equal to 0 and its standard deviation is 1.

The evaluation of the predictive power of the obtained index is done in terms of correlation with the individual estimation of the cognitive outcomes. More in depth, the ESCS index shows a correlation of 0.25 with the outcomes of Italian and 0.21 of Mathematics, that is very similar values of the OECD-PISA survey.

Table 2 gives a first idea of the association between the family background and the educational outcomes.

Table 2: How socio-economic background relates to student performance in the 5 Italian geographical areas

Area ¹	ESCS quartiles	Mean scores (Italian)	Mean scores (Mathematics)
North-West	I	473	477
	II	499	502
	III	513	511
	IV	528	529
North-East	I	472	486
	II	497	510
	III	511	519
	IV	530	536
Middle	I	465	466
	II	493	495
	III	506	502
	IV	526	521
South	I	481	486
	II	496	497
	III	520	520
	IV	540	524
South-Islands	I	443	441
	II	480	471
	III	499	487
	IV	529	507

Table 2 shows the mean scores² of Italian and Mathematics in the four ESCS quartiles. It is easy to see that the mean scores increase if the ESCS assumes higher values. That is, the individual family background exerts a positive effect on the educational outcomes with a difference greater than a half of standard deviation between pupils in the first ESCS quartile and pupil in the fourth ESCS quartile.

It is remarkable that the typical gap in terms of educational outcomes between North and South is mostly to impute to the regions of the area South-Islands. Furthermore, the above mentioned gap is greater for Mathematics than for Italian.

¹ *Nord-West:* Valle d'Aosta, Piemonte, Liguria, Lombardia. *Nord-East:* Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Emilia-Romagna. *Middle:* Toscana, Umbria, Marche, Lazio. *South:* Abruzzo, Molise, Campania, Puglia. *South-Islands:* Basilicata, Calabria, Sicilia, Sardegna.

² The mean scores are Rasch scores with a national average equal to 500 and standard deviation equal to 100.

Table 3: Mean scores and ESCS

Area	(1) Mean ESCS ¹	(2) Percentage of students that fall within the lowest 15% of the national distribution on the ESCS	(3) Mean score (Italian)	(4) Mean score (Italian) if the mean ESCS were equal to the national average	(5) Mean score (Math.)	(6) Mean score (Math.) if the mean ESCS were equal to the national average
North-West	0,13	13,0	505	502	507	504
North-East	0,03	12,2	502	502	513	512
Middle	0,28	8,6	503	496	501	495
South	-0,27	21,1	503	509	502	506
South-Islands	-0,17	18,9	482	487	472	476

Table 3 suggests several reflections and further researches. Indeed, it is particular remarkable the difference in terms of mean ESCS among the different areas of the country.

Furthermore, table 3 permits to evaluate the theoretical mean scores in Italian and Mathematics if all areas had the same level of wealth.

First, one can see that the outcomes of the North of Italy do not change considerably if the mean ESCS were the same of the national average. The opposite occurs in the South of the country. Second, in the South-Islands the theoretical mean scores corresponding to a mean ESCS equal to 0 increase considerably, but the unfavorable gap remains significant.

5 Final remarks

The definition and the computation of a social, economic, and cultural index is very important both from a methodological and from a practical point of view.

The use of discrete and continuous variables seems to be best solution that permits to enlarge the area of research. As usual, in this kind of survey the problem of the missing data is not negligible and requires more research in order to find better solutions.

The availability of an ESCS index of the Italian pupils is very important in order to study from a quantitative point of view the effect of the family background on the educational outcomes. For the first time, it is possible to verify the size of the influence of the ESCS on the cognitive results measured by a national survey.

¹ The mean ESCS for Italy is 0 with standard deviation equal to 1.

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