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ABSTRACT: The relationship between socio-economic status and student achievement is well documented and a widespread literature indicates that students from more advantaged backgrounds perform better at school. Despite this relationship, several international assessments have highlighted that in each country there is a relevant proportion of "resilient students", i.e. students who come from a disadvantaged socio-economic background but achieve relatively high levels of educational performance. In this paper, the determinants of resilience in the Italian educational system are investigated analysing data from the OECD-PISA 2009 edition, with a specific focus on the role of school-level variables that could help more students succeed. The aim is to target a specific category of resilient students, namely those who are characterised by a low socioeconomic background both at family level and at school level; therefore a novel statistical procedure is proposed to derive a sample of disadvantaged students who attend disadvantaged schools. Afterwards a multilevel logistic approach is adopted to determine which characteristics of students, families and schools, tend to give disadvantaged students a higher probability of becoming a resilient. Our results confirm that not only individual-level characteristics, but also some school factors (i.e. extracurricular activities and school leadership) play a role in this direction, suggesting policy and managerial implications.

JEL Codes: I21

Keywords: Inequality, disadvantaged schools, resilient students, school-level policies, educational production functions.

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1. Motivation and objectives

The recent economic literature pointed at demonstrating that individuals' competencies can influence not only their own future (both social and economic, i.e. earnings), but also macroeconomic growth. In a recent and influential study, Hanushek & Woessman (2011, p.190) conclude:

> "The results of growth modelling that employ measures of national cognitive skills strongly suggest that the basic human capital model is very relevant for aggregate outcomes. Variations in skills measured by international math and science tests are strongly related to variations in economic growth, and they solve many of the difficult measurement problems with the more traditional school attainment measures".

Therefore, the attention of policy-makers should be put on the factors that are able to positively influence students' results. As students' achievement can be considered as an indirect measure for human capital, and given that the latter is strongly associated to economic growth, then it is necessary to understand what is likely to affect achievement. Basically, the economic literature searched in two directions, namely the (i) role of family (socio-economic background) and (ii) school factors (Sousa & Armor, 2010, compared their relative influence in a sample of OECD countries through OECD Programme for International Student Assessment (PISA) data). In particular, with regard to the influence of family background, it is since Coleman's *et al.* (1966) study, that educational scientists, sociologists and economists acknowledge the importance of students' socioeconomic background (SES) in determining their educational achievement. The subsequent literature very early demonstrated that not only a student's SES matters, but also that of her/his classmates (the so-called "peer-effect") (Bradley & Taylor, 1998; a summary is provided by van Ewijk & Sleegers, 2010). Therefore, the average school's performance, as measured through scores in standardized tests, is likely to be strongly affected by the composition of students' intake: the higher their SES, the better the school's results, with clear implications for policy and managerial considerations. Thus, generating "adjusted" measures of schools' results became a very hot topic, and the economic literature developed

several methods to undertake such exercise. For instance, Ruggiero & Vitaliano (1999) and Stiefel *et al*. (1999) proposed approaches to control for environmental harshness when assessing the efficiency of public schools – and, more generally, studies about the schools' efficiency focused early on this issue, as Worthington (2001) demonstrates in his review. Value-added (VA) measures of schools and teachers' effectiveness became popular also because they can explicitly take into account baseline students' results, which are strongly influenced by their socioeconomic background, and were criticized when failed pursuing such objective (i.e. Ladd & Walsh, 2002).

Nevertheless, studying disadvantaged schools is an interesting topic *per se*. Even though OECD PISA data systematically show a strong correlation between school-level SES and schools' average performances, and despite the evidence of high between-schools variance, little attention has been paid to those schools which were able to obtain high grades in difficult situations – that is, educating a high proportion of students from disadvantaged background. By using predetermined criteria based on the proportion of disadvantaged students, it is possible to identify those schools which start with less probability to obtain high results in standardized tests; and focusing on them it is possible to identify those schools that, despite their relative socio-economic disadvantage, were able to obtain high scores (this is, for instance, the approach proposed by Tajalli & Opheim, 2004). Through the comparison of these schools with others in similar background conditions, it is possible to understand if there are systematic differences that explain their good results. The US economic literature spent some effort in this direction, by evaluating the impact of several educational interventions that aimed at "closing the gap" between advantaged and disadvantaged students (Gregory *et al.*, 2010). Moreover, a stream of the US academic interest is in the "high-flying schools", defined as the schools that obtain high test scores despite they serve a disadvantaged population (Harris, 2007). These studies highlighted that school factors can make a difference in helping disadvantaged students, but also that school's contribution, must be calculated in appropriate ways, through adequate methods and research designs (for instance, employing value-added models). Interestingly, this issue is under-considered in Europe and little attention has been devoted to the study of the so-called "resilient students", defined as those who,

despite their disadvantaged background, are able to obtain high academic results (see OECD, 2010a). In this stream of studies, the focus was then only on individuals, not schools; and the main findings actually show that individual "motivation" is the main strong factor associated with the probability to be a resilient student (OECD, 2010b). In the academic literature, only educational sociologists and psychologists put an effort in investigating the concept of academic resilience, and they found interesting patterns in this field (Martin & Marsh, 2009). However, it can easily be the case that also some organizational and economic variables (at school level) do play a role in influencing resilience. Educational production functions (EPFs) can be an interesting approach in this sense, as to model the relationship between school factors and the probability to be a resilient student. In this perspective, the traditional attention of economists to school resources (Hanushek, 1986) can be inserted in this specific research stream; and the research hypothesis to be tested is whether (in the case of disadvantaged schools) resources can actually help students in overcoming their disadvantaged background. Accordingly, in this paper we use the OECD-PISA 2009 wave of data to change the perspective, and investigate not only the role of student characteristics, but also the influence of school-level variables in affecting (disadvantaged) students' performance, in Italy. The focus is on fifteen years old students, who in Italy attend the second year of upper-secondary schooling. Widening the setting, our research question is: are there particular characteristics of disadvantaged schools that are positively associated with students' resilience (the latter defined as the ability of disadvantaged students to obtain high achievement scores)?

In a first stage, we propose a novel statistical procedure to derive a sample of resilient students who attend disadvantaged schools. Our aim, in this case, is to focus our attention on a specific category of resilient students, namely who do not benefit from a higher socio-economic background both at family and school-level; thus, we only selected schools in which the average socio-economic condition (as measured through the OECD indicator ESCS: Economic, Social and Cultural Status) is low. The choice of focusing not only on disadvantaged students, but on the subsample of these students into disadvantaged schools, is motivated on a policy ground. Indeed, students from a disadvantaged background can be helped by attending a school where

classmates are more socioeconomically affluent; the consequent benefits, however, would be not related to "school factors", but to positive peer effects related to a more favourable socioeconomic composition of the schools. Thus, little policy and managerial improvement can be pursued from this situation. On the contrary, restricting the analysis to a group of disadvantaged schools, which have common (disadvantaged) background characteristics, will help in identifying school-level factors specifically related to improving achievement for disadvantaged students (resilience). In other words, there are certainly resilient students also in not-disadvantaged schools, but this kind of resilience can actually be masked by the (advantaged) socioeconomic composition of the schools' body and not influenced by schools' activities.

In a second stage, we perform a multilevel logistic model to investigate which characteristics of students, families and schools, tend to give disadvantaged students a higher probability of becoming resilient. We take advantage of the high number of variables included in the OECD-PISA 2009 dataset, which allows us to test the statistical significance of a relevant number of school-level factors. In this perspective, the paper innovates in putting a relatively higher emphasis on "resilient schools" more than on individuals/students.

Our findings show that some school-level factors are indeed positively associated with students' probability to become resilient. As these factors are related with schools' degree of autonomy, the policy implication is that Italian schools should be allowed to enjoy more freedom in organising their own activities.

The remainder of the paper is organised as follows. Section §2 provides the background for our study. Section §3 describes the methodological approach and data. Section §4 contains the results, while section §5 concludes.

2. Background

2.1. Analysing resilient students

In line with the economic approach, we consider education as a productive process in which schools use students' ability and background to "produce" knowledge (educational production function):

$$y_{ij} = f[X_{1ij}, X_{2j}, \varepsilon_{ij}] \quad (1)$$

where y_{ij} is a measure for the achievement of the ith student at the jth school, X_{1ij} is a vector of student's characteristics, and X_{2j} is a vector of school's characteristics. The economics of education literature aims estimating the coefficients of each variable in the X_{1ij} and X_{2j} vectors.

The present research is specifically linked to those contributions that investigated the impact of schools' factors (processes and resources) on students' achievement. Such literature generally concludes that: "overall resource policies have not led to discernible improvements in student performance" (Hanushek, 2006 p. 902; see also Hanushek, 2003). This result, which is in line with pioneering Coleman's *et al.* (1966) study, has been questioned both theoretically and methodologically, especially in the European and British context, given the predominance of US data in the Hanushek's review: good summaries are provided by Vignoles *et al.* (2000), and Levacic & Vignoles (2002). Of particular interest is the contribution by Holmlund *et al.* (2010), who showed that increased resources in England from 2000 were related to higher achievement scores; moreover, such effect is greater for most disadvantaged students.

The present paper also relates to three other streams of the literature about the effects of school-level variables on students' performance.

The first group of studies is known as "educational/school effectiveness" (Scheerens & Bosker, 1997; Creemers & Kyriakides, 2008). Contributions belonging to this group look at developing school-level indicators and relating them with schools' performances. Scheerens (2000; p. 46), in a survey of the results obtained through the "educational effectiveness" approach, stated that scholars agree on the role exerted by the following factors: (i) achievement orientation (high expectations), (ii) co-operation, (iii) educational leadership, (iv) frequent monitoring, and (v) time, opportunity to learn and "structure" of the main instructional conditions. Our paper uses the OECD-PISA rich school questionnaire to pick up indicators that mirror many of these categories.

Another stream of the literature that influenced our approach is that of "disadvantaged schools". This set of studies suggests that different strategies are required for schools in difficult or challenging circumstances than for those in more advantaged contexts

(Muijs *et al.*, 2004; p. 151). The results provided by Levacic & Woods (2002) further claim to focus the attention to disadvantaged schools, as "(…) social disadvantage (…) also impacts negatively on the rate of improvement in examination results" (p. 208). In other words, such schools not only suffer a worse baseline starting point, but also are likely to improve less over time. In this light, it is then necessary to understand if are there schools' characteristics that can be beneficial in terms of academic achievement in these particular (disadvantaged) circumstances.

Lastly, research devoted to resilient students was informative to specify the focus of our attention on those students who, coming from bad socioeconomic backgrounds, are able to overcome this disadvantage and do well at school. OECD reports (OECD, 2010a) and academic studies (i.e. Martin & Marsh, 2009) were especially useful to conceptualise the type of students of interest for the analysis.

From an economic perspective, it is important for policy makers and stakeholders to be aware of the main drivers (at school level), which foster the resilience and make a positive difference in the lives of more vulnerable students. Moreover, there is evidence that a higher proportion of resilient students, in a country's educational system, is associated with higher (average) students' achievement. In the figure 1, we highlighted the relationship between (i) the percentage of resilient students[1] and (ii) the average OECD-PISA 2009 score, which shows a clear upward slope. Thus, from a policy perspective, it seems useful to investigate the factors associated to increases in the proportion of resilient students, as such factors will contribute to increase the country's educational performance level overall.

<Figure 1> around here

The present paper innovates the existent literature in two ways. First, we target the educational production function approach to a particular category of students, arguing that EPFs can be heterogeneous across different students' typologies. While previous literature suggests that, on average, school-level factors have only a limited effect on

[1]The percentage of resilient students for each country is estimated by OECD (for technical details see OECD, 2011). OECD classifies a student as resilient if "*he or she is in the bottom quarter of the PISA index of economic, social and cultural status (ESCS) in the country of assessment and performs in the top quarter across students from all countries, after accounting for socio-economic background*".

students' performances (Hanushek & Woessman, 2011), we investigate if such finding holds also for the particular group of resilient students. Second, we move the literature on educational effectiveness and resilient students a step further, by focusing not only on resilient students, but also specifically investigating resilient schools, which are characterised by a worse (average) socio-economic condition. This way, the paper explicitly controls for the potential confounding effect due to schools' compositional variables on the single students' performances – as only disadvantaged schools constitute our sample. An innovative by-product of this study is also the development of a novel statistical technique to derive a sample of resilient students within socially disadvantaged schools, which can be applied and extended to other countries in analogous studies. The approach we used in this paper is also to adopt a within-country definition of student resilience, which solves a partial shortcoming in the OECD's definition. Indeed, OECD considers as resilient a student who is in the bottom third of his/her country socio-economic distribution, but in the top third of the international test scores' distribution (OECD, 2011). This way, the definition is mixed, as is the interpretation of results; instead, our method (paragraph 3) allows for a complete and straightforward interpretation at country level.

2.2. The Italian educational system

In Italy, there are about 7.5 millions students, attending 33,000 schools and about 670,000 people are employed as tenured teachers (year 2009/10; source: Ministry of Education, www.miur.it). The educational system is articulated in three main cycles: elementary (primary) – grades 1-5, middle (junior secondary) – grades 6-8, and high (upper secondary) – grades 9-13. Three different types of upper-secondary scholls exist, and students are tracked (through a self-selection mechanism) in these three types: Licei (or "academic" schools), which mainly cover humanities and scientific fields – and are attended by better-off students, technical schools, and vocational schools. Private schools account for almost 8% of the system, and are periodically accredited by the Ministry of Education.

In this section of the paper, it is important to discuss some peculiar characteristics of the Italian educational setting. Italian public schools benefit a low degree of autonomy, in that the Ministry of Education strictly regulates a large part of their

activities. A slow process of devolving more functions to schools began during the nineties, when two laws attributed freedom to schools in organising their own teaching activities (laws n. 537/1993 and n. 59/1997). However, the reality of school autonomy is different from these laws' prescriptions, as school autonomy is constrained by the inability to choose the teachers and manage the budget for their tenured human resources. Indeed, the mechanism to recruit teachers is still centralized, and the Ministry of Education has the responsibility to allocate teachers to schools. In 1998, such responsibility has been devolved to education local authorities called Regional Educational Agency and Provincial Educational Agency; nevertheless, these local authorities are branches of the Ministry of Education. In 1999 a further regulation was approved (D.P.R. n. 275/1999), and it explicitly defines a mechanism for allocating teachers that considers the position of teachers in a local (Province) list. In such lists, teachers are ranked according to a score, which mainly reflects the years of experience (which is highly correlated with age). Thus, the older the teacher, the higher is his/her probability to be employed in the preferred school. Lastly, schools have no power over other most teachers-related matters. For instance, teachers' wages are determined and paid by the national government directly. The single school cannot fire its teachers, as their contracts are regulated (and signed) by the Ministry of Education. Currently, Italian schools manage facilities, integrative projects and have the possibility to collect money by private or local institutions. However, Italian schools tried to use their limited autonomy to experience innovations in the field; for instance, Agasisti & Sibiano (forthcoming) demonstrated that many Italian schools' principals adopted a proactive/entrepreneurial behaviour in organising their extracurricular activities, as well in programming their ordinary teaching duties.

Hence, overall the Italian educational system is characterised by low degrees of school autonomy; a recurrent debate deals with the opportunity to increase the freedom of schools in operating their activities, with the aim of fostering innovation and best practices in the field. This paper contributes to this debate, in that it tries to provide some evidence about the important role of school-level factors. The point of view is particular, and related to a specific aspect of the educational policies; by investigating whether there are school-level practices that are related with higher

students' performances in a specific subsample of (disadvantaged) students and schools, the paper tries to verify if there is a space for widening the role of school managers in implementing effective practices aimed at improving students' performances in difficult contexts and conditions.

3. Methodological approach and data

3.1. A methodology to identify "resilient students" and the dataset

The analysis of resilient students in Italian educational system draws upon OECD-PISA2009 (reading scores)[2]. The aim of the PISA project is to collect highly standardized data that can be used to compare competencies of 15-year-old students in the three main domains of reading, mathematics and science both within and between countries. Since the first cycle in 2000, PISA has been taking place every three years with a growing number of participating countries and each of these cycles looks in depth at a major domain. In 2009, the survey has involved roughly 475,000 students from 65 countries, including all OECD economies, and its main focus is on measuring performance in reading literacy. OECD-PISA not only allows to evaluate students' performance but also to gather data about their families and socio-economic background together with several school characteristics; the latter are particularly important for policy purposes, especially when discussing actions that can be undertaken at school level. School data are collected through a questionnaire filled in by the principals of schools that entered PISA national samples.

Focusing on the performance of Italian students, OECD-PISA2009 (in line with results by the previous editions) underlines the low performance of Italian 15-year olds in relation to their counterparts from most of the developed countries involved in the survey. Italian students reached average test scores – 483 points in mathematics, 486 in reading and 489 in science – consistently below the OECD averages[3] and the gaps between Italian students and their peers in the best performer countries, such as Korea and Finland, are extremely high. In particular, Italian 15 year-old students

[2] More specifically, we used the average of the five Plausible Values (PVs) for reading; the choice of reading instead of mathematics and science is due to the specific focus of the 2009 edition of PISA.

[3] According to PISA 2009 results, only seven OECD countries (*i.e.*, Czech Republic, Slovak Republic, Israel, Luxembourg, Austria, Turkey and Mexico) perform significantly worse than Italy on the reading scale.

perform in reading lower than Korean and Finnish students by an amount equivalent to nearly one year and a half of schooling. Despite of the low achievement of Italian students the proportion of resilient students is higher than the OECD average (OECD, 2011): from a policy and managerial perspective, this specific evidence leads to analysing and identifying the factors that may improve the performance of Italian socio-economically disadvantaged students.

In the literature there is no one commonly-used definition of "student resilience"; therefore resilient students are generally defined as students who come from a disadvantaged socio economic context and yet achieve relatively high level of educational performance. More specifically, OECD (2011) defines resilient students as "(those who) are among the best performers of all students of similar background internationally" (p. 1). In this paper, we propose a "relative" definition of resilience in a within-country perspective, in other words we identify students who are resilient within the country (Italian) sample of students – considering the country (Italian) average level of achievement and socio-economic background.

The subsample of "resilient" students (hereafter, RES) is compared with a complementary group of students defined as "disadvantaged low achievers" (hereafter, DLA) – i.e. students characterized by *jointly* poor socioeconomic background and low performance. In this light the analysis aims to explore the main determinants of student resilience focusing on student and school factors associated with a greater likelihood that a disadvantaged student would be resilient.

The identification of resilient students is based on an index summarizing the socio-economic background of individual students called ESCS. It is a comprehensive measure of socio-economic background, which captures students' family and home characteristics that describe their socioeconomic background. It includes information about parental occupational status and highest educational level, as well as information on home possessions, such as computers, books and access to the Internet (for additional information see OECD, 2012a, Annex A1). Index values are standardized such that the mean is equal to zero and the standard deviation equals one across all students in OECD countries. Therefore, a negative value on this index means that the student's socio-economic background is below that of the OECD

average student; the lower ESCS, the lower is the overall socioeconomic status of the student.

Central to our analytic exercise is to define a group of resilient students within disadvantaged schools. Consistently with previous literature about the results of Italian students in OECD-PISA exercises (Bratti *et al.*, 2007), a prerequisite of this identification procedure is the elimination of middle schools and regional vocational schools from the sample, as these schools are not comparable with the regular secondary schools attended by Italian students when they are 15 years old. The number of these schools is very low, therefore: 9.7% of the overall sample of Italian schools. Afterwards the first step of identification process (figure 2) consists of the selection of schools characterized by an average of ESCS index below the 33th percentile of whole distribution.

<Figure 2> around here

Within the subsample of disadvantaged schools, we dropped students with an ESCS indicator higher than the third quartile of the new distribution (that of students within disadvantaged schools, broadly defined) to guarantee comparability across students and be sure of considering only disadvantaged students. This subsample of disadvantaged students within disadvantaged schools is subdivided by performance thresholds, which are calculated by regressing student performance on the square of ESCS index (to allow for non-linearity in this relationship). The procedure of regressing on the square of ESCS index is coherent with the methodological approach suggested by OECD in selecting resilient students (see, for instance, OECD 2010a). Student performance levels were then defined by dividing regression residuals into equal thirds. Students were divided into three groups – namely successful, average, and low-performers – by looking at their performance in comparison to peers sharing similar socioeconomic background. Other cut-points (e.g., the 25th and 75th percentiles) could be used but the decision to divide the distributions into thirds is driven by balancing (i) the theoretical need for distinction with (ii) the statistical need

for large enough sample size[4]. Students were defined RES if they were disadvantaged students who perform in the top third of performance distribution after accounting for socio-economic background. Similarly, a disadvantaged student whose performance after accounting for socio-economic background lies in the lowest third was defined as DLA. The students in these two groups were then compared to study the determinants of resilience, both at individual and school level.

At the end of the statistical identification procedure (which also dropped the schools with less than 4 students), 302 schools compose the subsample of disadvantaged schools, while the resilient and the disadvantaged low-achievers students are 3,276 (50% are resilient and 50% are low achievers).

It is therefore important to remark some cautions about our dataset. OECD PISA is an important source of information to all those involved with schooling and school systems, and offers a great resource of valid and reliable data. At the same time, PISA also suffers some limitations and drawbacks, which limits its capacity to provide direct statistical estimates of the relationships of students and school factors with educational outcomes. In particular, students' performance depend on many factors, including all the education that they have acquired throughout their whole educational career and their experiences outside the school setting, rather than just the period in which they have interacted with their current teachers. The learning environment considered by PISA may only partially reflect the learning environment that formed students' educational experiences earlier in their school path, particularly in Italian education systems where 15-year-old students have been in the present school for only two or three years and students progress through different types of educational level at the pre-primary, primary, lower secondary and upper secondary levels; to the extent that students' current learning environment differs from that of their earlier school years, the contextual data collected by PISA are an imperfect proxy for students' cumulative learning environments, and the effects of those environments on learning outcomes is likely to be underestimated (OECD, 2010a). Turning to information from the school questionnaire, these are principals' self-reports and may be influenced by several factors in how individuals answer the questions.

[4] Moreover, the choice of three groups allows maintaining a sufficient number of observations (students) within each group.

Furthermore, the study of school resources requires accuracy that might not be easily captured in surveys, for example principal views on adequacy of resources is a weak variable since it does not really have a scale and measurable anchors. It is highly subjective, and also what is asked for represents no more than 10-15% of costs, as the bulk of resources (personnel) are leaving out. Although principals provide information about their schools, this data may be inaccurate and then matching that information with students' reports is not straightforward. Caution is therefore required in interpreting the main results, bearing in mind that there are potential measurement problems and omitted variables.

3.2. Disadvantaged students in Italy: descriptive statistics about low achievers and resilient

Table 1 reports descriptive statistics at individual level; those variables are then used in the multilevel model (§3.3). Here, we use them to describe the main characteristics associated with the status of RES. Immigrant status seems to play a major role; more than 10% of low achievers are immigrants (first or second generation), while they represent only 2% of resilient students. This information can suggest that in Italy immigrants are not completely integrated into the society, and the achievement gap reproduces social gaps (Buchmann & Parrado, 2006; OECD, 2006). The proportion of male students in the low achievers group is in line with previous evidence of relatively low performances with respect to female students, when considering reading (the opposite holds for mathematics) (OECD, 2006). A factor that is particularly important in determining the resilient status is interest for reading (as measured by the variable JOYREAD); on average, resilient students are more interested in reading than the group of low achievers. The latter declare a much lower interest for reading, with negative values and well below the national mean value. Analogously, the attitude towards computer is a specific feature of the resilient students; the values of indicator ATTCOMP[5] are higher for resilient students and

[5] The *index of attitude towards computers* (ATTCOMP) was derived from students' reports on the extent to which they agree with the following statements: *i)* it is very important to me to work with a computer; *ii)* I think playing or working with a computer is really fun; *iii)* I use a computer because I am very interested; and *iv)* I lose track of time when I am working with the computer. Higher values on this index indicate a more positive attitude towards computers.

above the national average. We consider both these indicators as proxies for students' motivation and/or innate ability. As pointed out by previous literature, motivation is one of the key individual-level factors associated with resilience; later on, we show that our results are in line with this evidence, too. A further element, which differentiates RES and DLA, is the relationship between students and teachers. A specific question of OECD-PISA questionnaire is about the sentence "I get along well with most of my teachers"; the answers differ across the two subgroups (90% of RES agree, compared to only 70% of DLA).

<Table 1> around here

When turning to the description of "resilient schools", we use school composition as main criteria. We present descriptive statistics of schools according to the proportion of resilient students, divided in the four quartiles (table 2). The hypothesis is that investigating differences between the various groups of schools would help in observing school-level factors associated with higher performances of disadvantaged students. The high differentiation between school types (*Licei*, technical and vocational schools) is coherent with the institutional characteristics of the Italian educational system, which is characterized by a self-selection of students – with better and advantaged students attending *Licei*. It is interesting to note that while *Licei* are not virtually represented in the first quartile (where there are schools with small proportion of resilient students), they account for the 25% of the fourth quartile – where, in turn, there are not vocational schools. The indicator for available school resources (SCMATEDU)[6] is particularly low for the schools in the first quartile, when compared with other groups and the national average. Such evidence suggests that school resources can be a useful factor to help students in overcoming social (and

[6] The index on the school's educational resources (SCMATEDU) was derived from seven items measuring school principals'perceptions of potential factors hindering instruction at their school (SC11). These factors are: i) shortage or inadequacy of science laboratory equipment; ii) shortage or inadequacy of instructional materials; iii) shortage or inadequacy of computers for instruction; iv) lack or inadequacy of Internet connectivity; v) shortage or inadequacy of computer software for instruction; vi) shortage or inadequacy of library materials; and vii) shortage or inadequacy of audio-visual resources. As all items were inverted for scaling,higher values on this index indicate better quality of educational resources.

achievement) gaps. An even further impact is that related to the time devoted to extracurricular activities. The reference indicator (EXCURACT)[7] is very different in the different groups, with a marked difference between the first and the fourth quartile: the institutions, which involve students more in out-of-curricula activities, are able to assure higher performance to their students. A potential direction for this effect is that extracurricular activities led students to spend less time in the disadvantaged family – and more time to cultural-related activities. Another school-level factor is the shortage of teachers (measured through the variable TCSHORT[8]): principals of schools with low proportion of resilient schools report lower levels of teachers' shortage – and, actually, students:teachers ratios are lower for them than for other groups. Another factor is the reported principal's feeling about students' absenteeism, which is much higher in schools with lower proportion of resilient students, suggesting this is not a major phenomenon in these cases. Lastly, the proportion of immigrants (measured at school level) is decreasing with the proportion of resilient students. Thus, immigrant students are less likely to be resilient, and if segmentation occurs (with high concentration of immigrant students in some schools), it tends to decrease students' resiliency in that school.

<Table 2> around here

We further looked at the distribution of DLA and RES students according to school-level characteristics (figure 3). The distribution of EXCURACT confirms that its mean is higher for RES, even though the overall shape is similar. The proportion of

[7] The index of extra-curricular activities (EXCURACT) was derived from school principals' reports on whether their schools offered the following activities to students in the national modal grade for 15-year-olds in the academic year of the PISA assessment (SC13): i) band, orchestra or choir; ii) school play or school musical; iii) school yearbook, newspaper or magazine; iv) volunteering or service activities; v) book club; vi) debating club or debating activities; vii) school club or school competition for foreign language mathematics or science; viii) <academic club>; ix) art club or art activities; x) sporting team or sporting activities; xi) lectures and/ or seminars; xii) collaboration with local libraries; xiii) collaboration with local newspapers; and xiv) <country specific item>. Higher values on the index indicate higher levels of extra-curricular school activities.

[8] The index of teacher shortage (TCSHORT) was derived from four items measuring school principals' perceptions of potential factors hindering instruction at their school (SC11). These factors are a lack of: i) qualified science teachers; ii) a lack of qualified mathematics teachers; iii) qualified <test language> teachers; and iv) qualified teachers of other subjects. Higher values on this index indicate school principals' reports of higher teacher shortage at a school.

qualified teachers is higher for schools attended by resilient students, suggesting a role for the quality of teaching force. While the distribution of the proportion of computer connected to the web (IRATCOMP) is similar between the two groups, that of the quality of educational resources (SCMATEDU) is much narrow for DLA, confirming that they attend schools in which the quality of educational resources is lower. Of particular interest is the figure about teachers' shortage (TCSHORT), which shows how DLA students attend schools characterised by serious problems on this ground.

<Figure 3> around here

3.3. Investigating the role of different variables on the probability to be a resilient student: the multilevel Logit model

To identify the main determinants of resilience a multilevel logistic regression is used as methodology. This technique is appropriate when the outcome variable for a regression analysis is dichotomous, in this case the outcome denotes whether a disadvantaged student is resilient (RES) or a low achiever (DLA), and it is useful to reflect the hierarchal nature of the education system characterized by students within schools.

Specifically, a two-level logistic random intercept model is adopted, in such models (Raudenbush & Bryk, 2002) giving a Bernoulli sampling model and a logit link function:

$$\eta_{ij} = logit(P_{ij}) = \log\left(\frac{P_{ij}}{1 - P_{ij}}\right) \quad (2)$$

the probability of being a resilient P_{ij} of student *i* from school *j* is modelled using the log of the odds of P_{ij}, i.e the ratio of probability of success (resilient) to the probability of failure (low achiever), as a sum of linear function of the explanatory variables at student and school level:

$$\eta_{ij=}\beta_{0j} + \sum_{k=1}^{m} \beta_k \cdot x_{ij} + \sum_{t=1}^{s} \beta_t \cdot z_{tj} \quad (3)$$

The model has a random intercept (β_{0j}) which varies between schools and it is equal to:

$$\beta_{0j} = \gamma_0 + u_{0j} \quad (4)$$

where γ_0 is the average intercept and u_{oj} is a residual component normally distributed with zero mean and τ_{00} variance:

$$u_{0j} \backsim N(0, \tau_{00}) \quad (5)$$

Then, the final equation of the model can be rewritten as:

$$logit(P_{ij}) = \log\left(\frac{P_{ij}}{1 - P_{ij}}\right) = \gamma_0 + \sum_{k=1}^{m} \beta_k \cdot x_{kij} + \sum_{t=1}^{s} \beta_t \cdot z_{tj} + u_{0j} \quad (6)$$

The second level variance is expressed by τ_{u}^{2} while the model does not include a separate parameter for the first level variance because the level one residual variance of the dichotomous output variable is described by the choice of the Bernoulli distribution rather than estimated separately (Hosmer & Lemeshow, 2000). The first step of estimation strategy consists of an intercept-only model –without covariates- to assess the magnitude of variation between schools in terms of resilience:

$$logit(P_{ij}) = \log\left(\frac{P_{ij}}{1 - P_{ij}}\right) = \gamma_0 + u_{0j} \quad (7)$$

As a second step, student-level variables were added as predictors of student resilience. Two categories of students predictors are included: (i) attitudinal factors ("motivation") which include Attitude towards computers, Attitude towards school and Joy/Like Reading, (ii) family's and personal characteristics: gender, immigration status and family structure.

Predictors of resilience at the school level included variables in the categories of school context, school resources and school policies and practices. School context variables are largely beyond the control of school and they include the school category (*Licei*, technical or vocational), the macro area and the school location (village, small town, town, city and large city). Category of school resources encompasses an index on the school's educational resources, an index of availability of computers, the proportion of qualified teachers, the student-teacher ratio and the index of teacher shortage. School climate and school practices are generally within the control of school employees and students it includes an index of extra-curricular activities, the principal perception of students absenteeism, the use of standardized assessment to make decisions about students' retention or promotion, the use of achievement data to evaluate teachers and principal's performance.

4. Results

The results obtained through the multilevel logit model presented in section §3.3 are reported in the table 3. In each column, different groups of variables are included into the model: (i) empty model, (ii) student's characteristics, (iii) schools' type and school factors, and (iv) macro-area dummies.

<Table 3> around here

The likelihood ratio test, which allows determining whether the between-cluster variance is equal to zero, gives a p-value <0.001 for each estimated model, suggesting that a multilevel approach is indeed required[9].

[9] The intercept in the unconditioned model is not statistically significant; such result is due to the composition of our sample, which hosts an equivalent 50% proportion of resilient and low-achievers

Student-level variables show some well-known facts, in that personal characteristics play a major role. The expected odds of female students' resilience are 3.43 times the odds of retention of male counterparts, while immigrant status is associated with lower log-odds of resilience equal to -2.13. An important point to be discussed is that our results show that a high proportion of immigrant students characterises the group of low performers students. The same holds for the "disadvantaged schools", which are characterized by higher proportions of immigrant students. This specific characteristic is likely to partially affect our results, as it drives the most part of the disadvantage phenomenon and, inversely, the probability of resilience. As descriptive statistics showed (table 2), the proportion of immigrants (measured at school level) is inversely related to the proportion of resilient students in a school; this evidence suggests that a high concentration of immigrant students acts as a negative peer effect, at least for those students who come from a disadvantaged background.

What is interesting to observe is that two individual-level variables capturing motivation, namely "joy in reading" (JOYREAD) and "positive attitude towards computers" (ATTCOMP) are positively associated with the probability to be resilient; as discussed in previous studies conducted by OECD, such individual factors are important to overcome a disadvantaged background. On the contrary, the structure of the family (i.e. the number of siblings, etc.) seems not related to the resilience probability. Lastly, the other student-level feature that is positively related to the probability of being a resilient student is the teachers' behaviour: "resilient students" are those who get along well with teachers. This effect is particularly strong: the odds ratio is around 3.93 points, and statistically significant. A potential interpretation is that in these schools, teachers collaborate on important and challenging aspects of their job, and helping disadvantaged students is probably one of these tasks; as a result, it looks that students get along well with them. Moreover, a more favourable school climate – of which relationships between students and teachers, as well as among teachers is a key element – has been demonstrated to be positively related to students' results, especially for low-income children (Lowenstein, *et al.*, 2011).

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students. The estimated variance of random intercept in the empty model is equal to 7.5, but introducing student-level variables (model 2) it is even larger than it was in the empty model; this finding is explained by adding level one variables with strong effect will tend to increase estimated level-two variance (Snijders & Bosker, 1999).

When adding school-level variables (model 3), student-level variables maintain their statistical significance and estimated coefficients, while the second-level variance steeply decreases (27% overall, from 8.93 to 6.53), meaning that our school-level variables capture a large parte of between-schools variation in influencing the probability of a student becoming resilient. The most interesting results deal with the inclusion of school-level resources and characteristics, as our aim is to underline whether "resilient schools" show features, which are positively associated with the probability to become a resilient student – that is, resilient students take advantage of the school they attend. In this perspective, we would investigate whether school-specific activities, like extracurricular activities or school climate, differ across schools and in influencing (resilient) students' results. If there is any influence of this kind, reflections about the desirable degree of school autonomy can be derived.
The school type matters a lot in predicting the probability to be a RES. Students enrolled in *Licei* schools are more likely to become resilient, when compared with those enrolled in technical and professional schools. Alternative explanations exist here. On one side, it has been demonstrated that students from more advantaged backgrounds tend to enrol to *Licei* more than those with disadvantaged backgrounds (Brunello & Checchi, 2007). However, here all the students in the sample come from less-advantaged background – as it is a prerequisite to become resilient; so this explanation can be safely ruled out. Thus, the other potential explanation is that *Licei* can have different characteristics, which help in raising students' performances. To test this hypothesis, we compared the available resources and other indicators to detect whether are there statistically different features among school types. Such an analysis has been conducted through ANOVA and Tukey's tests[10], which in turn do not reveal any statistical difference in available resources between *Licei* and other schools (Annex 1). As a consequence, our remaining interpretation is that *Licei*'s advantage can reside in their positive peer effects, as in average they are attended by students who are more motivated. Even though it is not possible to test directly such

[10] Tukey's multiple comparison test is used to compare the difference between each pair of means with appropriate adjustment for the multiple testing. Tukey's test calculates a critical value that can be used to evaluate whether differences between any two pairs of means are significant.

hypothesis, the lack of observable differences in terms of resources point to this direction.

It is interesting to note that schools' resources seem partially related to resilience: while the availability of computers (IRATCOMP) does not gain statistical significance, the index for the "quality" of educational resources (SCMATEDU) is positively associated with resilience (odds ratio = 1.55).

Among the other factors debated in the descriptive statistics, the effect of extracurricular activities (EXCURACT) is statistically significant and positive. As previously discussed, probably this variable captures the ability of a school to make its students less dependent on the family's cultural influence; at the same time, it might be the case that such indicator is a proxy of the overall cultural life (not only the curricular side) of the school. This latter finding is crucial in the argument of this paper; indeed, it sheds light on controllable factors that can positively influence students' performances. More specifically, our results suggest that disadvantaged schools should invest their resources in extracurricular activities, with the aim of (relatively) reducing the negative influence of the family background by involving students in cultural-related free activities. In addition, it is also likely that this variable captures some unobservable attitude of the students towards more engagement with the school's environment. Confirming this intuition, OECD (2012b) shows that schools with higher levels of extracurricular activities also report more positive attitudes towards subjects, suggesting that there is a link between extracurricular and engagement with curricular activities.

Some caution is required in interpreting the effect of teacher shortage (TCSHORT) on the likelihood of resilience. Indeed, this indicator is not based on objective data, but it reflects a principal's perception and it may be affected by measurement errors, which limit its validity and accuracy (White & Smith, 2005). The analysis seems to suggest that a higher shortage of teachers (TCSHORT) is positively related to the probability of resilience: a potential explanation might be that the availability of teachers is a key feature for making the school more able to assist disadvantaged students; then principals who care more about this problem (declaring a high shortage/need of teachers) operate in resilient schools. Lastly, it can be noted that schools, which care more about the problem of absenteeism, are more likely to be resilient. These results

are encouraging, as they are coherent with the role of EXCURACT: when students do not attend regularly schools, and spend less time in a favouring climate (the school as an educational community), it is more probable that they become DLA than RES. Then, also this indicator is coherent with the explanation that worse background family characteristics (to which absenteeism is surely related) can be attenuated by proactive behaviours of schools' actors – in this case, the extent to which the schools care about absenteeism. Overall, the results associated with variables obtained through principals' answer point at a confirmation that leadership exerted by principals themselves is an important feature of "resilient schools".

The inclusion of macro-area dummies (model 4) improves the model's explanatory power. The macro-area geographical factor is confirmed as one of the key explanation for students' performance in Italy, corroborating huge evidence in this sense (Montanaro, 2008; Agasisti & Vittadini, 2012). RES students are more likely to study in Northern Italy than in the South, in particular a student who attends a school of the North-East macro area has an odds of resilience 11 times greater than a students of a school of macroarea South and Islands. As a consequence, the model shows that not only family's socio-economic background is relevant, but also the wider territorial context plays a central role in influencing students' performance and resilience, and this creates vicious circles of virtuous consequences depending on the surrounding context. Indeed, students from disadvantaged families can benefit from living in socially and economically developed areas; thus, a better welfare climate can help these disadvantaged students in their climbing the "social pyramid". On the contrary, depressed social contexts add a negative "external" burden to the (already bad) situation of students from disadvantaged families living in these communities.

5. Concluding remarks

Overall, our study innovates the literature on the results of Italian students, by using OECD-PISA data in a new fashion. By focusing on a specific subgroup of students and schools, namely those that are more disadvantaged, we investigated the determinants of resilience – defined as the ability of overcoming a disadvantaged background.

From an economic perspective, the key message of this paper is that some "soft" managerial and organizational features of schools are as important as resources in helping students to become resilient. Better school climate and leadership characterise the "resilient schools". The policy implication is that reforms should promote those activities and dimensions of schools that favour (i) better relationships between students and teachers, as well as (ii) the diffusion of (good) extracurricular activities, together with (iii) the provision of adequate resources for curricular teaching – to avoid teachers' shortage and improving quality of teaching activities.

Overall, the school-level variables, which turn out as significantly related to the resilient status, confirm the importance of the quality of the teaching force; a result that is growingly confirmed and important in the economics of education. Our findings are in line with this evidence, as all the school factors which were statistically significant in explaining students' performance are related to the activities developed through teachers (quality of educational resources, teachers' shortage, extracurricular activities, etc.). In this direction, the results suggest that school factors can be useful to improve the performance of disadvantaged students; and, more precisely, that disadvantaged schools with certain characteristics can actually have an impact on their (disadvantaged) students.

From a policy perspective, this result is particularly relevant for the Italian context. As described in section §2, Italian schools have a low degree of autonomy; as a matter of fact, they cannot select their teachers, nor autonomously regulated their teaching programs and methods. The evidence presented in this paper confirms the necessity to increase the degree of schools' autonomy, as those dimensions on which they are already autonomous (i.e. extracurricular activities) turn out as positively related to the students' performances. Policies inspired by School Based Management (SBM) approaches can be useful in this direction (i.e. Dimmock, 1993).

A specific point is related to the possibility that leadership at school-level can exert a positive impact on students' results. A relevant literature points at this evidence (see for instance Sammons *et al.*, 2011 for the British case), and our findings are coherent in showing that, for instance, when schools' principals care about their students' behaviours (specifically, absenteeism) these schools are able to improve students' probability to be resilient.

Another key point is that geographical differences exist: schools in Northern Italy are more likely to impact positively on resilience. In the light that territorial differences are striking in explaining students' achievement differentials, this finding is particularly worrying. Indeed, it means that being immersed in a positive economic and social environment – often related to Northern Provinces – has an impact not only on overall students' performances, but also on the ability of less advantaged students to overcome their situation.

Summarizing, this study underlines the importance of looking at the bottom of the educational opportunities' distribution, and finds solutions for improving the performance of students who come from more disadvantaged contexts. While the bad news is already known, that is disadvantaged families and territorial's background are extremely related to bad academic performances; the good news is that it is possible to detect many school factors, which can positively help those disadvantaged students.

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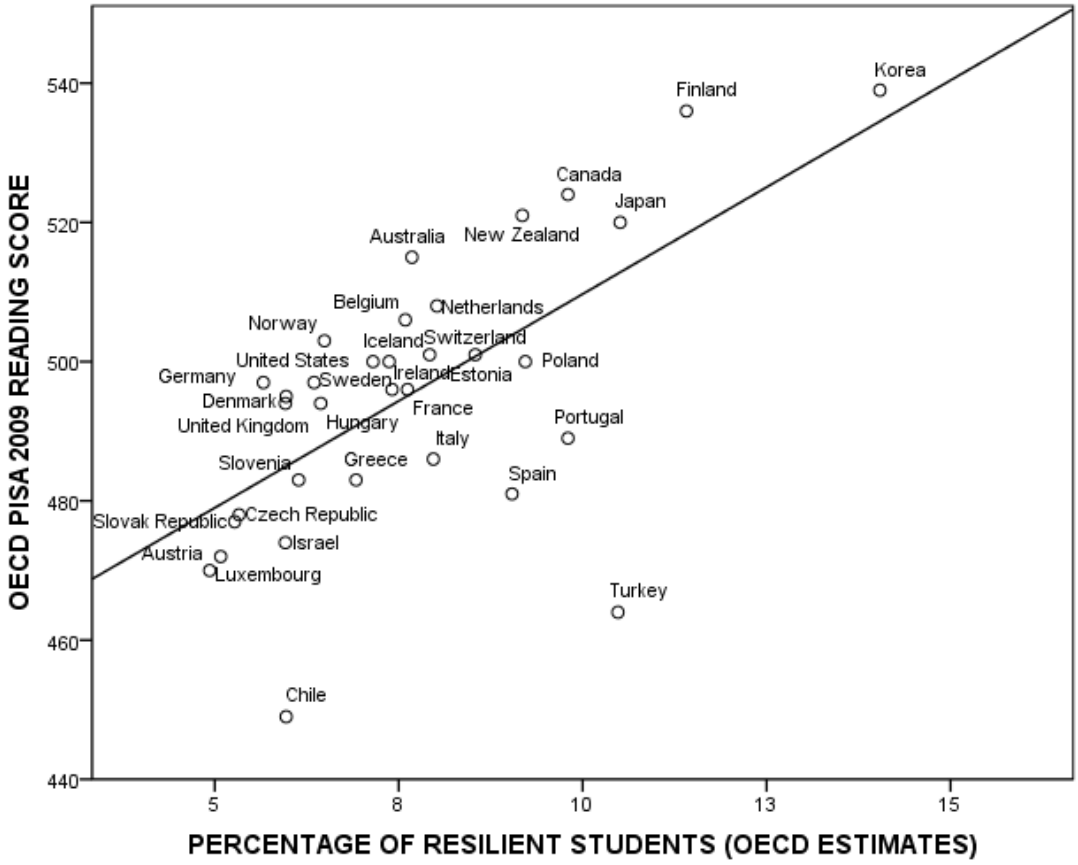
Figure 1. Resilient students and students' achievement:
a cross-country comparison - OECD-PISA2009 data



Notes: Mexico has been dropped as it shows an outlier achievement score (very low) in the sample.
R-squared of the relationship is around 0.41.

Figure 2. The multistage procedure to identify resilient (RES)
and Disadvantaged Low Achievers (DLA) students attending disadvantaged schools

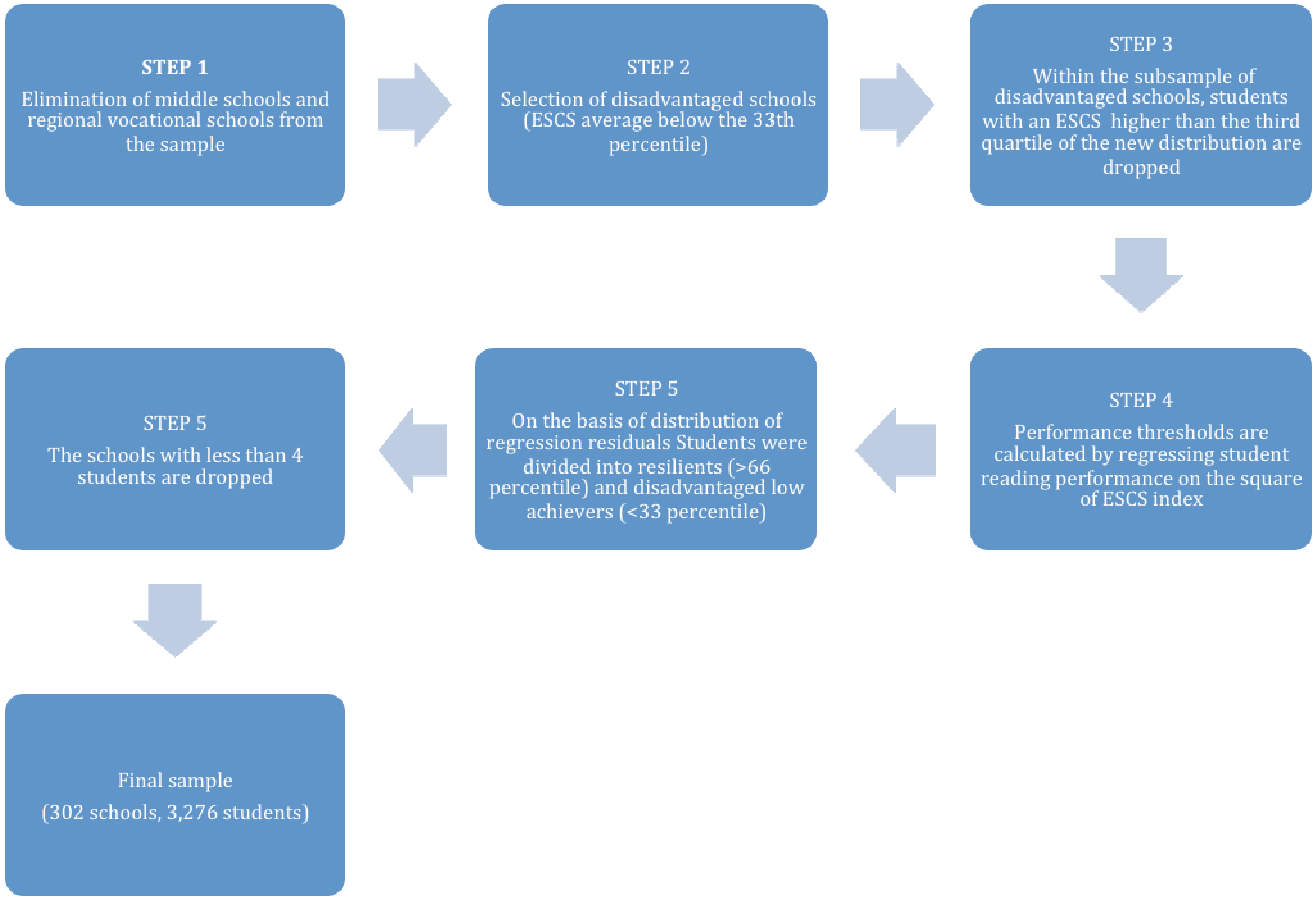


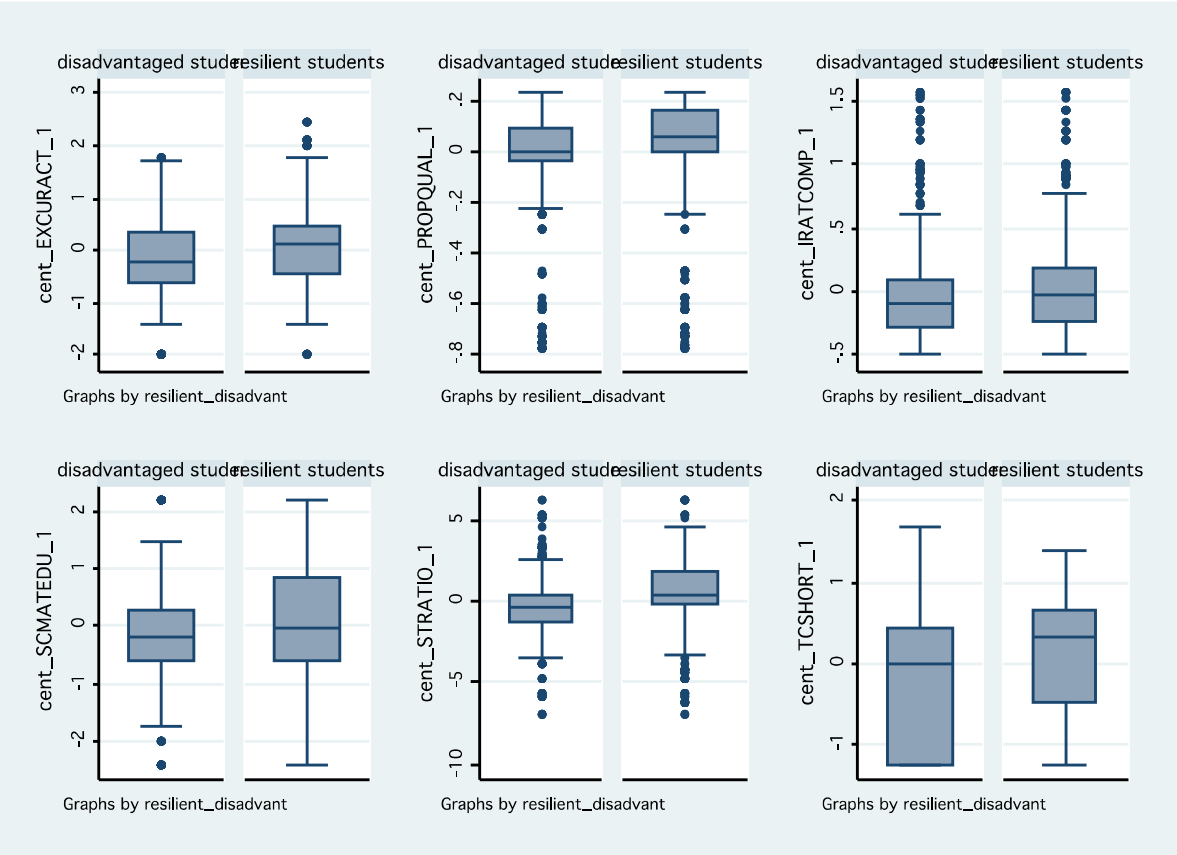
Table 1. Descriptive statistics: student-level variables

	Disadvantaged students – "low achievers"				Disadvantaged students – "resilients"				Italian students overall OECD PISA2009 samples			
	Mean	Std. Dev.	Min.	Max.	Mean	Std. Dev.	Min.	Max.	Mean	Std. Dev.	Min.	Max.
Reading performance (expressed by plausible values)	330.31	40.46	133.85	388.54	531.45	36.19	446.43	668.39	486.000	96.000	41.32	731.520
Index of Economic and Cultural Status (ESCS)	-0.979	0.593	-3.312	-0.068	-0.979	0.575	-2.921	-0.07	-0.123	1.015	-3.959	3.020
Immigration status=Native	0.892	0.310	0.000	1.000	0.974	0.160	0.000	1.000	0.936	0.245	0.000	1.000
Immigration status=Second generation	0.017	0.130	0.000	1.000	0.008	0.089	0.000	1.000	0.013	0.114	0.000	1.000
Immigration status=First generation	0.090	0.287	0.000	1.000	0.018	0.134	0.000	1.000	0.042	0.200	0.000	1.000
Gender=male	0.722	0.448	0.000	1.000	0.389	0.488	0.000	1.000	0.514	0.5	0.000	1.000
Gender=female	0.278	0.448	0.000	1.000	0.611	0.488	0.000	1.000	0.486	0.5	0.000	1.000
Family structure=Single parent	0.098	0.297	0.000	1.000	0.109	0.311	0.000	1.000	0.11	0.313	0.000	1.000
Family structure=Nuclear	0.873	0.333	0.000	1.000	0.888	0.316	0.000	1.000	0.867	0.339	0.000	1.000
Family structure=Mixed	0.029	0.169	0.000	1.000	0.004	0.06	0.000	1.000	0.01	0.101	0.000	1.000
Index of Attitude towards computers	0.071	0.893	-2.441	0.861	0.359	0.707	-2.441	0.861	0.288	0.766	-2.441	0.861
Index of Attitude towards school	-0.125	0.990	-2.989	2.009	0.021	0.883	-2.989	2.009	0.026	0.946	-2.989	2.009
Index of Joy/Like Reading	-0.466	0.694	-3.227	2.238	0.130	0.924	-3.227	3.495	0.063	0.943	-3.227	3.495
Teachers - Get along well=strong disagree	0.103	0.304	0.000	1.000	0.024	0.153	0.000	1.000	0.048	0.213	0.000	1.000
Teachers - Get along well=disagree	0.151	0.359	0.000	1.000	0.118	0.323	0.000	1.000	0.130	0.337	0.000	1.000
Teachers - Get along well=agree	0.545	0.498	0.000	1.000	0.614	0.487	0.000	1.000	0.598	0.490	0.000	1.000
Teachers - Get along well=strong agree	0.200	0.400	0.000	1.000	0.245	0.430	0.000	1.000	0.219	0.413	0.000	1.000

Table 2. Descriptive statistics: school-level variables, quartiles by proportion of resilient students in the school

	Subsample: all			1st quartile		2nd quartile		3rd quartile		4th quartile	
	Mean	St.Dev.		Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
School type: Licei	0.089	0.286		0.000	0.000	0.039	0.196	0.067	0.251	0.253	0.438
School type: technical schools	0.394	0.489		0.184	0.390	0.382	0.489	0.467	0.502	0.547	0.501
School type: vocational schools	0.517	0.501		0.816	0.390	0.579	0.497	0.467	0.502	0.200	0.403
Index on the school's educational resources (SCMATEDU)	-0.287	0.930		-0.405	0.802	-0.429	0.741	-0.251	1.155	-0.062	0.944
Index of availability of computers (IRATCOMP)	0.604	0.414		0.587	0.454	0.638	0.424	0.606	0.417	0.586	0.361
Proportion of qualified teachers	0.771	0.224		0.738	0.174	0.760	0.240	0.790	0.242	0.798	0.231
Index of Extra-curricular activities offered by school (EXCURAT)	-0.146	0.764		-0.324	0.730	-0.229	0.814	-0.074	0.762	0.046	0.705
Students/teachers ratio (STRATIO)	7.479	1.909		7.016	1.789	7.254	1.867	7.506	1.518	8.150	2.240
Index of TEACHER SHORTAGE (TCSCHORT)	0.191	0.830		0.127	0.820	0.127	0.871	0.073	0.848	0.439	0.738
Proportion immigrant students	0.055	0.078		0.082	0.099	0.053	0.079	0.041	0.063	0.042	0.058
Achievement Principal	0.169	0.375		0.197	0.401	0.158	0.367	0.200	0.403	0.120	0.327
Achievement Teachers	0.205	0.405		0.289	0.457	0.145	0.354	0.240	0.430	0.147	0.356
Assessments - Student Promotion	0.854	0.353		0.789	0.410	0.816	0.390	0.867	0.342	0.947	0.226
Location: village	0.033	0.179		0.026	0.161	0.039	0.196	0.000	0.000	0.067	0.251
Location: small town	0.291	0.455		0.237	0.428	0.289	0.457	0.333	0.475	0.307	0.464
Location: town	0.500	0.501		0.539	0.502	0.461	0.502	0.547	0.501	0.453	0.501
Location: city	0.149	0.357		0.158	0.367	0.197	0.401	0.107	0.311	0.133	0.342
Location: large city	0.026	0.161		0.039	0.196	0.013	0.115	0.013	0.115	0.040	0.197
Care about student absenteeism: not at all	0.033	0.179		0.013	0.115	0.026	0.161	0.040	0.197	0.053	0.226
Care about student absenteeism: very little	0.225	0.418		0.171	0.379	0.171	0.379	0.213	0.412	0.347	0.479
Care about student absenteeism: to some extent	0.563	0.497		0.539	0.502	0.645	0.482	0.560	0.500	0.507	0.503
Care about student absenteeism: a lot	0.179	0.384		0.276	0.450	0.158	0.367	0.187	0.392	0.093	0.293
Macroarea: North West	0.113	0.317		0.079	0.271	0.092	0.291	0.107	0.311	0.173	0.381
Macroarea: North East	0.156	0.363		0.079	0.271	0.079	0.271	0.160	0.369	0.307	0.464
Macroarea: Central Italy	0.126	0.332		0.211	0.410	0.118	0.325	0.133	0.342	0.040	0.197
Macroarea: South	0.288	0.454		0.303	0.462	0.382	0.489	0.227	0.421	0.240	0.430
Macroarea: Isles	0.318	0.466		0.329	0.473	0.329	0.473	0.373	0.487	0.240	0.430

Figure 3. The distribution of school level variables:
resilient students (RES) versus disadvantaged low-achievers (DLA)



Notes: all the variables are centred on the mean.
The name of the variables can be read in the vertical axis.
On the left: disadvantaged low achievers (DLA); on the right: resilient students (RES).

Table 3. The results from the multilevel logit model

	empty model		model 2			model 3			model 4		
	Coeff.	**Std.err.**	**Coeff.**	**Std.err.**	**odds ratio**	**Coeff.**	**Std.err.**	**odds ratio**	**Coeff.**	**Std.err.**	**odds ratio**
intercept	-0.154	0.172	-1.776***	0.351		-1.946***	0.589		-2.280***	0.622	
Attitude towards computers			0.456***	0.080	1.578***	0.461***	0.080	1.585	0.459***	0.080	1.583
Attitude towards school			-0.097	0.073	0.907	-0.094	0.073	0.911	-0.094	0.073	0.911
Joy/Like Reading			0.869***	0.088	2.385***	0.878***	0.088	2.407	0.883***	0.088	2.419
immigrate			-2.128***	0.301	0.119***	-2.075***	0.298	0.126	-2.172***	0.301	0.114
sex=female			1.233***	0.146	3.432***	1.138***	0.145	3.122	1.133***	0.145	3.105
dum_family_structure			-0.003	0.193	0.997	-0.016	0.193	0.984	-0.023	0.193	0.977
Teachers - Get along well - disagree			0.929***	0.338	2.533***	0.911***	0.337	2.486	0.898***	0.337	2.456
Teachers - Get along well - agree and strong agree			1.370***	0.305	3.934***	1.349***	0.304	3.854	1.355***	0.303	3.877
Lyceum						2.414***	0.650	11.183	2.936***	0.629	18.840
village o smalltown						0.468	0.396	1.597	0.145	0.389	1.156
city o largecity						-0.248	0.468	0.780	-0.576	0.445	0.562
Index on the school's educational resources (SCMATEDU)						0.442**	0.199	1.555	0.349*	0.188	1.418
The index of availability of computers (IRATCOMP)						0.157	0.449	1.170	-0.023	0.427	0.977
proportion of qualified teachers						0.611	0.742	1.842	0.934	0.708	2.546
The student-teacher ratio (STRATIO)						0.297***	0.098	1.345	0.236**	0.093	1.266
The index of teacher shortage (TCSHORT)						0.482**	0.206	1.620	0.369*	0.194	1.446
The index of extra-curricular activities (EXCURACT)						0.702***	0.231	2.019	0.560**	0.218	1.751
Achievement Principal						-0.386	0.519	0.680	-0.531	0.493	0.588
Achievement Teachers						-0.533	0.486	0.587	-0.276	0.460	0.759

	empty model		model 1			model 3			model 4		
	Coeff.	**Std.err.**	**Coeff.**	**Std.err.**	**odds ratio**	**Coeff.**	**Std.err.**	**odds ratio**	**Coeff.**	**Std.err.**	**odds ratio**
student_absenteism_a lot						-1.433***	0.457	0.239	-1.152***	0.434	0.316
assessment_student_promotion						0.495	0.486	1.641	0.224	0.464	1.252
North East									2.422***	0.524	11.268
North west									1.620***	0.554	5.053
Center									-0.627	0.548	0.534
South									0.435	0.423	1.545
Random effects	Estimate	Stand. Err.	Estimate	Stand. Err.		Estimate	Stand. Err.		Estimate	Stand. Err.	
Intercept (s.d.)	2.739	0.170	2.990	0.190		2.556	0.166		2,1648	0.157	
Log likelihood	-1455.202		-1270.127			-1219.258			-1202.907		
LR test vs. logistic regression	1629.710		1477.680			1003.510			834.49		
Prob>=chibar2	0.000		0.000			0.000			0.000		

note: *** p<0.01, ** p<0.05, * p<0.1

Annex 1. Differences between *Licei* and other schools

We firstly conducted an ANOVA to observe whether are there differences among different school's types (*Licei*, technical and vocational), in terms of available resources. The results are illustrated in table A.1.

<Table A.1> here

The findings underline that, for all variables – with the exception of TCSHORT -, the mean value is statistically different between groups. However, this result does not imply that *Licei* are different from other schools, but that at least one group of schools is statistically different. To determine if *Licei* are more resourced than other schools, we conducted a pairwise Tukey's test (table A.2).

<Table A.3> here

The empirical analysis shows that *Licei* and technical schools have very similar characteristics, and the latter have even better quality resources than the former. Instead, professional schools suffer a strong limitation of available resources – which explains the results from ANOVA.

Such characteristic of our sample is particularly important, as these differences (or this lack of differences between *Licei* and technical schools) hold in the subsample of disadvantaged schools, while similar tests in the whole sample of Italian students reveal that *Licei* have indeed better resources, on average.

Table A.1. Univariate ANOVA

		Sum of squares	df	Mean of squares	F	Sig.
SMEAN(SCMATEDU)	Between	209.866	2	104.933	130.415	0.000
	Within	2632.684	3272	0.805		
	Total	2842.549	3274			
SMEAN(EXCURACT)	Between	71.614	2	35.807	66.895	0.000
	Within	1751.408	3272	0.535		
	Total	1823.021	3274			
SMEAN(PROPCERT)	Between	3.953	2	1.976	80.135	0.000
	Within	80.700	3272	0.025		
	Total	84.653	3274			
SMEAN(IRATCOMP)	Between	20.244	2	10.122	74.412	0.000
	Within	445.079	3272	0.136		
	Total	465.323	3274			
SMEAN(TCSHORT)	Between	2.323	2	1.161	1.757	0.173
	Within	2162.619	3272	0.661		
	Total	2164.942	3274			
SMEAN(STRATIO)	Between	1039.546	2	519.773	168.015	0.000
	Within	10122.271	3272	3.094		
	Total	11161.817	3274			
Index of economic. social and cultural status (WLE)	Between	6.538	2	3.269	9.640	0.000
	Within	1109.660	3272	0.339		
	Total	1116.198	3274			

Table A.2. Tukey's tests

	(I) School type	(J) School type	Mean differences (I-J)	St.err.	Sig.	Confidence intervals 95%	
						Sup.	Inf.
SMEAN(SCMATEDU)	LICEI	Technical	-0.693*	0.056	0.000	-0.825	-0.561
		Vocational	-0.225*	0.055	0.000	-0.354	-0.097
	Technical	LICEI	0.693*	0.056	0.000	0.561	0.825
		Vocational	0.468*	0.033	0.000	0.390	0.546
	Vocational	LICEI	0.225*	0.055	0.000	0.097	0.354
		Technical	-0.468*	0.033	0.000	-0.546	-0.390
SMEAN(EXCURACT)	LICEI	Technical	0.020	0.046	0.903	-0.088	0.128
		Vocational	0.312*	0.045	0.000	0.207	0.416
	Technical	LICEI	-0.020	0.046	0.903	-0.128	0.088
		Vocational	0.292*	0.027	0.000	0.228	0.356
	Vocational	LICEI	-0.312*	0.045	0.000	-0.416	-0.207
		Technical	-0.292*	0.027	0.000	-0.356	-0.228
SMEAN(PROPCERT)	LICEI	Technical	0.045*	0.010	0.000	0.022	0.068
		Vocational	0.101*	0.010	0.000	0.078	0.123
	Technical	LICEI	-0.045*	0.010	0.000	-0.068	-0.022
		Vocational	0.056*	0.006	0.000	0.042	0.069
	Vocational	LICEI	-0.101*	0.010	0.000	-0.123	-0.078
		Technical	-0.056*	0.006	0.000	-0.069	-0.042
SMEAN(IRATCOMP)	LICEI	Technical	-0.273*	0.023	0.000	-0.328	-0.219
		Vocational	-0.178*	0.023	0.000	-0.231	-0.125
	Technical	LICEI	0.273*	0.023	0.000	0.219	0.328
		Vocational	0.095*	0.014	0.000	0.063	0.127
	Vocational	LICEI	0.178*	0.023	0.000	0.125	0.231
		Technical	-0.095*	0.014	0.000	-0.127	-0.063
SMEAN(TCSHORT)	LICEI	Technical	0.078	0.051	0.280	-0.042	0.197
		Vocational	0.093	0.050	0.146	-0.023	0.210
	Technical	LICEI	-0.078	0.051	0.280	-0.197	0.042
		Vocational	0.015	0.030	0.867	-0.056	0.086
	Vocational	LICEI	-0.093	0.050	0.146	-0.210	0.023
		Technical	-0.015	0.030	0.867	-0.086	0.056
SMEAN(STRATIO)	LICEI	Technical	1.285*	0.110	0.000	1.026	1.544
		Vocational	1.896*	0.107	0.000	1.645	2.149
	Technical	LICEI	-1.285*	0.110	0.000	-1.544	-1.026
		Vocational	0.611*	0.065	0.000	0.458	0.765
	Vocational	LICEI	-1.896*	0.107	0.000	-2.149	-1.645
		Technical	-0.611*	0.065	0.000	-0.765	-0.458
Index of economic. social and cultural status (WLE)	LICEI	Technical	-0.057	0.037	0.269	-0.142	0.029
		Vocational	0.039	0.036	0.525	-0.045	0.122
	Technical	LICEI	0.057	0.037	0.269	-0.029	0.142
		Vocational	0.095*	0.022	0.000	0.044	0.146
	Vocational	LICEI	-0.039	0.036	0.525	-0.122	0.045
		Technical	-0.095*	0.022	0.000	-0.146	-0.044

*. Statistical difference: 0.05.

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