Peer effects between non-native and native students: first evidence from Italy

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Abstract

This work focuses on 'peer effects' among pupils of different ethnic origins attending the same junior high school in Italy. In order to retrieve unbiased measures of the effects of non-native peers exposure on natives' attainment levels (*between-groups effects*), and of non-native peers exposure on non-natives' attainment levels (*within-group effects*), we exploit a unique dataset combining three different information sources: the *INVALSI First Cycle Test* data, administrative records from Ministry of Education Statistical Office, and data from Italian Population Census Survey. We base the estimation strategy on an aggregation procedure at school level and we tackle the potential omitted variable bias due to across school sorting with an instrumental variable approach. OLS estimates of the baseline model show a negative and significant effect of non-Italian students concentration on Italian peers' test score, but this evidence is reversed in the 2SLS estimates. The instrument used is a measure of immigrant concentration in the 'school catchment-area' that predates the outcome measure of ten years. Results are also robust to sensitivity checks, and across different specifications of peer groups based on citizenship, parents' origins and student's place of birth.

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Contents

1. Motivations and aims of the research

There is a vast literature on the effects of immigration on native labour market outcomes, but the question of whether immigration affects natives educational outcomes has received relatively little attention (Brunello and Rocco, 2011; Gould *et al.*, 2009)[2]. Economic literature on the effects of non-native students on the school systems in general, and on native peers' achievement is actually quite limited. While the first studies date back to the 'Coleman Report' (1966), works focused on the specific issue of the peer influence of non-native students on native students' educational outcomes only appeared in the last fifteen years, and developed an autonomous strand of literature only in recent years.

Our research focuses on 'social interactions'[3] among pupils of different ethnic origins attending the same class or the same school. In the existing literature social interactions among schoolmates are commonly referred to as 'peer effects' or 'peer-groups effects'[4]. Peer influence in general, but also in the specific case of the interactions between native and non-native students, may involve different outcomes such as achievement levels (as measured by test scores), teen pregnancy, drug use, high school attrition and drop-outs, college choice (Hanushek *et al.*, 2003), and it may have an effect in the accumulation and development of both cognitive and non-cognitive skills (Neidell and Waldfogel, 2010).

Dealing with peer effects of non-natives on natives' educational outcomes (and vice versa), we want to identify the effects on educational outcomes of non-natives on their native peers, and, in particular, we are interested in the identification of the causal link of the non-natives concentration on the educational outcomes of native students[5]. The research questions we try to answer are the following: are educational outcomes of native students influenced by the achievement of their non-

[2] Gould *et al.* (2009), "*[...] the effect of immigration on the local labour market has received considerable attention in the literature, but little is known about the impact of immigration on the school system".*

[3] We define 'social interactions' all forms of interdependencies among individuals in which preferences, beliefs and constraints faced by one socioeconomic actor are *directly* influenced by the characteristics and choices of others (Durlauf and Ioannides, 2009). Peer group influence is a particular form of social interaction. It refers to contemporaneous, and usually reciprocal, behavioural influences within a reference group so that the propensity of an agent to behave in some way varies positively with the prevalence of this behaviour in the group (Durlauf, 2004, and Manski, 2000). These interactions usually produce the well documented empirical regularity that "[...] agents belonging to the same group tend to behave similarly" (Manski, 2000).

[4] This terms usually indicates social interactions of children or young adults with people of similar age, in order to make a distinction from the broader 'neighbourhood effects' stemming from interactions with superiors, family or teachers (Gibbons and Telhaj, 2006).

[5] Data from Italian Ministry of Education generally only distinguish between *Italian* and *non-Italian* students, thus referring to a pure citizenship criterion. According to well-established criteria (see, for example, OECD, 2010), individuals whose parents were born abroad are defined as '*immigrants*': they are '*first generation immigrants*' if born abroad or '*second generation*' if born in the host country. All students born in the receiving country who have at least one parent who was also born inside the country are referred to as '*native*'. Loosely speaking, in the introductory part of the paper we often use these terms as synonyms, while in the applied work we will strictly refer to the Pisa-OECD (2010) categorization. See Appendix B for detailed description of categories creation.

native peers (and vice-versa)? If it is the case, in which way? Does the concentration of immigrant students influence natives' attainments? Because of the lack of other sufficiently reliable educational or outcome measures, we focus on attainment levels as proxied by standardized test scores. For our purposes, we use a unique and rich dataset for Italy (*INVALSI First Cycle Test*), combining the results of national test scores of all students at the end of the first cycle of Italian school system (8th grade students, i.e. students finishing their third year of the Italian middle grade comprehensive school[6]) with census data and administrative records on schools characteristics and socio-economic environment.

In the last two decades, a lot of Western countries have experienced massive immigration waves having different impacts and features in each country. Despite the growing relevance of this phenomenon in most European countries, and the well-established desegregation literature in the U.S., studies investigating the peer interaction between native and non-native students in European schools are just a few. Ammermueller and Pischke (2009) use PIRLS test scores to analyse, among others, peer effects in the ethnic composition of primary schools in Germany, France, Iceland, the Netherlands, Norway and Sweden. Aslund *et al.* (2009) study to what extent the lower achievement of non-native students in Sweden is due to the features of the neighbourhoods in which they grow. Jensen and Rasmussen (2008) exploit a rich dataset combining PISA test scores, administrative and census data in Denmark and find a negative effect of school ethnic concentration on cognitive outcomes for Danish native students[7]. Brunello and Rocco (2011) provide comparative evidence on the effect of the share of immigrants on natives' educational attainment exploiting PISA data for a sample including a lot of European countries.

Evidence on educational peer effects and social interactions in Italy have been presented only in few and recent papers: Cipollone and Rosolia (2007) in high school context; Brunello, De Paola and Scoppa (2010), De Paola and Scoppa (2010), De Giorgi, Pellizzari and Redaelli (2010), De Giorgi and Pellizzari (2010) in university contexts. To our knowledge, limited research has been done on the issue of social interactions among native and non-native students and their effects on cognitive outcomes, or on the use standardized tests on the whole population of Italian students at a certain grade. For these reasons, besides contributing to the still developing peer effects literature between non-immigrant and immigrant students, our study is somehow original in the Italian education economics literature.

[6] The Italian 'Junior High School Diploma' corresponds to ISCED level 2.
[7] Evidence on school composition and immigrant lower test scores for Denmark and Switzerland is also provided by Schindler (2007) and Meunier (2010), respectively.

2. Background

Contrary to many other European countries, immigration flows to Italy and the consequent presence of immigrant children in the Italian school system have a relatively recent history. Italy experienced only limited immigration before 1970, and until the early Nineties there was a substantial internal migration, from the South to the North of the country, and still relevant external migration. Massive immigration from Eastern countries and North Africa to Italy only started in the Nineties, but sharply increased over the last decade (Figure 1, Mencarini *et al.*, 2009). According to the *International Migration Outlook* (OECD, 2008), in the last decade the number of labour immigrants has risen more quickly in Italy and United Kingdom than in any other OECD country. As a consequence, the foreign resident population has risen rapidly: in 1999 it only accounted for 1.9% of the total resident population in Italy, in 2008 the share of foreign residents has grown up until 7.3% (Billari and Dalla Zuanna, 2008)[8].

The pattern of immigration has also been changing. In the past, immigration flows mostly consisted in low-skilled, low-wage and often undocumented men seeking work. A lot of them were seasonal workers, and they normally arrived and stayed for brief periods without their families. Starting from the late Nineties immigrants show the intention to settle permanently: immigration flows consist more and more of complete families and the number of children in immigrant families is rapidly increasing (Mencarini *et al.*, 2009). Then, 'second generation immigrants'[9] are nowadays a relevant part of the total immigrant population, and this is particularly relevant in the school context, where about 37% of the total population of non-Italian students enrolled in the Italian primary and secondary public schools are second generation immigrants (MIUR, 2009b).

2.1 Non-Italian students in the Italian school system

It is only in the last years that the Italian school system has been forced to face the 'immigration phenomenon'. According to the definition of the Italian Ministry of Education Statistical Service (MIUR 2009a), a non-Italian student is an individual enrolled in the Italian school system and having both parents without Italian citizenship[10]. Therefore, when we refer to a non-Italian student, we refer to a student without Italian citizenship, independently on the fact of

[8] Data from Billari and Dalla Zuanna (2008) are more realistic than the official Istat statistics as the foreign resident population in Italy includes both documented and estimated undocumented non-Italian citizens. In the school context, it is worthy to consider both documented and undocumented immigrants, given that all immigrant children, independently from their legal or illegal residential status have the right and the duty to go to school (DPR 394/99, art. 45).

[9] Broadly speaking, second generation immigrants are individuals born in Italy from non-Italian parents, typically children of immigrant households settled in Italy in the past ten or fifteen years.

[10] Notice that if a student has one the parents who is Italian, he automatically gains the Italian citizenship (because of the *ius sanguinis* rule) and so he is defined as Italian students independently from the country of birth.

being born in Italy or abroad[11]. The most up-to-date official information (MIUR 2009a, 2009b, 2010) show an increase of non-Italian students enrolled at kindergarten, primary and secondary levels by 14.5% and 9.6% in, respectively, 2007-08 and 2008-09 school years.

Table 1 records the total number and the percentage of non-Italian students enrolled in the school system, by school level (MIUR, 2009a, 2009b): if, in 1996-97, only 0.7% of students in the Italian school system had a non-Italian citizenship, in 2008-09 the average percentage has grown up to 7.0%, with peaks of more than 8% in primary and junior high (or, lower secondary) schools. Concerning the general time trends, Table 2 shows that the percentage variation in non-Italian students' population is now decreasing, after the peaks at the end of the Nineties and at the beginning of the present decade.

Students from Romania, Albania and Morocco contribute for almost 45% of the total non-Italian students population, and, in general, students from European countries (EU and non-EU) and from Africa cover more than two thirds of the non-Italian students population (MIUR 2009a, 2009b). As just mentioned, the new ingredient observed in the non-Italian students population in the last years is the growing number of non-Italian students born in Italy (so called, 'second generation' immigrants). Only for 2008-09 school year the Statistical Office provides a clear quantitative evidence (Table 3): almost 37% of non-Italian students are born in Italy (in some Northern regions - Lombardy and Veneto - the percentage increases up to 40%). Despite the limited evidence available, a clear pattern emerges from Table 3: the presence of 'second generation' non-Italian students is concentrated in the lowest education levels (i.e. kindergarten and primary school where, respectively, 73.3% and 45% of non-Italian students are born in Italy); the issue is less relevant in lower and upper secondary school (where, respectively, the percentage decreases to 18.8% and 7.5%). The remarkable presence of 'second generation' non-Italian students in the lowest educational level and kindergartens is probably a consequence of the massive migrant flows of the last decade. Second generation immigrants are children born in households settled in Italy during the last decade, therefore, although they maintain their foreigner status, they are in Italy since their birth and they are plausibly more integrated than non-Italian students born abroad and probably face less difficulties at school, at least in developing Italian language skills.

Finally, the distribution of non-Italian students is not homogeneous under many aspects. First of all, it is not geographically homogeneous. Figure 2 shows that the phenomenon is highly geographically concentrated in the North and Centre of the country and strictly depends on non-

[11] Actually, only recently (starting from the 2008-09 school year) the Ministry of Education Statistical Service has begun to record in a different way non-Italian students born abroad and non-Italian students born in Italy from (both) non-Italian parents, this latter being part of the category of 'second generation immigrants'.

Italian households residency decisions[12]. Lombardy is the region with the highest number of non-Italian students in absolute terms (151,899 individuals in 2008-09), while Emilia Romagna (12.7%) and Umbria (12.2%) are the two regions with the highest concentration with respect to their own regional students population (MIUR, 2009b). Second, non-Italian students are highly concentrated in public schools, with the only exception of pre-school education (i.e. kindergarten). Third, in the high schools (i.e. upper secondary education) the large majority of non-Italian students is enrolled in technical and professional tracks (MIUR 2009a, 2009b).

2.2 How non-Italian students perform compared to their Italian peers?

Immigrant students typically face more problems at school and have lower scores in standardized tests than their non-immigrant peers (OCSE, 2009), but it is still controversial whether 'first' and 'second' generation immigrant students perform differently and which are causes, consequences and possible policy implications (NESSE, 2008). Reasonably, one may argue that second generation migrant students should face less problems in the cognitive abilities development because they live in the host country since their birth, they probably attended kindergarten and primary schools with native mates, they should have developed less difficulties in the use of the host country language. However, this is not always the case. Stanat and Christensen (2006) show that PISA 2003 results have significant differences between non-native students born abroad ('first generation') and those born in the immigration country ('second generation'), and in many countries results of the firsts are slightly (but significantly) better that the seconds[13].

Educational outcome measures available in the Italian school system are just a few (drop-out rate, grade retention and final grade exams at the end of the primary, junior high and secondary education track), and, in our context, sometimes even misleading. Drop-out rate is a sufficiently precise measure, but is only provided at an aggregate level. Final grade exams traditionally suffer from a relatively poor signalling power, meaning that because of their non-standardized form and decentralized correction, comparisons across individuals, schools and areas is difficult and significantly biased (Montanaro, 2008; Cipollone *et al.* 2010). Grade retention is not reliable in the case of non-Italian students, given that allocation mechanism on non-Italian students into grades does not strictly follows an 'age-rule', but usually depends on the individual language skills and school staff decisions. As a result, the grade retention gap between Italian and non-Italian students, as shown in Figure 3, cannot be considered as an unbiased educational outcome measure.

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[12] This figure refers to junior high schools, but identical situations can be found in all school levels (see MIUR 2009b).

[13] Stanat and Christensen (2006) argue that the first generation non-native students are the more motivated learners and have positive attitudes toward school, while second generation youth born in the immigration country seems to have adapted to the less positive attitudes to school of their native peers.

One possibility to recover a standardized and reliable attainment measure is to use test scores. According to PISA 2006, non-Italian students perform worse than their Italian mates (Table 4). However, apart from PISA surveys which indeed exploits a representative sample of students population in each OECD country, *INVALSI First Cycle Test* is the first evidence in Italy of a standardized test providing information on the cognitive gap between Italian and non-Italian students for all students population at the end of the junior high school (8th grade students, i.e. *terza media*). Table 7 shows Invalsi IC 2010 test scores gaps between Italian and non-Italian students and confirms the broad results outlined form PISA 2006: non-Italian students perform generally worse than their Italian peers, and the gap seems to be higher in the language skills rather than in Maths.

3. Literature

The empirical analysis of the effects of non-native students' educational outcomes stems from the 'desegregation' literature[14], which examines the effect of minority students on the achievements of the other students in the U.S. schools (Gould, Lavy and Paserman, 2009). Early desegregation literature proposes a variety of analyses on the relationship between ethnic origins and achievement (among the others: Armor, 1972, 1995; Cook, 1984; Crain 1970; Crain *et al.* 1978), but does not consider social interactions between native and non-native students as a potential educational input. The first study mentioning the contribution that the class and school ethnic composition has on the individual achievement is the 'Coleman Report' (Coleman, 1966)[15]. Starting from Coleman (1966), scholars in the sociology of education have long argued that, apart from students' ability and background, peers influence is an important determinant of students' achievement (Kramarz *et al.*, 2008). Economic literature on peer effects at school among native and non-native students only appears in the Nineties, while interest on the economic analysis of social interactions was flourishing.

Endogenous sorting and selection issues are crucial in the estimation of the causal effect on educational outcomes of non-natives on their native peers (and vice-versa). First of all, one must account for the endogenous placement of immigrants into some geographical areas that are usually

[14] For decades economists and sociologists studied the effects of desegregation plans imposed by U.S. Courts, starting from *Brown vs. Board of Education*, 347 U.S. 483 (1954). The ruling in *Brown v. Board of Education* (1954) held that 'separate but equal', while not inherently unconstitutional in all areas, was unconstitutional in the case of education because separate education for blacks and whites could not be equal. This ruling led to dramatic changes in schools throughout the country (Hanushek *et al.*, 2009).

[15] "[...] those inputs characteristics of schools that are most alike for Negroes and whites have least effect on their achievement. The magnitudes of differences between schools attended by Negroes and those attended by whites were as follows: least, facilities and curriculum; next, teacher quality; and greatest, educational backgrounds of fellow students. The order of importance of these inputs on the achievement of Negro students is precisely the same: facilities and curriculum least, teacher quality next, and backgrounds of fellow students, most", Coleman (1966).

more likely to be populated with lower-achieving native students, regardless of the local level of immigrant concentration (Gould *et al*., 2009). As a consequence, ethnic concentration in the schools may be endogenous because of parents' housing decisions: individuals sort into neighbourhoods because they want - or do not want, or they are forced - to live in a 'ghetto' area, or in areas where an occupation is more likely to be found, or in areas where renting houses is less expensive, and so on. Second, the peer group can be the result of individual choices: for example, given the residential choice of the household, individuals living in a given area choose a certain school on the basis of some (perceived) school quality. Third, given the school choice, the allocation of non-native students among the classes within a certain school is usually not random. Ammermueller and Pischke (2009) provide evidence of the non-random assignment of non-natives students within school and within classes in some European country. It is worthy to underline that non-random allocation of non-native students is not only the results of endogenous individual choice, but also depends on school staff, municipalities choices and law regulation[16]. As a general result, the vast majority of cross-sectional variation in students' peers is generated by selection: students self-select into schools based on their family background and income, parents' job locations, residential preferences, school rules, educational preferences and even ability (Hoxby, 2000).

Apart from self-selection issues, the estimation of a reduced form model retrieving the peer effect parameters is also hard because of the problems arising from the presence of the correlated effects that will give rise to a bias if they are correlated with peer group composition (Manski, 1993). Omitted variables related to school outcomes might be correlated with school resources and bias the estimation (Jensen and Rasmussen, 2008). This is particularly serious in educational contexts, given that even school resources are not randomly allocated across schools but rather follow criteria including the percentage of non-native students. Thus, if some school or classroom characteristics are not controlled for, the estimated parameters will be biased.

Recent papers have adopted three main kinds of identification strategies to address these issues. The first approach exploits sources of random variation from natural or quasi-natural experiments, such as the enforcement of desegregation programs like the 'Moving to Opportunity' program in the Boston school district. The second approach follows aggregation procedures to a city or metropolitan level eliminating the bias due to selection issues in intra-city location choice. The third strategy exploits within-school sources of exogenous variation in classes or adjacent school-cohorts composition. In the following sections we review the most recent studies based on

[16] In Italy, Heads, School Boards and Municipalities must collaborate to allocate non-Italian students within schools and within classes in such a way to avoid segregation problems (see Appendix A).

these three possible identification strategies, while the final section accounts for the literature on peer effects in Italian education contexts.

3.1 Experimental or quasi-experimental evidence

Guryan (2004) conducts a quasi-experimental analysis of the effect of school segregation on black dropout rates, using variation in the scope and timing of major court ordered desegregation plans[17] in the 1970s and 1980s. He finds a modest but statistically significant effect, with black dropout rates falling 3 percentage points relative to whites as a result of policies that, on average, reduced relative black exposure to black schoolmates by about 20 percentage points. However, it is possible that in the longer run some of the integrative effect of desegregation programs is offset by a rise in within-school segregation. Guryan's (2004) estimates, which identify segregation effects on the earliest affected cohorts, would not incorporate such offsetting effects (Card and Rothstein, 2007).

Angrist and Lang (2004) provide an extensive study of one of the most important desegregation plan implemented in Boston school districts (i.e. the Metco program), moving low-achievers black students to preeminently white schools in the rich Boston suburbs. The effect of Metco students on the achievement of non-Metco students are estimated using two models. The first is a regression of the average national percentile rank of non- Metco students on the fraction Metco in a grade, school, and year. The second approach uses micro data and adds controls for student characteristics. Both OLS and IV estimates using micro data from Brookline district show no effect of Metco students in the full sample of non-Metco students. The OLS estimates are precise enough to rule out test-score-mediated peer effects at the high end of those reported in the literature, although smaller effects are possible. Moreover, in contrast with most of the findings in previous research on peer effects, Angrist and Lang (2004) results also imply no adverse impact of increasing the fraction minority on most students.

Experimental evidence on the effects of neighbourhood peers comes from the recent Moving to Opportunity (MTO) project, which offered incentives for public housing residents to move to lower poverty neighbourhoods (Sanbonmatsu *et al*., 2006). MTO had a modest effect on the quality of subjects' neighbourhoods (lowering the poverty rate by about 13 percentage points), but no significant effect on children's academic achievement. The experiment has very limited power to measure the effect of exposure to minority neighbours, however, since it only lowered the fraction of minority neighbours of the treatment group by about 7 percentage points.

[17] Plans applied by States, usually following Courts decisions, started in the late Fifties after the *Black vs Board of Education* ruling, aimed at diminishing the segregation of minorities within schools and schools districts.

In order to identify the causal link of the immigrant concentration on the outcomes of natives, Gould *et al.* (2009) exploit the variation in the number of immigrants in 5th grade conditional on the total number of immigrant students in grades 4 to 6. Basic OLS results (in various functional specifications) are consistent with the evidence of an adverse effect of immigrants on the rate of matriculation but no effect on dropout rates. IV results point to a stronger adverse effect of immigrant concentration on native outcomes, but the estimates are not significantly different from the OLS coefficients. Their approach is interesting and new under two main aspects: first, they use a quasi-experimental evidence claiming that early '90 immigration waves in Israeli can be considered as an exogenous variation in immigrants flows; second, they focus on long-term outcomes (rather than contemporaneous peers' outcomes effects).

Aslund *et al.* (2009) estimate to what extent the lower achievement of immigrant students is due to the characteristics of the neighbourhoods in which the immigrants grow up. Since recently arrived immigrants tend to settle in close proximity to people sharing their ethnic background (Stark 1991), they pay particular attention to the characteristics of the ethnic community. The estimation strategy relies on a governmental placement policy to generate exogenous variation in the initial residential distribution in Sweden. Between 1987–1991 Swedish authorities assigned refugees to their initial location, and since individuals were not free to choose, Aslund *et al.* (2009) argue that the initial location was independent of (unobserved) individual characteristics. The results show that peers matter: a standard deviation increase in the fraction of highly educated peers raises student performance by 0.9 percentile ranks.

3.2 Non-experimental evidence: aggregation and within-school estimation strategies

On the one hand, studies based on aggregation and differentiation procedures try to solve the sorting within and across cities and metropolitan areas though averaging procedures; on the other hand, studies based on within-school variations argue that there may be idiosyncratic variation in adjacent cohorts or in class composition within a given school that can be exploited in order to disentangle peer effects parameters[18].

Although students of differing abilities may sort to different schools or neighbourhoods within a given city, averaging and differentiation procedures generally assume that the distribution of potential abilities across 'metropolitan' areas is as good as random (conditional on observed control variables). Evans, Oates, and Schwab (1992) use the average characteristics of the metropolitan area as instruments for peer group characteristics. The authors are among the first to

[18] All these studies cannot overcome the well-known 'reflection problem' (Manski, 1993) and thus estimate reduced form equations without making distinction between 'endogenous' and 'exogenous' peer effects.

address the endogeneity issue in the empirical estimation of peer effects, stating that the 'peer group' is often itself a matter of individual choice (Evans *et al.*, p. 967)[19] and using instrumental variables to tackle the issue.

Cutler and Glaeser (1997) extend this idea distinguishing between the outcomes of blacks and whites in the same city, under the weaker assumption that the black-white *difference* in potential ability in a city is unrelated to the degree of residential segregation. The authors examine the effects of segregation on outcomes for blacks in schooling, employment, and single parenthood. Their identification strategy is based on aggregation at a city level to avoid the bias due to selection issues in intra-city location choice. Their empirical strategy aims at examining whether outcomes for minorities as a whole are better or worse in cities that are more racially segregated compared to cities that are less racially segregated. They deal with endogeneity issues by instrumenting segregation measures with factors that are unlikely to be directly related to black outcomes but that should affect segregation. They use two sets of instruments: the first is public finance characteristics of the metropolitan statistical area that might increase the benefits of segregation or the ability to segregate; the second set of instruments is based on the topography of the metropolitan statistical area, such as the number of inter- and intra-county rivers in the metropolitan statistical area. Their instrumental variables results suggest that segregation leads to adverse outcomes, not that adverse outcomes result in more segregation. They also find only a small effect of segregation on outcomes for whites.

Card and Rothstein (2009) basic framework is very similar. They extend Cutler and Glaeser's (1997) analysis by including a much richer set of family background and metropolitan-level control variables that may be correlated with segregation, by distinguishing between the effects of school and neighbourhood exposure, and by focusing on test scores as a measure of achievement. Card and Rothstein (2009) address the endogeneity of school and neighbourhood choice by aggregating to the metropolitan level and relating the black–white achievement gap in different cities to the degree of racial segregation in the area, as measured by the black–white difference in relative exposure to minority neighbours and schoolmates. Aggregation abstracts from differences among families in tastes for mixed-race neighbourhoods, while differencing eliminates the effect of city-wide variables that may be correlated with racial segregation (such as the level of school spending or the efficiency of local schools). They reach two main conclusions. First, there is

[19] "…individual households, in making their location choice, are also choosing a peer group for many of the relevant local services, including local public schools. In such a setting, the peer group becomes an endogenous variable, determined in part by household choice. Once this is recognized, it is clear that the estimation of the 'standard model' by ordinary least squares or other techniques that do not allow for the endogeneity of the peer group are inappropriate. The direction of the bias introduced by ignoring simultaneity depends on the relationship between the unobserved factors that deter-mine the peer group and the unobservable factors that determine performance" (Evans *et al.*, p. 968).

a robust and quantitatively important relationship between black relative test scores and the degree of segregation in different metropolitan areas. Second, neighbourhood segregation seems to matter more than school segregation.

Within-school estimation strategies are exploited in Hoxby (2000), Hanushek *et al.* (2003, 2009), Ammermueller and Pischke (2009), and Jensen and Rasmussen (2008). Hoxby (2000) exploits variations in the racial and gender composition of adjacent cohorts within the same grade and within the same school. In her view, there is some idiosyncratic variation in adjacent cohorts that can be defined as unexpected and unaffected by schools and parents manipulating assignments to schools and classes[20]. Time trends in racial composition are a special concern for this identification strategy because a school might have a trend in the share of its students who are immigrants, and the trend might be associated with trends in other local variables that are unobserved but affect achievement as well. Hoxby (2000) controls for time trend in racial school composition and finds it has some effects on students' achievement, and these effects are generally higher among students of the same ethnic group than among students belonging to different ethnic groups.

Hanushek *et al.* (2003, 2009) use variation across cohorts, as Hoxby (2000) but in a different empirical model and identification strategy, based on individual fixed effects retrieved tracking the same cohorts over time. The estimation of peer group effects relies therefore on cohort differences in the changes in racial composition as students' progress through school, i.e., the estimates are identified by small differences in the within school and grade pattern of percent black, percent Hispanic, and ability between cohorts (Hanushek *et al.*, 2009). The estimates reported by Hanushek, *et al.* (2009), imply that excess exposure of black students to black grade mates causes the black-white test score gap to grow by 0.07 standard deviations with each year in school. The concern in the Hanushek *et al.* (2009) study is that there may be systematic trends in the ethnic composition of schools that covary with trends in average student characteristics at the school level.

Ammermueller and Pischke (2009) exploit within-school variation in classes composition. The idea behind this kind of strategy is the observation that different schools draw students from different neighbourhoods, and hence from different family backgrounds. In the case of primary schools, however, it is possible to argue that pupils are divided into classes almost randomly; hence, class groups appear not to be formed on the basis of ability or family background. The identifying assumption is not met if, for example, there is any kind of tracking or sorting on the basis of some (unobserved or observed) students' characteristics into classes within schools. The authors consider

[20] For example: if a cohort has more female than the previous cohort, for random reasons, some students in the cohort will experience a peer group that has more female than usual.

a variety of possible definitions of peer groups based on gender, family background characteristics, ethnic origins and spoken language. Basic results on peer effects are corrected using IV because of measurement error. However, in the case of peer effects between native and non-native children they show that their identifying assumption is not met and estimates are not reliable. In the other cases they find peer effects vary quite widely across countries, their final estimates turn out to be larger than most of the estimates in the existing literature.

Jensen and Rasmussen (2008) analyse the effect of ethnic concentration in schools on the cognitive outcomes of children. They use a rich dataset for Danish ninth-grade students, based on PISA test scores as measure of students' cognitive abilities and administrative and census information on students, schools and neighbourhoods. The authors estimate a simple education production function (EPF), following Todd and Wolpin (2003) specifications, using PISA scores as outcome measures and the ethnic concentration of each school as one of the school inputs. In order to correct for the endogeneity in schools ethnic concentration authors apply both IV and school fixed-effects, using as instrumental variable the ethnic concentration in a larger geographical area where school is located. As this variable is surely correlated with the ethnic concentration in the school but not with the mean cognitive outcomes, it turns out to be a valid instrument to tackle the endogeneity problems in school ethnic concentration. IV results show that there is a negative effect of ethnic concentration on students' outcomes, and that this is significant only for the native Danish children.

Brunello and Rocco (2011) study whether a higher share of immigrant pupils affects the school performance of natives using aggregate multi-country data from PISA finding a negative but small effect. The analysis is conducting exploiting aggregation at the country level to avoid sorting problems of immigrant students within each country. Fixed effects and country socio-economic indicators are also used to solve the problem of across country sorting and time trends in immigrants residential choices. They also find evidence that, conditional on the average share of immigrant pupils, a reduction of the dispersion of this share between schools would have a small positive effects on the test scores of natives.

3.3 Educational peer effects in Italy

Evidence on educational peer effects in Italy is limited, and few recent papers deal with educational peer effects in university contexts. Brunello, De Paola and Scoppa (2010), De Paola and Scoppa (2010) analyse administrative records of students enrolled at the University of Calabria, a middle-sized public university in the South of Italy. Similarly, De Giorgi, Pellizzari and Redaelli (2010), De Giorgi and Pellizzari (2010) exploit administrative records of students enrolled at

Bocconi University, a private university in Milan. All these studies exploit identification strategies based on random allocation of students to courses, classes or residential accommodation, focus on different possible specifications of peer groups and find sizeable peer effects. In particular, De Giorgi, Pellizzari and Redaelli (2010) apply a new strategy to estimate peer effects in the college major choice. The authors demonstrate that, in a context where peer groups do not overlap fully, it is possible to identify all the relevant parameters of the standard linear-in-means model of social interactions. Results show that individuals are more likely to choose a major when many of their peers make the same choice.

Cipollone and Rosolia (2007) focus on a population of high school students and provide evidence on the causal effect of the schooling achievement of young men on those of young women. Identification strategy is based on a natural experiment exploiting the exemption from compulsory military service granted to a few specific cohorts of males living in southern Italy as a result of an earthquake in 1980. Even their estimates show rather strong peer effects: a 1 percentage point increase in males' graduation rates raises females' rates by 0.7 to 0.8 percentage points.

4. Data and descriptive statistics

In order to retrieve an unbiased measure of the causal link between non-natives school concentration and educational outcomes of native students, we exploit a unique dataset combining three different information sources: the *Invalsi First Cycle Final Exam* data[21], administrative records from *Ministry of Education Statistical Office*, and data from *Italian Population Census Survey 2001*[22]. 'Invalsi First Cycle Final Exam' (from now on 'First Cycle' or 'IC') contains school level information and Maths and Language test scores results and individual information for each 8th grade student enrolled in a public or private Italian junior high school. Three waves are available, corresponding to the final exam results of all 8th grade students in 2007-08, 2008-09 and 2009-10 school years (about 500,000 students per wave). Administrative records from Ministry of Education Statistical Office provide general information about some school characteristics and refer

[21] *Invalsi First Cycle data* are the first experience of standardized test scores census survey taken on all Italian students. INVALSI (*Istituto Nazionale per la Valutazione del Sistema Educativo di Istruzione e di Formazione*) is the independent public institute established in 2004 to start a rigorous and objective evaluation of the Italian school system and Italian students' attainment levels. Starting from school year 2009-10, census survey on attainment levels and schools quality are conducted in grade 2 and 5 (primary schools), grade 6 and 8 (junior high schools) and grade 10 and 14 (high schools). As stated in the L. No. 176/2007, the 'First Cycle Final Exam' corresponds to 8th graders test and has been conducted since 2007-08 school year. However, only starting from the 2009-10 s.y., test scores contribute for one sixth of the final junior high school grade, while in previous years the test results did not enter directly in the final grade. Invalsi IC data are the first experience of standardized test scores census survey taken on all Italian students.

[22] Many people collaborate to make available the dataset used. We thank: Claudio Rossetti (Luiss), Patrizia Falzetti (Invalsi) and Marco Mignani (Invalsi) for their work in merging Census and Miur data with the Invalsi IC datasets; Paolo Sestito (Bank of Italy), Piero Cipollone (Invalsi and Bank of Italy) for fruitful discussions and data support.

to 2005-06, 2006-07 and 2007-08 school years. Available information is matched to Invalsi First Cycle data through an anonymous school identifier. Finally, Census 2001 data contain information about resident population in Italy in 2001. Each school is matched to a group of census divisions. The matching technique is designed in order to associate to each junior high school a group of census divisions constituting its 'catchment area' (Barbieri, Rossetti and Sestito, 2010). In the following paragraphs we explain in detail the individual and school level information available and provide some descriptive statistics.

4.1 Individual level information

Invalsi *First Cycle Final Exam Data* is a newly available census survey of Mathematics and Italian Language attainment levels for 8th grade students (ISCED 2 level) enrolled in all Italian public and private junior high schools. Individual information is provided by the school administrative staff through school administrative records (thus, not directly asked to students). The dataset contains test scores and individual information on 1,504,286 8th grade students, aged between 13 and 14, who took the Invalsi standardized tests at the end of the 'first cycle' of compulsory education in the Italian schools[23] (i.e. after five years of primary education and three years of junior high school). Data contain separate test scores for Maths and Italian Language[24] ranging from 0 to 100, as they are expressed as percentage of right answers. In addition, because of cheating evidence in preliminary data analysis (Invalsi 2008a, b, 2009, 2010), for each student we have both the row and cheating-corrected Maths and Language test score[25]. For each student we know: year of birth, gender, citizenship (Italian, non-Italian), place of birth[26]; how long the student is in Italy if born abroad (from primary school, for 1-3 years, less than 1 year); mother's and father's place of birth (Italy, EU, European but non-EU, other non-European country) [27], grade retention (if the student is 'regular' i.e. if, at the end of 2010, he/she is 14 years old; 'in advance' i.e.

[23] Both Math and Italian Language *First Cycle Invalsi Exam Test* take place in all junior high schools in June. Each part usually lasts one hour and between Language and Math test students have a fifteen minutes break.

[24] Italian Language exam is divided into three parts: narrative text comprehension, expositive text comprehension and grammar. The total Italian Language test score is obtained from the sum of the three parts.

[25] Sensitivity analysis confirm that raw and cheated-corrected results coincide once we control for geographical differences (i.e. we introduce in the model macro-area, regional or province dummies). Therefore, we stick on the raw test scores results and add geographical controls and a subject and school specific dummy indicating if the school has an high-cheating evidence based on the cheating coefficients calculated by Invalsi on the basis of a fuzzy-logic correction procedure explained in detail in Invalsi (2010, Appendix 9). In particular, the 'high-cheating dummy' identifies, for each year and subject, the schools in the lowest decile of the distribution of the subject specific cheating coefficient (i.e. the schools with the highest evidence of cheating behaviours). Robustness checks replicate the construction of the 'high-cheating dummy' with different percentiles (1-5, 1-15, 1-20) without showing differences in the results.

[26] For IC 2007-08, and IC 2008-09 the students' place of birth is indirectly obtained through the survey question "*How long is the student living in Italy?*". If the answer is "*Always*", we define that the student's place of birth is "*Italy*", otherwise the student is considered as "*Born abroad*". With respect to previous waves, we only lack the information on students' month of birth, omitted because of Privacy Law restrictions.

[27] Information concerning parents' place of birth is not available for the IC 2007-08 wave.

younger than ‘regular’ students, or ‘held back’ i.e. older than ‘regular’ students), school and class identifier (so, given a school, we can identify the class attended in that school by each student). Combining this information and following the categorization implemented in OECD Pisa Program, we are able to distinguish between Italian and non-Italian, native and non-native, immigrant and non-immigrant students, and, amongst immigrant students, first and second generation students[28]. Table 5 describes the distribution of these different categories across Italian geographical macro-areas (North, Centre, South). For instance, referring to the IC 2009-10 wave, it can be noticed that although the overall percentage of non-Italian 8th grade students is 7.22%, there is a sharp difference across the country, with peaks of 11.99% in the North East and minimum levels in the South (1.93%) and in the Islands (1.72%). Similar patterns emerge from previous waves[29].

4.2 School level information

Invalsi and MIUR Statistical Office provided us with additional school level information. The census Invalsi IC Exam covers 5,699 junior high schools in 2007-08, 5,803 in 2008-09 and 5,733 in 2009-10. For each junior high school we know: ownership (i.e. public (state) school or private (recognized) institution), administrative organization (i.e. whether it is an institute having both elementary and junior high schools – that we define as ‘*K-8 school*’- or whether it is a simple junior high school, administratively independent from other elementary schools - that we define a ‘*middle school*’[30]); the province where the school is located; total number of students enrolled in 6, 7 and 8 grade, and the total number of classes for each grade[31]; total number of teachers hired in the school; total number of support learning teachers for students with handicaps or language difficulties; number of students with disabilities for each grade; total number of class making ‘normal’ (i.e. 30-hours) or ‘extended’ (i.e. 40-hours) weekly time schedule[32]. Finally, we have the information of the municipality where a school is located only in the case in which the school is

[28] ‘*First-generation immigrants*’ refers to those persons who were born abroad and whose parents were also born abroad, while ‘*second-generation immigrants*’ refers to persons who were themselves born inside the receiving country but whose parents were born abroad. Together, the first- and second-generation immigrants constitute the ‘*immigrant students*’ group. By contrast, all students born in the receiving country who have at least one parent who was also born inside the country are referred to as ‘*native*’ (OECD, 2010). See Appendix B for details.

[29] Besides being the most recent survey, Invalsi First Cycle 2009-10 wave has more precise information on relevant variables (in terms of missing values). Missing values on relevant variables are due either because they might not be reported by the school administrative staff or because parents decide not to provide it at the time of the student’s enrolment. Moreover, cheating problems are less relevant with respect to the previous waves (see Invalsi 2010, Appendix 9).

[30] The terms *K-8 school* and *middle school* mimic the US traditional distinctions among different types of middle grade schools configurations.

[31] Junior high schools in Italy enroll students from grade 6 to 8. Thus, we have the total number of students enrolled and the number of classes by each grade in each school.

[32] In most of the cases it is also possible to recover the information of whether a given class follows a ‘normal’ or ‘extended’ time schedule.

located in a municipality with at least three junior high schools[33]. Descriptive statistics on school-level characteristics are shown in Table 5.

Then, for each junior high school we define a 'catchment area' aimed at identifying the area where the majority of school attendants live[34]. Each catchment area is composed by a number of census divisions linked to each school according to a given algorithm (Barbieri *et al.*, 2010)[35]. Having identified catchment areas, we can link to each school about two hundreds variables from 2001 Italian Population Census Survey covering demographic and socio-economic information on resident population (gender, age, ethnic origins, education, labour force participation, occupation), households composition and houses characteristics. Given that First Cycle Invalsi data lack of individual information about socio-economic family background (such as parents' occupation, education level end household income measures), catchment area information are useful in order to fill this informational gap, taking catchment areas socio-economic indicators as proxies for socio-economic background of the students enrolled in each junior high school.

4.3 Descriptive statistics

The final students population is constituted by 1,504,286 8th grade individuals enrolled in Italian junior high schools[36]; test scores range from 0 to 100 and refer to Italian Language and Mathematical skills. We perform descriptive OLS regressions on each single year and on the pooled student population of the three years in order to provide a description of the individual determinants of the IC Invalsi test scores results (Table 6). We control for regional differences in the test scores (dummies for 20 Italian regions) for the single waves regressions, and for territorial differences and time trends in the pooled (i.e. year and region*year dummies). In general, we notice that across years differences in the estimated coefficients are quite limited (both in terms of directions and dimensions), so that we simply focus on the pooled regression results, without loss of generality. *Coeteris paribus*, non-Italian students score significantly lower than their Italian peers and the gap is more pronounced in language skills (-15.9% in Language and -13.9% in Maths); females have

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[33] Restriction imposed by Italian Privacy Authority. In the end, we have the municipality information for more than 60% of the schools.

[34] The matching procedure is used in Barbieri *et al.* (2010). See for details Barbieri *et al.* (2010), Appendix A.

[35] The procedure for the association between school and census divisions assigns for each school the closest divisions (in terms of geographic distance) so that the 'relevant resident population' living in those divisions contains at least $k>1$ times the number of students enrolled in that particular school (Barbieri *et al.*, 2010). The 'relevant population' is defined according to the 10-14 years resident population in the census data, while the multiplicative factor k is set equal to ten and it allows the overlapping of census divisions among different (but geographically not distant) junior high schools. As a result, the matching procedure links each school j with N_j census divisions constituting the school 'catchment area' and for each school j the socio-economic background variables are obtained as average of the socio-economic variables of each school catchment area.

[36] We exclude all individuals who did not sit either Maths or Italian Language test (0.73% of the total students population).

lower scores in Maths (-1.08%) and higher in Language (+1.01%) with respect to males (in accordance with general literature concerning gender differences in skills accumulation); students who enrolled earlier than natural age (i.e. students 'in advance') show a positive differential in test scores results (+6.67% Language, +7.83% Maths). Finally, being held back induces a strong and negative effect on test scores. The effects are however different with respect to the Italian and non-Italian students: *coeteris paribus*, Italian students held back show results between 20% and 23% lower than Italian regular students, while non-Italian held back students show results that are between 6% and 13% lower than their non-Italian regular mates. This descriptive result is probably due to the allocation of non-Italian students to the initial grade. Non-Italian students are allocated to a given grade on the basis of their Language skills and not on the basis of a simple 'age-rule' (see Appendix A for details). This seems to be confirmed by the fact that non-Italian held back students show greater gaps in Language skills with respects to Maths, while Italian held back students do not show relevant differences between Language and Maths skills.

Table 7 shows test scores gaps according to the categorization previously introduced with respect to the students' origins (Italian vs. non-Italian students, native vs. non-native, non-immigrant vs. immigrant students and first and second generation) and focusing on the 2009-10 wave[37]. Test scores gaps between Italian and non-Italian, native and non-native, immigrant and non-immigrant students are large and statistically significant. Descriptive evidence confirms general results common in the European literature: first, immigrants, non-native and non-Italian students perform worse than their non-immigrant, native and Italian peers (however, the different categorization does not seem to induce significant changes in the test scores gaps); second, gaps are greater in the Language test and lower for Maths (probably because a non mother-tongue language is more difficult to learn with respect to a more universal mathematical language); third, the partition between first and second generation immigrant students is informative: second generation students perform better than first generation peers. Test scores distribution is also different: non-native, non-Italian and immigrant students are more similar to a normal distribution with respect to their peers, and show a lower variance.

Thus, two individual characteristics (students' origins and retention) seem to induce greater test scores gaps. Figure 4 combines individual information in IC 2009 and 2010 waves to identify differences in grade retention according to geographical macro-area, and being first or second generation immigrant vs. non-immigrant. The percentage of 'held back' students is much greater for first generation (59.76%) and second generation (15.71%) immigrants with respect to the non-

[37] Similar results are obtained with previous waves. Notice that in the 2008 wave only citizenship criteria can be applied.

immigrant student population (6.24%). This evidence still confirms that the allocation of immigrant students across grades (in the same school) is not random, but rather decided by school staff (as established in D.P.R. No. 394/1999, see Appendix A). On the other hand, there is no evidence of differences in grade retention across geographical areas.

At the school level, Table 5 figures out a general portrait of school population and composition characteristics with respect to the school geographical location and students' origins. Residential choices of non-Italian individuals and families are mirrored in the school population composition as emerges from a purely descriptive point of view from Figure 2: the areas of the country having a greater concentration of non-Italian resident population also record greater percentage of non-Italian students in junior high schools (MIUR 2009b, ISTAT 2010). Figure 5 confirms this general evidence also in our data: Northern regions experience the highest school share of non-Italian, non-native and immigrant students, while the percentage of non-Italian students dramatically falls in the South. Second generation immigrants generally cover a small percentage of the total student population, ranging from 1.33% in the North West to 0.05% in the South and Islands.

To capture geographical differences in the school population composition, distribution and concentration we also calculate two measures commonly used in residential and school segregation literature: the dissimilarity (D) and the exposure (E) index. To make comparisons possible across waves, we calculate the indices referring to the general distinction, based on citizenship criteria, between Italian and non-Italian students. Nonetheless, the same indices calculated with respect to native/non-native or immigrant/non-immigrant groups for IC 2009 and 2010 hold similar conclusions.

The first dimension we analyse is the *evenness* in the distribution of non-Italian students, as measured by the dissimilarity index, proposed by Duncan and Duncan (1955), Taueber and Taueber (1965), and extensively used in school and residential segregation analysis (among the others, Cutler *et al.* 1999; Clotfelter, 1999; Allen and Vignoles, 2004). Suppose to divide a given area j in N_j sections ($i=1...N_j$), the dissimilarity index (D) measures the percentage of a group's population (in our case, non-Italian students) that would have to change section for each section to have the same percentage of that group as the whole area (Echenique and Fryer, 2007). Defining the two groups as the non-Italian (NI) and Italian (I) student group, and taking as reference area the province (j), and being each section a junior high school of the province ($i=1...N_j$) we obtain the dissimilarity index for each province j measuring the evenness of the distribution of non-Italian students across all junior high school of the province, in symbols:

$$D^j = \frac{1}{2}\sum_{i=1}^{N_j}\left|\frac{NI_i}{NI_j} - \frac{I_i}{I_j}\right|$$

where NI_i and I_i, and NI_j and I_j represent, respectively, the total number of non-Italian and Italian students in school *i* / in province *j*. *D* ranges from 0 (perfectly even distribution, meaning 'no segregation') to 1 (perfectly uneven distribution, i.e. 'maximum segregation'). As elementary and junior high schools students in Italy attend schools following a residential criterion (apart from private institutions, students have to attend elementary and junior high schools in the same municipality where they live), we calculate *D* for each province (*j*) according to the non-Italian students concentration in each school of the province (so, *Nj* = No. of schools in Province *j*). The province level is chosen as reference level because school districts authorities in Italy (i.e. *Provveditorati agli Studi*) are partitioned according to provinces geographical boundaries and are coordinated at a regional level by a general office. We also provide *D** as weighted mean of *D* at regional or geographical macro-area levels, with weights proportional to the total number of students per province (Allen and Vignoles, 2004).

The second dimension we analyze is *isolation*, which is a measure of the extent to which non-Italian students are exposed only to non-Italian peers, rather than to Italian. In particular, the Exposure Index ($E^j_{I/NI}$) is a measure of the exposure of Italian students to non-Italian students in each school district (i.e. province) *j*:

$$E^j_{I/NI} = \frac{\left[\sum_{i=1}^{N_j} I_{ij}\left(\frac{NI_{ij}}{NI_{ij}+I_{ij}}\right)\right]}{\left[\sum_{i=1}^{N_j} I_{ij}\right]}$$

where I_{ij} represents the sum of Italian students in school *i* of province *j*, and similarly NI_{ij} represents the sum of non-Italian students in school *i* of province *j*; N_j is the total number of junior high school in province *j*. This measure is a refinement of the simple school concentration percentage presented in Figure 5 and is generally interpreted as the racial composition (percentage of non-Italian students) enrolled with the average Italian student (Clotfelter, 1999). As for *D*, we also provide *E** as weighted mean of *E* at regional or geographical macro-area levels, with weights proportional to the total number of students per province.

Results are constant across the three waves and show a clear pattern (Figure 6 and Table 8): Exposure Index is generally inversely related to the Dissimilarity Index in the Southern regions, while they are almost similar in the North and Centre, so that in the areas of the country where the school concentration, and, consequently, the Exposure Index, is low, the Dissimilarity Index is generally high. Thus, in the South non-Italian students are less but more 'segregated' in some school districts, while in the North and Centre they are generally evenly distributed across schools and school districts.

To conclude, general descriptive evidence show a sizable gap in test scores results between Italian and non-Italian students, which are similar with respect to the native/ non-native and immigrant non-immigrant categorization, non-Italian test score distribution also show a smaller variance and is closer to the normal distribution than the one for Italian students. The gap is greater in Language than in Math and second generation immigrants score relatively better than first generation immigrant students. Grade retention and territorial location have a great impact on lower test scores, and retention turns out to cover more than half of the first generation students' population and thus being closely related to a non-Italian status. Finally, there are sharp differences in the school concentration of non-Italian students across regions and areas: the comparison between exposure and dissimilarity indices outlines that the regions where the presence of non-Italian students is numerically less important, also show a great polarization of the small group of non-Italian students only in some school districts.

5. Empirical framework

At present, natural or quasi-natural variation in non-native peers exposure is not available in the Italian school context, and the only reliable data on students' attainment levels are the Invalsi standardized test scores results, which, however, have the clear limit of being cross-sectional. Moreover, from the descriptive evidence and the analysis of the institutional framework (see Appendix A) it emerges that non-Italian, immigrant and non-native students: (*i*) score significantly lower than Italian peers in Invalsi First Cycle Language and Math Exams (although second generation immigrants show better results); (*ii*) are not-randomly distributed across schools within school districts, and across grades and classes within schools; (*iii*) are concentrated in some areas of the country (probably because of families' residential choices); (*iv*) are generally 'held back' students. On the one hand, within school allocation of non-Italian students is clearly not random, because they are not randomly allocated across classes (of the same grade), and across grades (in the same school, as the high percentage of held back students shows). For these reasons, in our view, within school variation in non-Italian peers exposure across classes (Ammermüller and Pischke, 2009), or across adjacent schoolmates cohorts (Hoxby, 2000) are not a sufficiently reliable estimation strategies. On the other hand, the lack of panel data evidence on students attainments prevent from the construction of a cumulative educational production function with peer effects

(Hanushek *et al.* 2003, 2009). Given all these elements, we think that the a reliable estimation strategy aimed at disentangling the causal effect of non-native students' concentration on natives' attainment (and vice versa) should start from an aggregation procedure at school level.

We build our estimation strategy combining approaches of a number of studies (Card and Rothstein, 2007; Evans *et al.*, 1992; Cutler and Glaeser, 1997; Jansen and Rasmussen, 2008; Aslund *et al.*, 2009) and hinging upon aggregation procedures and IV. Aggregation at the school level This approach seems the more appropriate to tackle sorting problems across schools and regions that turned out to be particularly serious in our case. In short, we base the estimation strategy on an aggregation procedure and we tackle the potential bias due across schools sorting with an instrumental variable approach. From Card and Rothstein (2007), Cutler and Glaeser (1997) and Brunello and Rocco (2011), we take the result that aggregation procedures help in avoiding selection problems in placement of minority students. However, we detach from their approaches under many aspects. First, we use census data on students' test scores (thus avoiding selection into SAT tests that was one of the major concerns in Card and Rothstein's work); second, we combine together aggregation and averaging procedures with IV; third, we focus on within school peer interactions.

5.1 Baseline model: aggregation at school level

We posit that students attending the same school and grade can be generally classified in two groups (*j=A,B*) according to citizenship criteria (*A=Italian*, *B=non-Italian*), immigrant status (*A=non-immigrant*, *B=immigrant*) or parents' origins (*A=native, B=non-native*). Peer interactions may take place *within* and *between* the two groups and influence cognitive outcomes, such as educational attainment represented by test scores results. Therefore, we assume that a student's outcome (*y*) depends on individual characteristics (*X*), school characteristics (*S*), average socio-economic characteristics of the school-catchment area (*W*) and unobserved error term. In the case of between-groups peer interactions, we assume that the each student's outcome also depends on the percentage of the other group's individuals (*P*) that student *i* experiences within the reference group (grade and school mates), whereas in the case of within-groups interactions we assume that each student's outcome also depends on the percentage of individuals of the same group (*P*) that student *i* experiences within the school and grade mates. Thus, in year *t*, for the generic groups *A* and *B*, in school *s* we have:

$$\boldsymbol{y}_{ist}^{A} = \boldsymbol{X}_{ist}^{A}\boldsymbol{\alpha} + \boldsymbol{P}_{st}^{B}\boldsymbol{\beta} + \boldsymbol{S}_{st}\boldsymbol{\theta} + \boldsymbol{W}_{s}\boldsymbol{\gamma} + \boldsymbol{\eta}_{st}^{A} + \boldsymbol{e}_{ist}^{A} \text{ (Eq. 1)}$$

$$\boldsymbol{y}_{ist}^{B} = \boldsymbol{X}_{ist}^{B}\boldsymbol{\alpha} + \boldsymbol{P}_{st}^{B}\boldsymbol{\beta} + \boldsymbol{S}_{st}\boldsymbol{\theta} + \boldsymbol{W}_{s}\boldsymbol{\gamma} + \boldsymbol{\eta}_{st}^{B} + \boldsymbol{e}_{ist}^{B} \text{ (Eq. 2)}$$

Equation 1 represents the between groups effects, while Equation 2 the within group effects[38]. The error term incorporates two parts: a school-specific component (η^{j}_{st}) common to each student of group *j* (*A, B*) in school *s* and a student-specific component (e^{j}_{ist}). We assume that the student-specific error averages to zero for each group *j* in each school *s*. In the basic specification we identify the two groups with Italian and non-Italian students (*j=Ita, NI*), and we focus on the social interactions between Italian and non-Italian students and within the group of the non-Italian students. Therefore, our basic equations take the following form:

$$\boldsymbol{y^{Ita}_{ist}} = \boldsymbol{X^{Ita}_{ist}\alpha} + \boldsymbol{P^{NI}_{st}\beta} + \boldsymbol{S_{st}\theta} + \boldsymbol{W_{s}\gamma} + \boldsymbol{\eta^{Ita}_{st}} + \boldsymbol{e^{Ita}_{ist}} \quad \text{(Eq. 3)}$$

$$\boldsymbol{y^{NI}_{ist}} = \boldsymbol{X^{NI}_{ist}\alpha} + \boldsymbol{P^{NI}_{st}\beta} + \boldsymbol{S_{st}\theta} + \boldsymbol{W_{s}\gamma} + \boldsymbol{\eta^{NI}_{st}} + \boldsymbol{e^{NI}_{ist}} \quad \text{(Eq. 4)}$$

The upper index classifies students according to their Italian (*Ita*) or non-Italian (*NI*) status[39], where, for example, y^{Ita}_{ist} represents 8th grade student's *i* test score, belonging to Italian students group, in school *s* and school year *t*.

All the equations presented so far should be interpreted as a reduced-form linear-in-means model for peer effects estimation where the sum of the endogenous and exogenous effects arising from exposure to peers are incorporated in β (Manski, 1993). Hence, one important limitation of our estimation is that we cannot distinguish whether β reflects the exogenous effects of student's peers characteristics or the endogenous effects operating through student's peers achievement (i.e. the well-known Manski's 'Reflection Problem'). Anyway, finding evidence of the 'social effects' (i.e. the sum of the endogenous and exogenous effects) is still of substantial policy interest (Ammermüller and Pischke, 2009; Hoxby, 2000), while we leave to future research the task to estimate the pure endogenous effect in a similar context.

Even in the reduced form model to disentangle 'social effects' from correlated effects is difficult in practice because of self-selection and omitted variables bias, and, in fact, the key issue in the identification of peer group effects on achievement is the separation of the effects of peers from other confounding influences (Hanushek *et al.* 2003). Our estimation strategy is therefore aimed at controlling any source of bias given by correlated effects arising if we omit relevant components of *W* and *S* that are correlated with *P* and to solve with aggregation procedures the sorting problems.

[38] Note that two other equation specular to the two presented can also be estimated.

[39] For the sake of simplicity, we use in the exposition of the empirical framework the simple Italian vs. non-Italian students categorization. However, in the results and robustness analysis we account for the differences according to the native vs. non-native, and non-immigrant vs. first and second generation immigrants.

The first step consists of moving from individual-level data to school-level averages. Aggregation at the school level solves the problem of endogenous sorting of non-Italian students across classes in the same school; the mean outcome for group *j* in school *s* is given by:

$$\bar{\boldsymbol{y}}_{st}^{Ita} = \bar{\boldsymbol{X}}_{st}^{Ita}\boldsymbol{\alpha} + \boldsymbol{P}_{st}^{NI}\boldsymbol{\beta} + \boldsymbol{S}_{st}\boldsymbol{\theta} + \boldsymbol{W}_{s}\boldsymbol{\gamma} + \boldsymbol{\eta}_{st}^{Ita} \quad \text{(Eq. 5)}$$

$$\bar{\boldsymbol{y}}_{st}^{NI} = \bar{\boldsymbol{X}}_{st}^{NI}\boldsymbol{\alpha} + \boldsymbol{P}_{st}^{NI}\boldsymbol{\beta} + \boldsymbol{S}_{st}\boldsymbol{\theta} + \boldsymbol{W}_{s}\boldsymbol{\gamma} + \boldsymbol{\eta}_{st}^{NI} \quad \text{(Eq. 6)}$$

$\bar{X}_{st}^{Ita}$ represents the mean characteristics of Italian students in school *s*, P_{st}^{NI} is the fraction of non-Italian students in school *s* attended by Italian students. School and catchment area characteristics do not change with respect to previous equations because they are calculated as school-level characteristics. Thanks to the original dataset used, catchment area information are obtained using socio-economic data that predates the outcome measures (from *Italian Resident Population Census 2001*), therefore the possibility of correlation between *W* and the other elements in the equations is reasonably reduced in our estimates. However, two potential issues concerning *W* must be considered: first, different time patterns in the IC Invalsi data and catchment area level indicators; second, the use of mean socio-economic indicators not directly retrieved from the student populations who took the Invalsi test. Time concerns are, however, limited as socio-economic conditions across Italian territory did not change significantly in the past ten years. Secondly, the identification strategy hinges upon an averaging procedure in order to solve endogeneity and sorting problems, so that individual indicators would not have had in any case a direct implementation in the estimated model. Moreover, the use of socio-economic indicators not directly obtained as an average of some peers' characteristics and that predate the outcome measure help to limit endogeneity problems in peer effects estimations (Angrist and Pischke, 2008; Ammermüller and Pischke, 2009).

The baseline models exploits the cross-sectional dimension of data both at school level, and estimations are replicated for the three available waves of the IC Invalsi data (school years 2007-08, 2008-09, 2009-10). However, we also provide a school level pooled-OLS model on the whole school population for the three available waves:

$$\bar{\boldsymbol{y}}_{st}^{Ita} = \bar{\boldsymbol{X}}_{st}^{Ita}\boldsymbol{\alpha} + \boldsymbol{P}_{st}^{NI}\boldsymbol{\beta} + \boldsymbol{S}_{st}\boldsymbol{\theta} + \boldsymbol{W}_{s}\boldsymbol{\gamma} + \boldsymbol{\phi}_{t} + \boldsymbol{\eta}_{st}^{Ita} \quad \text{(Eq. 7)}$$

$$\bar{\boldsymbol{y}}_{st}^{NI} = \bar{\boldsymbol{X}}_{st}^{NI}\boldsymbol{\alpha} + \boldsymbol{P}_{st}^{NI}\boldsymbol{\beta} + \boldsymbol{S}_{st}\boldsymbol{\theta} + \boldsymbol{W}_{s}\boldsymbol{\gamma} + \boldsymbol{\phi}_{t} + \boldsymbol{\eta}_{st}^{NI} \quad \text{(Eq. 8)}$$

where ϕ_t represent year dummies. Given that catchment-area socio economic characteristics (W_s) do not vary in time by construction compensate for this, we introduce province*year fixed-effects that help to capture part of unobserved heterogeneity mirrored by different socio-economic conditions of schools and underlying students' families populations. Moreover, province by year fixed effects should capture possible recent time trends in immigrants settlements across Italian territory.

5.2 Across schools sorting and IV

Conducting our analysis at the school level raises the important issues of the potential bias from sorting of non-Italian students across schools due to students' families residential choices. For instance, in big cities immigrant families tend to settle in suburbs where location fees are lower, and generally reflect a lower socio-economic status of all (Italian and non-Italian) households living in that area. Therefore, for schools located in that area the higher percentage of non-Italian students may be reasonably correlated to lower scores of Italian peers. Nevertheless, this may be due not only because the exposure to higher percentage of non-native schoolmates *causes* some externalities on Italian peers, but also because Italian students' test scores are lower *per se*, due to the underlying lower socio-economic status of suburbs families. Thus, if we fail to control for all possible elements in schools and catchment area characteristics in the school-level equations we have omitted variable bias. With respect to the empirical framework proposed, any non-randomness in the sorting of students to schools or neighbourhoods produces a school-by-origin component, η_{js}, which may be correlated with the observed variables and bias OLS estimates of β, γ and θ of school-level (and student-level) equations. In particular, this will lead to a substantial correlation between P_s and the outcome measure used.

To address these problem we apply an instrumental variable approach arguing that we can exogenize across schools sorting instrumenting the actual percentage of non-Italian students in each school (P_s) with the number of resident immigrants living in the school catchment area in 2001 (Z_s), i.e. ten years before the test scores used as outcome measure. This is a simplified version of the classical 'shift-share methodology' (Card, 2001) that exploits the fact that immigrants tend to settle in places where immigrants from the same country already reside (Barone and Mocetti, 2010)[40]. Therefore, first stage and reduced form equations will take the following forms:

$$\boldsymbol{\hat{P}_{st}^{NI} = Z'_s\pi + \bar{X}_{st}^{Ita}\alpha + S_{st}\theta + W_s\gamma + r_{st}} \text{ (First stage)}$$

[40] In addition to peer effects studies cited above, different versions of this instrumental variable approach have been often used in the estimation of the effects of immigration on local labour markets and, more generally, in migration and segregation literature.

$$\bar{\boldsymbol{y}}_{st}^{Ita} = \bar{\boldsymbol{X}}_{st}^{Ita}\boldsymbol{\alpha} + \widehat{\boldsymbol{P}}_{st}^{NI}\breve{\boldsymbol{\beta}} + \boldsymbol{S}_{st}\boldsymbol{\theta} + \boldsymbol{W}_{s}\boldsymbol{\gamma} + \boldsymbol{\eta}_{st}^{Ita} \quad \text{(Eq. 5')}$$

$$\bar{\boldsymbol{y}}_{st}^{NI} = \bar{\boldsymbol{X}}_{st}^{NI}\boldsymbol{\alpha} + \widehat{\boldsymbol{P}}_{st}^{NI}\breve{\boldsymbol{\beta}} + \boldsymbol{S}_{st}\boldsymbol{\theta} + \boldsymbol{W}_{s}\boldsymbol{\gamma} + \boldsymbol{\eta}_{st}^{NI} \quad \text{(Eq. 6')}$$

The exogeneity of the instrument (Z_s) relies on the fact that it is antecedent to the outcome measures used and therefore uncorrelated with Invalsi test scores results. This exclusion restriction seems reasonable, claiming that Z_s (non-Italian residents in each school catchment-area in 2001) is able to influence the Invalsi test scores only through the effects of the actual non-Italian students school share (P_s). On the other hand, the validity of the instrument is based on the fact that the number of non-Italian individuals who lived in the school catchment-area in 2000-2001 is supposed to be a good predictor of the actual percentage of immigrant residents in the school area, and, as a consequence, of the actual native/non-native composition of the school population. In fact, it has been demonstrated that early settlements of migrants tend to have an attractive power to successive migrants waves because of some 'network effects'[41] also in the Italian context (see Barone and Mocetti 2010 for a general discussion), and the first stage estimations confirm this is also true in our data (Table 13). The coefficient of the instrument (π) always has a positive and significant impact on the endogenous variable (P_s), and F-statistics strongly reject the null of weak instrument (Yogo and Stock, 2005).

[41] See Bartel (1989), and Barone and Mocetti (2010) for recent evidence on Italian local labour markets.

6. Results

Table 9 and Table 11 show the estimation results of school level regressions where we test the effect of non-Italian school share on the mean test score of Italian students (*between peer groups effects*, Eq. 5 and 7), while Table 10 and

Table 12 contain the estimation of the *within-groups effects* (Eq. 6 and 8), thus they consider the effects the non-Italian students school share on the test score results of non-Italian students. A complete list and description of the control variables used can be found in Appendix B.

In general, OLS and Pooled OLS regressions show a negative and significant impact of the non-Italian school share both between and within the two peer groups. Effects are generally less significant for the first wave (IC 2008), which has the greater number of missing information and lacks of important individual regressors, such as parents' origins and pupils' place of birth, while they do not change a lot if we refer to the second (IC 2009) and third wave (IC 2010). The sign, the size and the significance of the estimated coefficients vary a little once we add province fixed-effects and cheating dummies.

Focusing on the Pooled OLS results (Table 11 and Table 12), the *between groups* effects are smaller with respect to the *within group* effects. The gap is higher in Language than in Math. Moreover, concerning differences with respect to the two subjects, the between groups effects are larger in Math (increasing of one percentage point the school share of non-Italian students induces a decrease of about 13% in the mean test score of Italian peers) than in Language (-7%). The general pattern of the OLS results induce to suppose that there are negative and significant peer effects, moreover, between peer groups effects seem to be smaller than within group. For instance, concerning Language test scores, a one point percentage increase in the non-Italian school share has a negative impact on the same non-Italian peers' test scores which is almost three times the impact on the Italian peers' ones. This difference is interestingly less pronounced in Math test scores (but always sizable).

6.1 2SLS results

Results so far shown induce to suppose negative and singificant effects both within and between peer groups increasing with the percentage of non-Italian peers in the school. However, the negative correlation may be induced by sorting of non-Italian students across schools. In our framework, 2SLS estimations are aimed at disentangling an *average causal response* to the increase of one percentage point in the non-Italian school share on the Italian and non-Italian mean test scores (Acemoglu and Angrist, 2000). In fact, 2SLS estimations of Eq. 5' (Table 14) and 6' (Table 15) add interesting insights to our causal investigation.

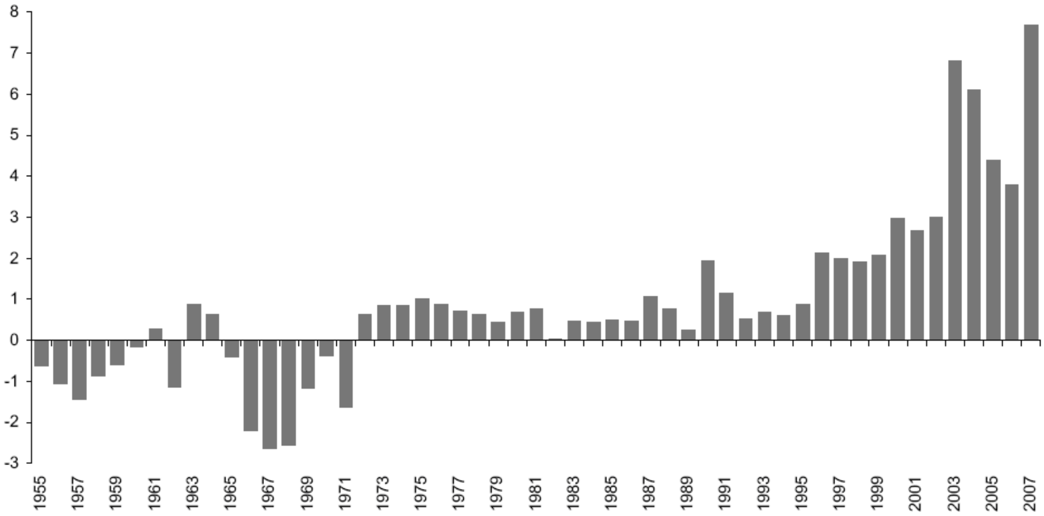
On one hand, within peer effects estimations are still negative, significant and generally increased with respect to simple OLS estimations (the first wave still has non significant results); there are not huge differences with respect to the subject and results including perovince fixed-effects and catchment area variables. On the other hand, between peer groups effects estimations show a less definite pattern: results loose significance with respect to the OLS regressions and the direction of the effect is not clear. Language mean test score results of Italian peers seem to be positively influenced by an increase in non-Italian school share (this is true for the 2010 wave and the pooled sample), or at least effects are not significant. Math results are not statistically significant, and we still find positive effects in 2010.

2SLS estimation results lead us to conclude that there is a strong and negative impacts of non-Italian school share on the test scores results of non-Italian students[42], but that the negative between groups peer effects estimation found in the OLS framework are probabily due correlation induced by sorting on non-Italian students across schools. Thus, we cannot conclude that the exposure to highest percentage of non-Italian peers in the school causes negative effects on the attainment levels of Italian students. This is particularly evident for the Language skills of Italian students that seem, indeed, to benefit from the interaction with non-native peers. The average causal response for a percent point increase in the non-Italian school share is thefore different for the two types of peer interactions. Within the non-Italian peer groups a percent point increase in the non-Italian school share lowers mean test scores results of non-Italian peers by more than a half, and the response is not different with respect of the subject. Between the two peer groups, the average causal response to such an increase is positive (though weakly significant) in Language and non-significant effects in Math.

[42] These results are in line with the majority of the literature on '*racial peer effects'* (Hoxby 2000; Hanushek *et al.* 2003, 2009) wich find evidence of negative and sizable within-race peer effects.

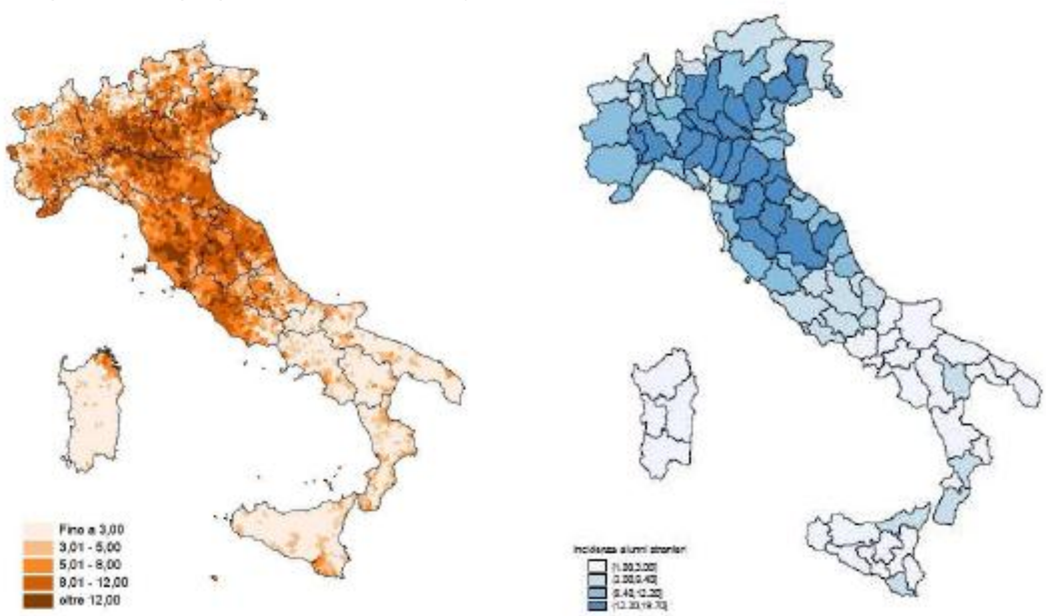
Figures

Figure 1. International migration balance, Italy: 1955-2007.



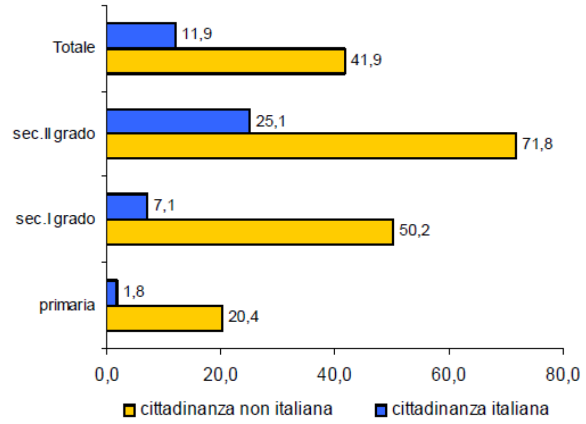
Source: Mencarini *et al.* (2009, p. 2), built on Istat Data.
Note: the figure shows the difference between the number of immigrants and emigrants per 1,000 residents. A negative number indicates that there are more net emigrants than net immigrants.

Figure 2. Comparison between residential and school segregation in Italy. Figure on the left: percentage of non-Italian citizens in resident population (geographical distribution by Municipality). Figure on the right: percentage of non-Italian students in junior high schools (geographical distribution by Province).



Source: Figure on the left**:** ISTAT (2010), based on resident population on the 1st January 2010; Figure on the right: MIUR (2009b), based on 2008-09 school year.

Figure 3. Percentage of students enrolled one or more years later than regular path, by school level.



Source: MIUR (2009b), based on 2008-09 school year.

Figure 4. Percentage of 'held back students' according to macro-area and origins (non immigrants, first and second generation immigrants) in Invalsi IC 2009 and 2010 waves.

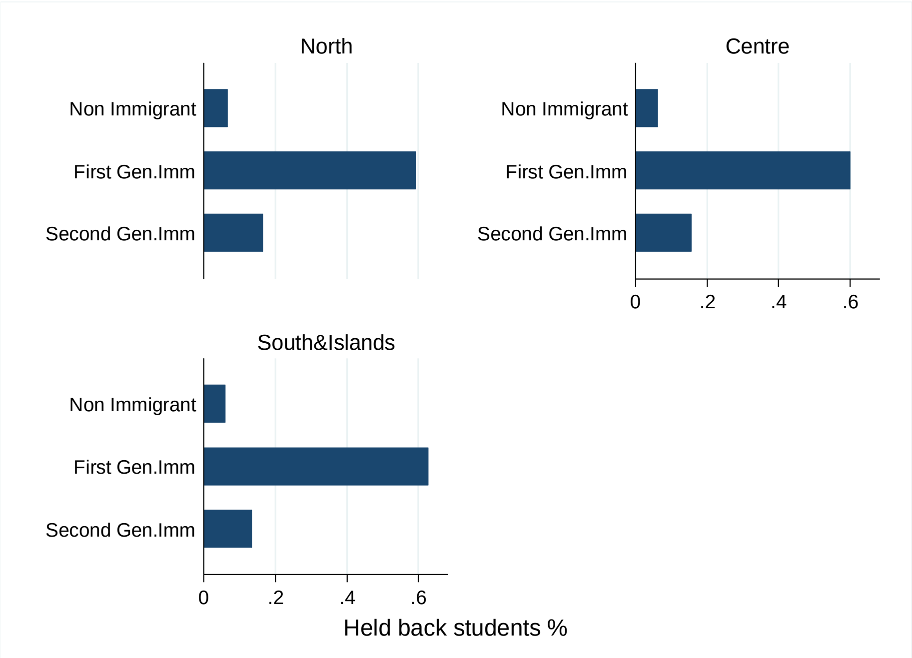


Figure 5. Average percentage of student per school according to students' origins categorization and geographical macro-area (Invalsi IC data).

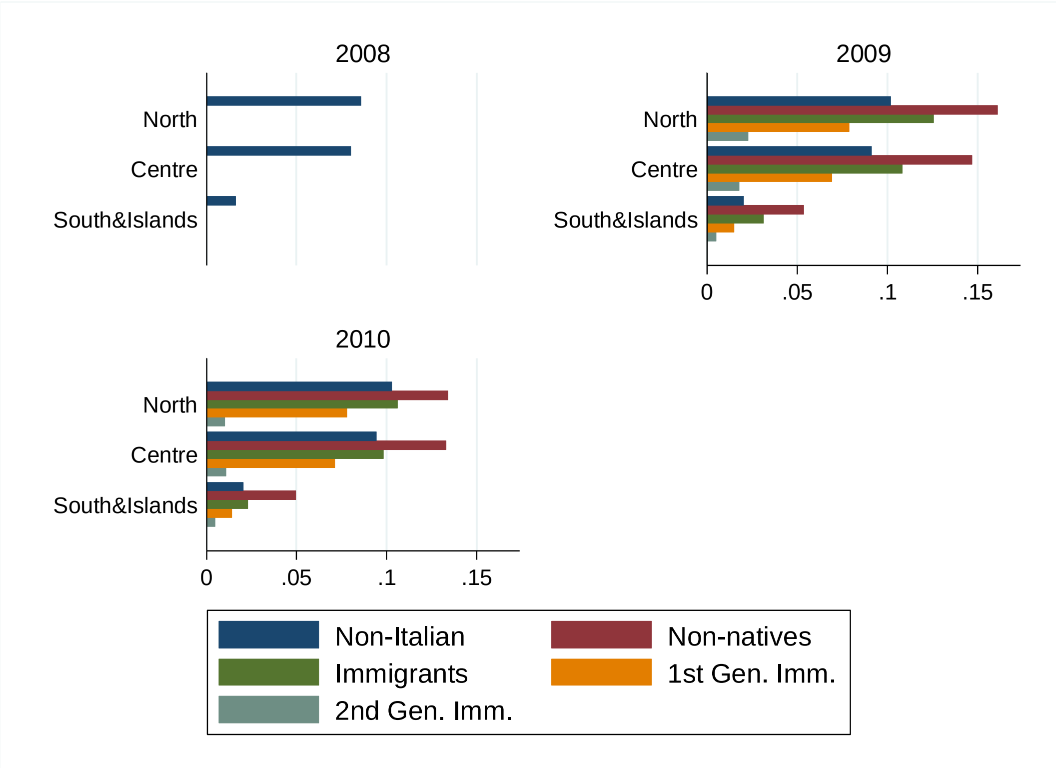
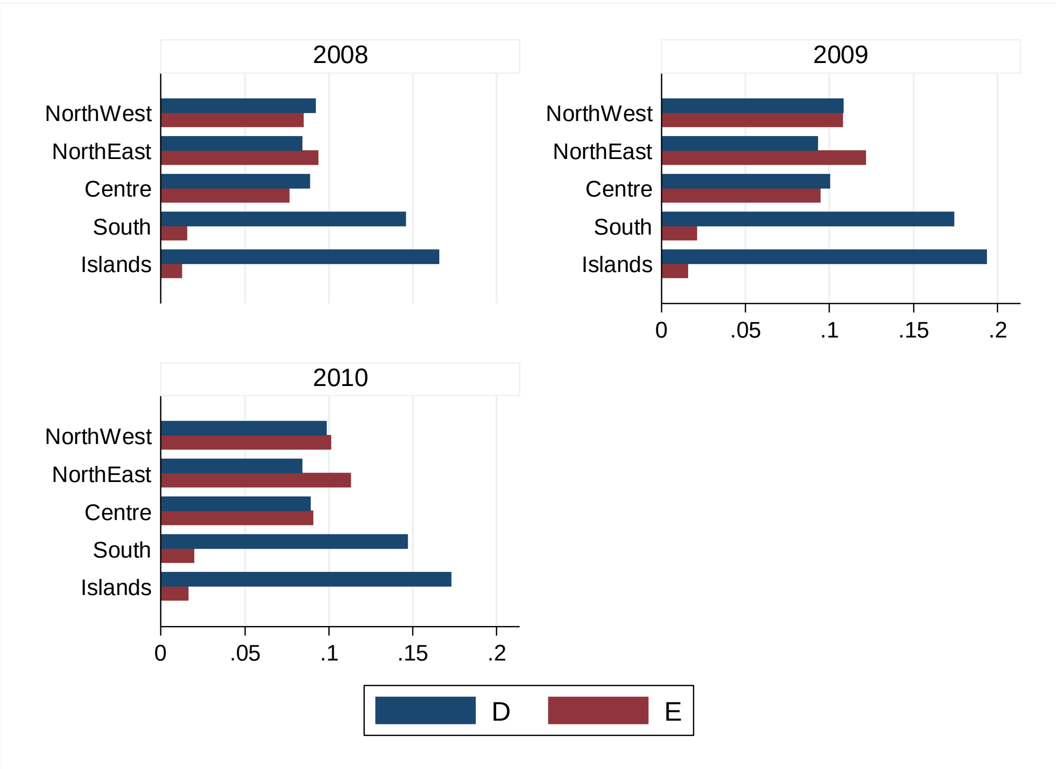


Figure 6. Dissimilarity (D) and Exposoure (E) Indeces across geographical areas (Invalsi IC data).



Tables

Table 1. Non-Italian Students, school level detail, available data.

School Year	*All Levels*		*Kindergarten*		*Primary*		*Lower Secondary*		*Upper Secondary*	
	Total No.	%	Total No.	%	Total No.	%	Total No.	%	Total No.	%
1996/1997	59389	0.7	12809	0.8	26752	1.0	11991	0.6	7837	0.3
1997/1998	…	…	…	…	…	…	…	…	…	…
1998/1999	85522	1.1	…	…	…	…	…	…	…	…
1999/2000	119679	1.5	…	…	…	…	…	…	…	…
2000/2001	147406	1.8	…	…	…	…	…	…	…	…
2001/2002	181767	2.3	39445	2.5	84122	3.0	45253	2.5	27594	1.1
2002/2003	232766	3.0	48072	3.0	100939	3.7	55907	3.1	34890	1.3
2003/2004	282683	3.5	59500	3.6	123814	4.5	71447	4.0	52380	2.0
2004/2005	361576	4.2	74348	4.5	147633	5.3	84989	4.7	63833	2.4
2005/2006	424683	4.8	84058	5.0	165951	5.9	98150	5.6	83052	3.1
2006/2007	501445	5.6	94712	5.7	190803	6.8	113076	6.5	102829	3.8
2007/2008	574133	6.4	111044	6.7	217716	7.7	126396	7.3	118977	4.3
2008/2009	629360	7.0	125092	7.6	234206	8.3	140050	8.0	130012	4.8

Source: own elaboration from MIUR (2009a, 2009b).

Table 2. Variation in non-Italian students enrolled, school level detail.

School Year	*All Levels*		*Kindtergarden*		*Primary*		*Lower Secondary*		*Upper Secondary*	
	(A)	(B)	(A)	(B)	(A)	(B)	(A)	(B)	(A)	(B)
1996/1997	100	-	100	…	100	…	100	…	100	…
1998/1999	144	44.00	…	…	…	…	…	…	…	…
1999/2000	202	39.94	…	…	…	…	…	…	…	…
2000/2001	248	23.17	…	…	…	…	…	…	…	…
2001/2002	306	23.31	308	-	314	-	377	-	352	-
2002/2003	392	28.06	375	21.87	377	19.99	466	23.54	445	26.44
2003/2004	476	21.45	465	23.77	463	22.66	596	27.80	668	50.13
2004/2005	609	27.91	580	24.95	552	19.24	709	18.95	815	21.87
2005/2006	715	17.45	656	13.06	620	12.41	819	15.49	1060	30.11
2006/2007	844	18.08	739	12.67	713	14.98	943	15.21	1312	23.81
2007/2008	967	14.50	867	17.24	814	14.11	1054	11.78	1518	15.70
2008/2009	1060	9.62	977	12.65	875	7.57	1168	10.80	1659	9.27

Source: own elaboration from MIUR (2009a, 2009b). **Notes:** Column *(A)* contains the increment with respect to 1996-97 school year (=100); column *(B)* contains the percentage increase with respect to the (available) year before.

Table 3. Non-Italian students born in Italy, detail for 2008-09 school year, by school level.

School level	*No.*			*% wrt Total Students Pop.*			*% wrt Non-Italian Students*		
	Born in Italy	Born abroad	Total	Born in Italy	Born abroad	Total	Born in Italy	Born abroad	Total
Kindtergarden	91647	33445	125092	5.5	2.1	7.6	73.3	26.7	100
Primary	105292	128914	234206	3.7	4.6	8.3	45.0	55.0	100
Lower Secondary	26366	113684	140050	1.5	6.5	8.0	18.8	81.2	100
Upper Secondary	9698	120314	130012	0.3	4.5	4.8	7.5	92.5	100
Total	233003	396357	629360	2.6	4.4	7.0	37.0	63.0	100

Source: own elaboration from MIUR (2009b).

Table 4. Differences in test scores between native and non-native students, in some OECD countries.

	Native students		*Second-generation students*		*First-generation students*	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
Australia	529	(2.0)	528	(5.7)	527	(5.7)
Austria	523	(3.5)	431	(13.4)	435	(10.9)
Belgium	523	(2.4)	443	(7.3)	430	(8.3)
Canada	541	(1.8)	528	(4.8)	519	(5.2)
Denmark	503	(2.9)	418	(11.0)	414	(8.0)
France	505	(3.5)	456	(10.4)	438	(10.1)
Germany	532	(3.2)	439	(8.7)	455	(8.8)
Greece	478	(3.2)	-	-	428	(10.3)
Ireland	510	(3.0)	-	-	500	(14.6)
Italy	479	(2.0)	-	-	418	(8.2)
Luxembourg	511	(1.6)	445	(3.0)	445	(3.7)
Netherlands	534	(2.3)	455	(11.2)	467	(10.2)
New Zealand	536	(2.6)	508	(8.0)	526	(6.6)
Norway	493	(2.5)	-	-	433	(11.2)
Portugal	479	(2.9)	-	-	412	(11.1)
Spain	494	(2.4)	-	-	428	(7.2)
Sweden	512	(2.3)	464	(6.0)	434	(8.1)
Switzerland	531	(2.9)	462	(4.8)	436	(6.9)
United Kingdom	519	(2.0)	493	(8.9)	479	(14.7)
United States	499	(4.3)	456	(6.7)	442	(7.9)
OECD average	506	(0.5)	466	(2.2)	453	(2.1)

Source: PISA 2006, test scores in Science.

Table 5. Individual and school level descriptive statistics.

Idividual Level	*IC 2007-08*				*IC 2008-09*				*IC 2009-10*			
	North	*Centre*	*South*	*Tot.*	*North*	*Centre*	*South*	*Tot.*	*North*	*Centre*	*South*	*Tot.*
No. Students	201,650	89,870	204,339	495,859	211,567	93,440	205,856	510,863	206,530	91,629	199,405	497,564
% Non-Italian	9.49	8.07	1.48	5.95	11.20	8.97	1.83	7.04	11.24	9.28	1.84	7.12
% Non-natives	.	.	.	.	13.65	11.23	3.12	9.02	13.77	12.05	3.44	9.36
% Immigrants	.	.	.	.	11.42	9.02	1.98	7.21	11.24	9.47	1.99	7.22
% First Gen. Imm.	.	.	.	.	8.56	6.62	1.28	5.25	8.41	6.82	1.24	5.21
% Second Gen. Imm.	.	.	.	.	2.22	1.63	0.45	1.37	1.01	1.17	0.40	0.78
School Level	*IC 2007-08*				*IC 2008-09*				*IC 2009-10*			
	North	*Centre*	*South*	*Tot.*	*North*	*Centre*	*South*	*Tot.*	*North*	*Centre*	*South*	*Tot.*
No. Schools	2313	998	2388	5699	2359	1017	2427	5083	2368	1009	2356	5733
% Public Schools	83.48	85.77	95.27	88.82	83.59	86.52	95.09	88.91	83.78	86.72	95.33	89.04
% K-8 schools	65.58	61.72	60.26	62.68	66.21	63.32	95.10	63.26	69.04	67.19	66.04	67.49
Avg. No. Students per School	295.32	301.62	287.48	293.11	341.94	342.03	298.58	322.21	306.61	315.50	291.01	301.72
Avg. No. Students per Class	21.08	20.68	19.36	20.28	21.20	20.83	19.75	20.48	21.30	21.00	20.08	20.74
Pupil-teacher Ratio	21.30	20.06	15.35	18.35	11.60	11.64	10.30	11.02	21.15	15.74	13.12	16.77
% Schools linked to Catchment Area Info.	95.72	94.99	93.34	94.59	94.82	94.00	93.08	93.95	93.12	92.86	91.85	92.55

Table 6. Descriptive OLS: individual charactersitics determinants of Invalsi IC test scores.

	Dep. Var.: Log Individual Language Test Score				*Dep. Var.: Log Individual Maths Test Score*			
	2008	*2009*	*2010*	*Pooled*	*2008*	*2009*	*2010*	*Pooled*
Non-Italian	-0.1455***	-0.1161***	-0.0933***	-0.1592***	-0.1693***	-0.1009***	-0.0852***	-0.1394***
	(0.0034)	(0.0054)	(0.0050)	(0.0021)	(0.0045)	(0.0057)	(0.0054)	(0.0023)
Female	0.0383***	0.0281***	-0.0358***	0.0101***	-0.0501***	-0.0356***	0.0497***	-0.0108***
	(0.0008)	(0.0009)	(0.0009)	(0.0005)	(0.0014)	(0.0011)	(0.0012)	(0.0007)
Italian held back	-0.1833***	-0.2176***	-0.1969***	-0.2075***	-0.3022***	-0.2262***	-0.2028***	-0.2341***
	(0.0024)	(0.0031)	(0.0028)	(0.0017)	(0.0038)	(0.0033)	(0.0030)	(0.0021)
Non-Italian held back	-0.1260***	-0.1207***	-0.1244***	-0.1318***	-0.0593***	-0.0563***	-0.0778***	-0.0635***
	(0.0047)	(0.0051)	(0.0047)	(0.0028)	(0.0056)	(0.0044)	(0.0046)	(0.0027)
In Advance	0.0563***	0.0669***	0.0864***	0.0667***	0.0952***	0.0607***	0.0869***	0.0783***
	(0.0025)	(0.0028)	(0.0039)	(0.0018)	(0.0040)	(0.0029)	(0.0051)	(0.0024)
Always stayed in Italy		0.0568***	0.0421***			0.0213***	0.0256***	
		(0.0048)	(0.0042)			(0.0052)	(0.0044)	
Mother Born in Italy		0.0054**	0.0084***			0.0033	0.0044	
		(0.0026)	(0.0024)			(0.0027)	(0.0028)	
Father Born in Italy		0.0186***	0.0260***			0.0111***	0.0130***	
		(0.0030)	(0.0029)			(0.0032)	(0.0030)	
State School	-0.0153***	-0.0170***	-0.0322***	-0.0214***	0.0014	0.0251***	-0.0220***	0.0007
	(0.0044)	(0.0042)	(0.0040)	(0.0030)	(0.0078)	(0.0061)	(0.0064)	(0.0050)
K8 School Type	-0.0167***	-0.0136***	-0.0157***	-0.0156***	-0.0319***	-0.0226***	-0.0191***	-0.0246***
	(0.0026)	(0.0027)	(0.0028)	(0.0019)	(0.0042)	(0.0033)	(0.0041)	(0.0028)
Additional controls:								
High Cheating Dummy	X	X	X	X	X	X	X	X
Region FE	X	X	X		X	X	X	
*Region*Year FE*				X				X
Year dummies				X				X
R sq.	0.084	0.104	0.127	0.115	0.082	0.080	0.102	0.188
Adj.R sq.	0.084	0.104	0.127	0.115	0.082	0.080	0.102	0.188
Clusters	5684	5688	5624	6289	5684	5688	5625	6290
N	484,372	433,902	418,197	1,461,915	484,286	433,940	418,197	1,461,851

(Robust std. errors in parenthesis, clustered at the school level), sig. level: * p<0.1, ** p<0.05, *** p<0.01

Table 7. Descriptive statistics at the individual level on IC 2010: students' origins and test scores.

	% Students	*Mean*	*Median*	*2nd Q.*	*3rd Q.*	*Variance*	*Skewness*	*Kurtosis*	*Δ Mean [(a)-(b)]*
	Italian Language Test Score								
Italian *(a)*	92.878	60.904	63.110	51.125	73.440	304.074	-0.813	3.825	7.418*
Non-Italian *(b)*	7.122	53.486	54.251	42.418	65.250	274.005	-0.378	3.166	
Native *(a)*	91.253	61.056	63.212	51.248	73.582	303.770	-0.822	3.850	6.985*
Non Native (b)	8.747	54.071	55.066	43.436	66.029	275.061	-0.403	3.186	
Non Immigrant (a)	92.777	60.968	63.152	51.172	73.508	304.107	-0.818	3.839	6.922*
Immigrant (b)	7.223	54.046	55.003	43.448	65.926	272.829	-0.401	3.193	
1st Gen. Imm. (a)	6.021	53.398	54.165	42.351	65.067	271.577	-0.368	3.167	-5.046*
2nd Gen. Imm. (b)	0.931	58.444	59.983	48.699	69.612	256.839	-0.659	3.750	
	Math Test Score								
	% Students	*Mean*	*Median*	*2nd Q.*	*3rd Q.*	*Variance*	*Skewness*	*Kurtosis*	*Δ Mean [(a)-(b)]*
Italian (a)	92.878	52.262	52.195	41.865	64.049	272.017	-0.208	3.029	4.602*
Non-Italian (b)	7.122	47.659	47.126	37.226	57.292	229.224	0.006	3.164	
Native (a)	91.253	52.431	52.265	41.957	64.179	271.088	-0.208	3.031	4.522*
Non Native (b)	8.747	47.909	47.206	37.265	57.524	231.432	-0.010	3.150	
Non Immigrant (a)	92.777	52.347	52.222	41.917	64.116	271.213	-0.206	3.029	4.399*
Immigrant (b)	7.223	47.947	47.233	37.273	57.491	229.623	-0.004	3.157	
1st Gen. Imm. (a)	6.021	47.663	47.134	37.232	57.263	226.876	0.011	3.179	-2.253*
2nd Gen. Imm. (b)	0.931	49.916	49.731	39.671	59.884	240.780	-0.133	3.083	

Notes. Test scores range from 0 to 100 (percentage of right answers) and are cheating-corrected. The last column contains standard t-test (with different variances) results on the difference between means of each (a) – (b) category; star indicates whether the mean difference is statistically significant (p.val≤0.05).

Table 8. School segregation measures: Dissimilarity (D, D*) and Exposure (E, E*) Indices.

Area	*D*	*D**	*E*	*E**
North West	0.0997	0.1107	0.0980	0.0979
North East	0.0871	0.0844	0.1095	0.1103
Centre	0.0926	0.1018	0.0873	0.0784
South	0.1557	0.1652	0.0186	0.0136
Islands	0.1774	0.1797	0.0148	0.0141
Total: Italy	0.1227	0.1297	0.0645	0.0608

Notes. D* and E* represents, respectively, the Dissimilarity and Exposure Index at the regional level as weighted average of D and E at province level, weights equal to the total number of students by province.

Table 9. Effect of non-Italian students school share on mean test scores of Italian peers: OLS results (2008-2009-2010 IC waves).

	Dep. Var.: Language Log School Mean Score for ***Italian Students***								
	2008			2009			2010		
Non Italian ss	-0.0446	-0.0397	-0.0363	-0.0497	-0.0625	-0.0847**	-0.0882***	-0.0860***	-0.0624**
	(0.0296)	(0.0305)	(0.0295)	(0.0384)	(0.0389)	(0.0364)	(0.0292)	(0.0285)	(0.0273)
R sq.	0.127	0.183	0.246	0.338	0.403	0.489	0.329	0.390	0.507
Adj.R sq.	0.122	0.158	0.223	0.334	0.386	0.475	0.325	0.372	0.493
	Dep. Var.: Maths Log School Mean Score for ***Italian Students***								
	2008			2009			2010		
Non Italian ss	-0.1501***	-0.1277***	-0.1177***	-0.0888**	-0.1031**	-0.1135***	-0.1158***	-0.0993**	-0.0954**
	(0.0465)	(0.0471)	(0.0442)	(0.0445)	(0.0453)	(0.0426)	(0.0427)	(0.0425)	(0.0396)
R sq.	0.153	0.220	0.422	0.254	0.349	0.435	0.124	0.197	0.397
Adj.R sq.	0.148	0.196	0.404	0.250	0.331	0.418	0.119	0.175	0.380
N	4137	4137	4137	4522	4522	4522	4676	4676	4676
Controls:									
Always been in Italy				X	X	X	X	X	X
Parents' Origin				X	X	X	X	X	X
Catchment Area	X	X	X	X	X	X	X	X	X
Province FE		X	X		X	X		X	X
Cheating Dummy			X			X			X
(Robust Std. Errors in parenthesis). Significance level: * p<0.1, ** p<0.05, *** p<0.01									

Table 10. Effect of non-Italian students school share on mean test scores of NON-Italian peers: OLS results (2008-2009-2010 IC waves).

	*Dep. Var.: Language Log School Mean Score for **NON-Italian Students***								
	2008			2009			2010		
Non Italian ss	-0.0837	-0.0688	-0.0793	-0.1988**	-0.1893**	-0.2244**	-0.2142***	-0.2104***	-0.1748**
	(0.0637)	(0.0672)	(0.0620)	(0.0915)	(0.0951)	(0.0934)	(0.0793)	(0.0795)	(0.0782)
R sq.	0.069	0.143	0.159	0.157	0.201	0.228	0.052	0.102	0.131
Adj.R sq.	0.062	0.106	0.123	0.151	0.172	0.200	0.045	0.069	0.099
	*Dep. Var.: Mathematics Log School Mean Score for **NON-Italian Students***								
	2008			2009			2010		
Non Italian ss	-0.0596	-0.0361	-0.0500	-0.1910**	-0.1782*	-0.1893**	-0.1615**	-0.1561**	-0.1695**
	(0.0700)	(0.0689)	(0.0697)	(0.0870)	(0.0912)	(0.0887)	(0.0770)	(0.0780)	(0.0764)
R sq.	0.042	0.118	0.160	0.181	0.224	0.243	0.055	0.099	0.165
Adj.R sq.	0.035	0.080	0.124	0.175	0.196	0.215	0.048	0.066	0.135
N	2965	2965	2965	3545	3545	3545	3633	3633	3633
Controls									
Always been in Italy				X	X	X	X	X	X
Parents' Origin				X	X	X	X	X	X
Catchment Area	X	X	X	X	X	X	X	X	X
Province FE		X	X		X	X		X	X
Cheating Dummy			X			X			X
(Robust Std. Errors in parenthesis). Significance level: * p<0.1, ** p<0.05, *** p<0.01									

Table 11. Effect of non-Italian students school share on mean test scores of Italian peers: pooled-OLS results.

	Dep. Var.: Language Log School Mean Score for Italian Students		
	POOLED OLS		
Non Italian ss	-0.0542**	-0.0776***	-0.0763***
	(0.0216)	(0.0215)	(0.0200)
R sq.	0.280	0.342	0.430
Adj.R sq.	0.273	0.326	0.415
	Dep. Var.: Mathematics Log School Mean Score for Italian Students		
	POOLED OLS		
Non Italian ss	-0.1335***	-0.1145***	-0.1372***
	(0.0286)	(0.0290)	(0.0264)
R sq.	0.393	0.428	0.527
Adj.R sq.	0.387	0.413	0.522
Clusters	5000	5000	5000
N	13,335	13,335	13,335
Controls			
School Charact.	X	X	X
Catchment Area	X	X	X
Province Dummies	X		
*Province*Year Dummies*		X	X
Year Dummies	X	X	X
Cheating Dummy			X

(Robust Std. Errors in parenthesis, Clustered at the School level). Significance level: * p<0.1, ** p<0.05, *** p<0.01

Table 12. Effect of non-Italian students school share on mean test scores of NON-Italian peers: pooled-OLS results.

	Dep. Var.: Language Log School Mean Score for NON-Italian Students		
	POOLED OLS		
Non Italian ss	-0.1873***	-0.1924***	-0.1944***
	(0.0477)	(0.0496)	(0.0468)
R sq.	0.126	0.154	0.178
Adj.R sq.	0.115	0.126	0.150
	Dep. Var.: Maths Log School Mean Score for NON-Italian Students		
	POOLED OLS		
Non Italian ss	-0.1816***	-0.1630***	-0.1970***
	(0.0475)	(0.0478)	(0.0460)
R sq.	0.138	0.171	0.176
Adj.R sq.	0.126	0.144	0.165
Clusters	4297	4297	4297
N	10143	10143	10143
Controls			
School Characteristics	X	X	X
Catchment Area	X	X	X
Province Dummies	X		
*Province*Year Dummies*		X	X
Year Dummies	X	X	X
Cheating Dummy			X

(Robust Std. Errors in parenthesis, Clustered at the School level). Significance level: * p<0.1, ** p<0.05, *** p<0.01

Table 13. First stage regression.

	Endogenous Dep. Var.: Non-Italian students school share (P_s)			
	2008	*2009*	*2010*	*Pooled*
Non-Italian Residents in the school catchment area in 2001 (Z_s)	0.00436***	0.00595***	0.00458***	0.00510***
	(0.00038)	(0.00036)	(0.00032)	(0.00021)
All exogenous regressors (S, X, W, Province FE)	X	X	X	X
*Year*province FE*				X
First stage F-statistics	188.67	342.66	260.92	809.43
R sq.	0.593	0.711	0.6821	0.659
Adj.R sq.	0.581	0.702	0.6731	0.650
N	4137	4522	4676	13335

(Std. Errors in parenthesis). Significance level: * p<0.1, ** p<0.05, *** p<0.01

Table 14. 2SLS regression: effect of non-Italian students school share on mean test scores of Italian peers.

	Dep. Var.: Language Log School Mean Score for Italian Students							
	2008		*2009*		*2010*		*Pooled*	
Non Italian ss	-0.0195	-0.1836	0.1258	-0.0091	0.2748***	0.2227*	0.1308	0.0267
	(0.1776)	(0.2256)	(0.1083)	(0.1222)	(0.1060)	(0.1208)	(0.0818)	(0.0969)
R sq.	0.169	0.179	0.384	0.403	0.355	0.373	0.323	0.341
Adj.R sq.	0.147	0.154	0.368	0.386	0.339	0.356	0.307	0.324
	Dep. Var.: Maths Log School Mean Score for Italian Students							
	2008		*2009*		*2010*		*Pooled*	
Non Italian ss	-0.2089	-0.6055*	-0.1601	-0.2642*	0.0379	0.0376	-0.1000	-0.2313*
	(0.2580)	(0.3361)	(0.1357)	(0.1526)	(0.1602)	(0.1900)	(0.1154)	(0.1388)
R sq.	0.206	0.203	0.339	0.347	0.191	0.196	0.423	0.427
Adj.R sq.	0.185	0.179	0.322	0.328	0.171	0.173	0.409	0.412
N	4137	4137	4522	4522	4676	4676	13335	13335
Controls								
Always been in Italy			X	X	X	X	X	X
Parents' Origin			X	X	X	X	X	X
Catchment Area		X		X		X		X
*Province FE (Prov*Year FE for Pooled)*	X	X	X	X	X	X	X	x

(Robust Std. Errors in parenthesis, Clustered at the School level for Pooled). Significance level: * p<0.1, ** p<0.05, *** p<0.01

Table 15. 2SLS regression: effect of non-Italian students school share on mean test scores of NON-Italian peers.

	Dep. Var.: Language Log School Mean Score for Italian Students							
	2008		*2009*		*2010*		*Pooled*	
Non Italian ss	-0.0690	0.0468	-0.7936***	-0.8257***	-0.5566***	-0.5064***	-0.4876***	-0.5683**
	(0.2455)	(0.3268)	(0.1572)	(0.1720)	(0.1459)	(0.1087)	(0.1773)	(0.2208)
R sq.	0.137	0.142	0.189	0.192	0.087	0.097	0.147	0.149
Adj.R sq.	0.103	0.106	0.162	0.163	0.057	0.064	0.120	0.121
	Dep. Var.: Maths Log School Mean Score for Italian Students							
	2008		*2009*		*2010*		*Pooled*	
Non Italian ss	0.4094	0.2076	-0.8746***	-0.8647**	-0.4976***	-0.4706***	-0.5702***	-0.6763***
	(0.3166)	(0.4051)	(0.3283)	(0.4073)	(0.1116)	(0.1136)	(0.1864)	(0.2285)
R sq.	0.103	0.115	0.209	0.211	0.087	0.094	0.162	0.162
Adj.R sq.	0.068	0.077	0.183	0.182	0.057	0.061	0.135	0.134
N	2965	2965	3545	3545	3633	3633	10143	10143
Controls								
Always been in Italy			X	X	X	X	X	X
Parents' Origin			X	X	X	X	X	X
Catchment Area		X		X		X		X
*Province FE (Prov*Year FE for Pooled)*	X	X	X	X	X	X	X	x

(Robust Std. Errors in parenthesis). Significance level: * p<0.1, ** p<0.05, *** p<0.01

Appendix A. Institutional framework

The existing normative framework about non-Italian students in the Italian school system and the 'Gelmini rule'

During the past twenty years, the Italian Ministry of Education has produced some administrative acts[43] concerning the growing phenomenon of the presence of non-Italian students in the school system, disciplining the basic tools to implement a correct integration of native and non-native students (the so called 'intercultural education approach'), and establishing additional funding for the schools having more than 10% of non-Italian students (C.M. n. 155/2001).

The Italian normative discipline of migration and migration flows[44] recalls the duty of the schools to implement adequate intercultural education, to preserve and add value to the differences brought by non-native students and their culture. The principles of the law are enforced through the D.P.R. No. 394/1999, which constitutes the reference regulatory framework. The basic elements to recall are three: first, the right and the duty for every immigrant individual in school age, to be enrolled in the suitable school institution, independently from their legal or illegal status[45]; second, the duty for every school to accept and enrol them in every moment of the school year; third, the competence of the School Board and Head (i.e. *Collegio Docenti* and *Dirigente Scolastico*) to allocate foreign students so to avoid the "constitution of classes where their presence is predominant".

As a general rule, non-Italian students should be allocated to the grade and class appropriate for their age (so called 'age-rule'); however, the School Board may allocate students to a lower or upper grade depending on the native country school system, language skills, type of school path followed in the previous school system[46]. Notice also that students previously enrolled in a school in an EU country should be automatically allocated to the appropriate Italian grade and school corresponding to their age[47]. Finally, schools are encouraged to collaborate with other Public Institutions to provide a suitable redistribution of non-Italian students especially in highly concentrated areas in order to prevent social segregation phenomena[48].

[43] Among others: C.M. 8/9/1989, n. 301 "*Inserimento degli alunni stranieri nella scuola dell'obbligo. Promozione e coordinamento delle iniziative per l'esercizio del diritto allo studio*", C.M. 22/7/1990, n. 205, "*La scuola dell'obbligo e gli alunni stranieri. L'educazione interculturale*", C.M. 1/3/2006, n. 24, "*Linee guida per l'accoglienza e l'integrazione degli alunni stranieri*".

[44] Legge n. 40/1998, art. 36. The law n. 189/2002 (so-called 'Bossi-Fini') introduced a new regulatory framework to control immigration flows (innovating the previous law n. 40/1998) but did not change in any part the normative framework for the enrollment of immigrant children, established in the D.P.R. No. 394/1999.

[45] The D.P.R. introduces in the Italian legislative framework the content of the *Human Rights Convention* (U.N., 1948) and *International Convention on Children Rights* (U.N., 1989).

[46] D.P.R. No. 394/1999, art. 45, c.2., and C.M. 15/1/2009, n. 4, par. 10.

[47] D. lgs. n. 297/1994, art. 115-116.

[48] D.P.R. No. 394/1999, art. 45, c.3-5 and C.M. 15/1/2009, n. 4, par. 10.2.

As a consequence, the allocation of non-Italian students is not random in at least three possible dimensions: among schools in the same geographical area, within grades in each school, and within classes in each grade. Moreover, EU citizens are typically treated differently. These aspects are crucial in the choice of an appropriate identification strategy.

Table A1. Presence of non-Italian students per classes.

	Classes with a percentage of Non-Italian students > 30%							
	Primary				Lower Secondary			
	Non-Italian students		Only Non-Italian students born abroad		Non-Italian students		Only Non-Italian students born abroad	
	N.	%	N.	%	N.	%	N.	%
Piemonte	817	11.1	175	12.7	341	10.9	215	13.7
Lombardia	2040	27.4	218	16.6	915	29.3	423	27.0
Veneto	989	13.1	117	8.4	393	12.6	189	12.1
Friuli VG	176	2.4	38	2.9	104	3.3	59	3.8
Liguria	258	3.8	89	6.9	118	3.8	90	5.7
Emilia Romagna	950	12.7	128	9.2	417	13.4	173	11.0
Toscana	567	7.9	90	6.9	236	7.6	115	7.3
Umbira	242	3.3	46	3.4	91	2.9	50	3.2
Marche	307	4.2	57	4.4	124	4.0	49	3.1
Lazio	550	7.4	130	9.7	272	8.7	139	8.9
Abruzzo	79	1.2	43	3.7	20	0.6	11	0.7
Molise	13	0.2	13	1.0	4	0.1	4	0.3
Campania	43	0.6	36	2.7	10	0.3	7	0.4
Puglia	27	0.9	7	0.8	10	0.3	3	0.2
Basilicata	5	0.1	2	0.2	2	0.1	1	0.1
Calabria	84	1.2	77	5.8	19	0.6	17	1.1
Sicilia	117	2.0	53	4.4	42	1.3	20	1.3
Sardegna	15	0.4	6	0.5	4	0.1	3	0.2
Italia	7279	100	1325	100	3122	100	1568	100

Source: MIUR (2010).

In January 2010, the Italian Ministry of Education introduced a new rule for the allocation of non-Italian students within classes and schools, establishing that class should not contain more than 30% of non-Italian students[49]. The idea behind the implementation of such a threshold is to avoid social segregation in the schools and in the classes within schools, especially in areas where immigrant population, and, as a consequence, the concentration of non-native students enrolled at schools, is particularly high. As a matter of fact, the rules in the D.P.R. No. 394/1999 already established that the allocation of non-Italian students within classes in a school should be decided by the School Board and Head in order to avoid the creation of any sort of 'ghetto-classes', however, the new regulation seems to reorganize in a less discretional way the general rules for the allocation of non-Italian students within the classes of the same school and also within schools operating in the same territory introducing the mandatory threshold.

[49] "*Indicazioni e raccomandazioni per l'integrazione di alunni con cittadinanza non italiana*", MIUR, Circolare Ministeriale No. 2/2010 (C.M. 8/1/2010, n. 2).

The rule (that we name ‘*Gelmini rule’* form the surname of the actual Italian Ministry of Education) is enforced starting from the first-grade-classes of primary, lower and upper secondary schools of the 2010-11 school year. Its impact is not huge but still relevant, especially in the North and Centre of Italy: in Lombardy, for example, more than 29% of the classes in the lower secondary schools have a concentration of more than 30% of non-Italian students (the percentage decreases to the 27% if we consider only non-Italian students born abroad) (see Table A.1, MIUR 2010).

Appendix B. Categories definitions and variables used

Categories definitions

We partition students of Invalsi IC data into three main categories following criteria generally used in Pisa-OECD surveys (see, for example, OECD, 2010). The first category refers to the simple student's citizenship, thus we distinguish between *Italian* and *non-Italian* students. We remind that Italian citizenship follows a, so called, '*ius sanguinis*' rule: a student is an *Italian* student if at least one of the parent is an Italian citizen. Data from Italian Ministry of Education generally only make this type of distinction. This first categorization is obtained thanks to the variable 'student citizenship', which distinguish between Italian and non-Italian students and it is available for all the three IC data waves. The second category distinguishes between *immigrant* vs. *non-immigrant* students: according to Pisa-OECD criteria, individuals whose both parents were born abroad are defined to as '*immigrants*'. On the contrary, '*non-immigrant*' students have at least one parent born in Italy. This category is obtained through two variables containing the information on the parents' place of birth (Italy or abroad), and have a greater percentage of missing (3.92% of the final student population). Immigrant students are then partitioned according to their place of birth: '*first generation immigrants*' are students born abroad, while '*second generation immigrants*' are students born the host country (Italy). Finally, all students born in the receiving country who have at least one parent who was also born inside the country are referred to as '*native*'. The *native* vs. *non-native* categorization exploits both the information on the student's and parents' place of birth. The identification of immigrant and non-native students is only possible for the 2009 and 2010 waves of IC data.

Table B.1 and Table B.2 show the variables used in the creation of the categories, missing values and how categories creation can intersect each other's. Immigrant and native status do not depend on citizenship criteria, but only on the student's and parents' place of birth[50]. Basically, the immigrant status is defined according to the fact that both parents are born abroad; on the contrary, the native status is defined according to fact that the student is born in Italy (from, at least one parent born in Italy), all students born abroad or born in Italy from both parents not born in Italy are defined to as non-natives. The Italian vs. non-Italian category is defined according to the simple student's citizenship criterion and it is useful to allow comparison and match data with Italian Ministry of Education Statistical Office which generally only divide students according to origins following the citizenship partition.

[50] This is in order to allow international comparisons which must exclude citizenship criteria because citizenship is conferred according to country-specific rules.

Table B.1. Relevant variables description and categories obtained.

Variable Name	*Description*	*Values*	***Category obtained***			
			Italian vs. non-Italian	*Immigrant vs. non-immigrant*	*1st and 2nd generation (immigrant)*	*Native vs. non-native*
Citizenship	Student citizenship	Italian; non-Italian	X			
Place of birth	Student's place of birth	Italy; UE; Other European countries (not EU); Other Countries			X	X
Father's place of birth	Student's place of birth	Italy; UE; Other European countries (not EU); Other Countries		X	X	X
Mother's place of birth	Student's place of birth	Italy; UE; Other European countries (not EU); Other Countries		X	X	X
In Italy	Answer to: "How long is the student living in Italy?"	Always; from primary school; 1-3 years; less than 1 year				

Notes. The student population considers all 497,564 8th grade students who sit both the Italian Language and the Mathematics Invalsi Test. Thus, the student population used in empirical estimations excludes 3,661 students who were absent at (at least) one of the two tests.

Table B.2. Categories creation.

Variable	***Values***	***Categories***												
		Immigrant	*1st gen. Imm.*	*2nd gen Imm.*	*Non Immigrant*			*Non Native*		*Native*			*Italian*	*Non-Italian*
Mother's Place of Birth	Italy				*X*	*X*		*X*		*X*	*X*			
	Abroad	*X*	*X*	*X*			*X*	*X*	*X*			*X*		
Father's Place of Birth	Italy				*X*		*X*	*X*		*X*		*X*		
	Abroad	*X*	*X*	*X*		*X*		*X*	*X*		*X*			
Student's Place of Birth	Italy	*X*		*X*	*X*	*X*	*X*		*X*	*X*	*X*	*X*		
	Abroad	*X*	*X*		*X*	*X*	*X*	*X*						
Student's Citizenship	Italian												*X*	
	Non-Ita.													*X*

The variable containing the information of how long the student has been living in Italy (since his/her birth, or - if born abroad - since primary school, from less than one year, for more than one but less than three years) is used as an individual level variable. Missing data, particularly relevant for the last variable introduced, may be due to different reasons: misreporting of school administrative staff, missing information, or students' parents refusal to provide information at the time of the enrolment[51].

[51] In fact, information concerning parents' place of birth and period stayed in Italy if born abroad – which show the highest percentage of missing data – are not compulsory by law, so that parents can decide not to provide them to the school administrative staff at the moment of the enrolment.

Variables used

Table B.3 contains the complete list of the control variables used in the empirical analysis. We also provide a short description and divide the variables according to individual level (*X*), school level (*S*) and catchment area (*W*).

Table B.3. Control variables description.

Type	***Name***	***Description***	***Source***
Individual (X)	*female*	Fraction of group j females in school s	Invalsi
	late	Fraction of group j retained students in school s	
School level (S)	*istituto*	Dummy equal 1 if "K-8 school"	Invalsi
	statale	Dummy equal 1 if State school	
	tot_alunni *tot_alunni2*	School size, given by the total number of students in the school and its square	MIUR / Invalsi
	avg_class *avg_class2*	Average class size in each school and its square	
	handicap_percent	Percent of students with disabilities in the school	
	pt_ratio	Pupil-to-teacher ratio	
	it_ratio	Non-Italian students-to-Support Teacher ratio	
	tl_class_iii	Fraction of 40-hours classes in 8^{th} grade	
Province Fixed Effects	*provFE_**	Dummies for provinces (103 dummies)	
Catchment Area (W)	*lpop*	Log of total resident population	Census 2001
	illiterate	Fraction of illiterate pop.	
	university_edu	Fraction of pop. with university level education	
	m_occup_rate	Male occupation rate	
	f_occup_rate	Female occupation rate	
	agri_oc	Fraction of workers occupied in agriculture	
	self_empl	Fraction workers self-employed	
	commuter	Fraction of resident commuting every day for school or working reasons	
	avg_family_members	Average number of family members	
	house_poor	Fraction of houses without clean water	
	house_new	Fraction of houses built after 1980	
	avg_rooms	Average number of rooms per house	

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