UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

Dipartimento di Economia e Finanza

SOUTHERN EUROPE RESEARCH IN ECONOMIC STUDIES

Educational Inequality in Italy: Official Grades vs. Standardized Test Scores

Raffaele Lagravinese

Vito Peragine

Giorgia Zotti

SERIES WORKING PAPERS n. 07/2024

Educational Inequality in Italy: Official Grades vs. Standardized Test Scores

Raffaele Lagravinese, Vitorocco Peragine, Giorgia Zotti

Abstract

This study explores the disparities between official high school grades and standardized test scores (Invalsi) among Italian students, drawing on 2022 data from final-year high school students. The analysis reveals that official grades are consistently inflated and show less variability compared to standardized scores, which exhibit greater inequality. Socio-demographic factors such as gender, geographic location, and parental background play a significant role in shaping these disparities. Using a Blinder-Oaxaca decomposition, the study uncovers performance differences linked to gender, origin, and school type, highlighting a narrower grade-score gap among students in northern Italy and those attending Liceo.

Keywords: Inequality of Opportunity, Education, Regions, Italy.

JEL codes: D63; I24; I28; O52

1 Introduction

Grades play a crucial role in educational systems worldwide, acting as a key indicator of school performance. Beyond their immediate purpose in assessing student knowledge and skills, grades also serve as a signal with significant implications in labor markets and higher education admissions (Spence, 1973). Although the primary goal of education is skill acquisition, grades often act as a proxy for unobservable traits such as discipline, intelligence, and perseverance. Employers rely on grades to reduce information asymmetry, using them as a tool to identify candidates who are likely to succeed in competitive environments. School grades are widely considered a holistic measure of student academic performance, reflecting not only cognitive abilities, but also effort, consistency, and classroom behavior. Grades are determined by teachers, which introduces a subjective component, but also allows for the assessment of a broader range of skills. For example, grades often incorporate elements like participation, homework completion, and project work—skills valued in real-world settings. Economic research highlights the predictive power of grades for long-term outcomes. Studies such as Heckman *et al.* (2006) emphasize the importance of non-cognitive skills—like perseverance and time management—which grades are more likely to capture compared to standardized tests. In addition, grades are a cumulative record that offers a longitudinal view of a student's progress and resilience over time. However, grades are not without their criticisms. One major concern is grade inflation, which can undermine their reliability. Babcock (2010) documents the increase in grades in the United States over decades, suggesting that differences in grading standards between schools and regions may distort comparisons. In addition, grades can reflect teacher biases—whether conscious or unconscious—based on factors such as gender, race, or socioeconomic background (Lavy, 2008).

Grading systems within countries often exhibit regional disparities, leading to significant differences in academic outcomes. These disparities raise concerns about equity and comparability, particularly in countries where educational outcomes are crucial to access to higher education, scholarships, and job opportunities. In Italy, for example, high school grades are used as one of the criteria for admission to programs with limited enrollment (such as Medicine and Architecture), or they can serve as one of the indicators for public competitions or for accessing scholarships. This undermines the principle of meritocracy. Regional differences in grading practices are well-documented in all countries. These variations arise from factors such as socioeconomic disparities, differences in teacher training, and localized educational policies. Wealthier regions often benefit from better-funded schools, greater parental involvement, and access to additional resources, leading to higher average grades. In contrast, economically disadvantaged regions may face resource constraints, overcrowded classrooms, and less qualified teachers, resulting in lower average grades (Hanushek & Woessmann, 2011). Cultural attitudes toward education and regional autonomy in policymaking can lead to differing rating standards. In countries like Germany, where education policy is partially decentralized, regional disparities in grading are often attributed to differences in curriculum standards and assessment criteria Gärtner & Heine (2020). Variability in teacher perceptions and expectations can exacerbate grading disparities.

To address the significant heterogeneity of grades and enable assessments that allow for comparisons between regions and countries, standardized tests have been developed in recent years. These tests have the advantage of being uniform for everyone and transparently allow comparisons across territories, taking into account socio-economic factors that clearly influence students' performance. Standardized tests aim to provide an objective, comparable measure of students' abilities across different schools and regions. Tests like the PIRLS, TIMSS, or PISA are designed to assess specific cognitive skills such as critical thinking, problem-solving, and mathematical reasoning. Their standardization ensures that all students face the same questions under similar conditions, making these tests attractive for policymakers and researchers interested in large-scale comparisons. Economic literature often points to the role of standardized tests in predicting college performance and labor market outcomes. Studies by Neal & Johnson (1996) highlight the strong correlation between test scores and future earnings, suggesting that standardized assessments capture essential cognitive skills valued in the economy. Moreover, these tests are less susceptible to grade inflation and provide a more consistent benchmark across time and space. The limitations of standardized tests are equally well-documented. Critics argue that such tests often fail to capture creativity, teamwork, and other non-cognitive skills crucial for success in modern economies. Moreover, the "high-stakes" nature of these tests can incentivize teaching to the test, narrowing the curriculum and disadvantaging students who excel in less testable domains. Carneiro & Heckman (2003) also point to the socioeconomic disparities in test performance, as access to preparatory resources can heavily influence outcomes.

Standardized tests are often used within the literature on Education Inequality of Opportunity (EIoP) to identify the main circumstances that impact inequality. Several studies have demonstrated the strong correlation between educational inequalities and socioeconomic background, highlighting how disparities in education translate into long-term income inequality (Ferreira, 2001; Turčínková & Stávková, 2012). Addressing EIoP could thus significantly reduce overall inequality, as improving education access and quality for disadvantaged groups is key to narrowing income disparities. Among the most suitable international standardized tests for the analysis of EIoP is undoubtedly the PISA dataset (Programme for International Student Assessment) launched every three years by the OECD. The test is conducted on fifteen-year-old students and provides a wide range of information on academic performance and family background. One of the first studies that uses the PISA test to analyze EIoP in Italy is the one by Checchi & Peragine (2005). The authors highlight the significant performance differences among Italian students in various regions. Gamboa & Waltenberg (2012) studied EIoP in Latin American countries and identified parental education and school type as the primary sources of EIoP, with gender having less impact. Ferreira & Gignoux (2014) found that up to 35% of disparities in educational achievement in countries such as France, Germany, and Bulgaria could be explained by circumstances like gender and family background. Peragine *et al.* (2015) analyzed EIoP in Arab countries across three PISA cycles, incorporating immigration status as a circumstance variable in the model. Results showed different conclusions depending on the country and the set of circumstances included in the model.

To the best of our knowledge, no study in the current literature has analyzed EIoP by comparing the outcomes between official grades and standardized tests. This is particularly relevant in a context like Italy, where the results differ significantly and exhibit notable territorial disparities.
Starting in 2007, INVALSI tests *(Istituto Nazionale per la Valutazione del Sistema Educativo di Istruzione e di Formazione)* were introduced across the entire Italian territory. The Invalsi tests were designed as a tool to monitor and assess students' competencies in key areas (Italian, Mathematics, and later, English) and to provide valuable data for improving the national education system. These tests have the advantage of being the same for all students at every level, allowing for comparisons between different schools and territories across the country. Moreover, they often submit quizzes similar to those in standardized tests in other OECD countries.
Compared to the PISA data, which represent only a sample of the population and are administered exclusively to 15-year-old students every three years, the INVALSI tests are mandatory for the

entire student population across various school years and are conducted annually. This guarantees that all students are evaluated using the same questions and standards. However, the results of these tests do not impact students' final grades. Instead, it is the official final grades that are used by students for university admission or entry into the workforce. Examining the differences between these two assessments is, therefore, highly relevant for two reasons. First, to provide more precise estimates of EIoP; second, to highlight potential discrepancies in the evaluations and implement appropriate policies aimed at making results more consistent across the entire national territory.
Specifically, this study aims to address this gap by examining the differences between official grades and standardized test results in the context of (EIoP), with a particular focus on the territorial disparities observed in Italy.

This study analyzes the gap between Official grades and Invalsi test scores in high schools in Italy, focusing on the role of sociodemographic factors and the predictive value of Middle school grades for final-year performance. Moreover, this research is situated in a context of growing interest in educational evaluation methodologies, where fundamental questions are raised about the educational system's ability to allocate competencies and, consequently, opportunities equitably.
Our findings reveal significant disparities between Official grades and Invalsi scores, with the former consistently higher and less variable. Through the lens of the Inequality of Opportunity theory and employing the parametric method in the ex-ante version, inequality in Invalsi scores is greater than the one in the Official grades distribution. Key factors such as gender, province of residence, and parental education level emerge as significant influencers of these differences.
A Blinder-Oaxaca decomposition further explains performance differences rooted in gender, origin, and school type, highlighting smaller gaps for students in northern Italy and those attending Liceo. Moreover, the role of parental education and occupation is emphasized, demonstrating a significant impact on student's educational outcomes, where children from more educated and professionally skilled backgrounds perform better. Therefore, this study contributes to a deeper understanding of the factors influencing academic disparities and the dynamics of educational inequality, offering valuable insights for policy and educational practice.

The rest of the paper is organized as follows. Section 2 presents a description of the Italian education system. Section 3 describes the data and provides a comprehensive description of the grade distributions considered for this study, along with a focus on the specific circumstances considered students' backgrounds. The subsequent section outlines the various methodologies employed in the research. The results of these analyses are then detailed in Section 5. Section 6 concludes.

2 Italian Education System

The Italian education system, as described by OECD (2023a) in the *Education at Glance 2023 Report*, is structured into three primary levels: primary education, lower secondary education, and upper secondary education. Primary education, known as *(scuola primaria)*, starts at age six and lasts for five years. Following this, students transition to lower secondary education, or *(scuola secondaria di primo grado)*, which spans three years for students aged 11 to 14. The final stage, upper secondary education, or *(scuola secondaria di secondo grado)*, lasts five years, encompassing various types of schools such as *(liceo)* (academic), *(istituto tecnico)* (technical), and *(istituto professionale)* (vocational). The first two years of upper secondary education are compulsory, while the remaining three years are optional (OECD (2023b)).

As mentioned in the previous section, the Invalsi is a national standardized testing system in Italy that is analogous to the OECD's PISA. Invalsi aims to standardize and compare students' skills nationwide, offering a uniform measure of educational outcomes in subjects such as Italian language (ITA) and mathematics (MAT). These tests are administered to students at various stages of their education (grades 2, 5, 8, 10, and 13), providing an objective measure of students' abilities and allowing comparisons across different regions and schools (INVALSI (2023)).

Despite the objective nature of Invalsi scores, official grades given by teachers are subjective, but carry significant weight. These grades are crucial in determining students' academic and professional futures, affecting university admissions, especially for courses with limited enrollment, eligibility for scholarships, and other opportunities. High school grades can provide significant advantages in these contexts. This discrepancy between standardized test scores and official grades highlights the importance of both metrics in the Italian educational system (di Statistica (Istat) (2022)).
The Ministry of Education sets national curriculum, but schools have the flexibility to adapt these programs to local needs, a concept known as differentiated autonomy. This allows schools some autonomy to modify and implement curricula, taking into account regional and local adaptations to better serve their student populations (Ministero dell'Istruzione (2021)). Regional variations in educational outcomes are evident in both Invalsi scores and official grades, reflecting the diverse educational landscape in Italy. INVALSI (2023) provides a detailed analysis of regional differences in the test results for high school students in Italy. Italian regions are classified into three groups based on the percentage of students who achieve academic excellence. Group 1 includes regions where over 20% of students are considered academically excellent, such as Valle d'Aosta, the autonomous province of Trento, Veneto, and Friuli-Venezia Giulia. These regions demonstrate strong academic performance, with a significant proportion of students excelling in the Invalsi tests. Group 2 consists of regions with 10% to 20% of students classified as excellent, including Piemonte, Liguria, Lombardia, the autonomous province of Bolzano, Emilia-Romagna, Toscana, Umbria, Marche, Lazio, Abruzzo, Molise, and Basilicata. Although the performance is positive, it is less pronounced than in Group 1. Group 3 comprises regions where less than 10% of students reach excellence levels, indicating areas with greater educational challenges. These regions include Campania, Puglia, Calabria, Sicilia, and Sardegna, where academic performance is generally lower, and fewer students achieve high levels of competence. These regional differences reflect not only variations in students' abilities and outcomes but also disparities in access to educational resources and learning opportunities, highlighting the need for targeted interventions to support the less-performing regions.

An examination of equality of opportunities in Italy reveals significant regional disparities. Inequality of opportunity accounts for one-third of overall income inequality in Italy, with less developed southern regions experiencing higher levels of inequality, exacerbated by gender disparities. These regions suffer from low per-capita income and high-income inequality, with individuals from lower social origins facing greater disadvantages in securing good jobs. This phenomenon is linked to advantages from family networking in the North and fewer job opportunities in less technologically advanced areas, contributing to internal migration and a "brain drain" from the South to the North. This migration is driven by differing unemployment rates and poor family backgrounds, highlighting systemic issues in the labor market (Checchi & Peragine (2010)). Furthermore, analysis of the highest scores achieved by high school graduates reveals an unexpected dominance of southern regions. When considering the proportion of graduates who attained the highest possible

scores—“one hundred” and “one hundred with honors”—Calabria ranks first with 17.5%, followed by Puglia at 15.5%, and Sicily at 14%. In contrast, northern regions exhibit significantly lower percentages of high-achieving students: Valle d’Aosta reports only 3.8%, Lombardy 5.5%, Piemonte 6.8%, and Veneto 6.9%. This trend illustrates that as one moves down the Italian peninsula, the proportion of students receiving top scores increases.
The Italian education system, therefore, is a complex structure with significant regional variations and a blend of standardized assessments and subjective evaluations. While Invalsi serves to standardize and compare skills across the country, the official grades awarded by teachers have profound implications for students’ future opportunities. This dual system underscores the importance of both objective and subjective measures in assessing educational outcomes and shaping students’ academic paths (OECD (2023b)).

3 Official Grades and Invalsi Scores distributions

The dataset employed for the analysis is from the Invalsi database, and it is related to a survey conducted in 2022 on last year’s Italian high school students. The sample includes 196867 students, and the analysis is performed on two distributions: Invalsi scores and Official grades. The former is the result of the standardized tests in Italian and Mathematics, whereas the latter reflects the grades awarded to students in Italian and Mathematics for the first semester of the academic year 2021-2022.

The Invalsi scores range between 1 and 5, which represents the maximum, while the Official grades distribution runs from 1 to 10, where 10 assesses the best performance. To make the scoring systems comparable, the Official grade distribution is rescaled to match the Invalsi scoring scale. In Tables 1 and 2, there are all descriptive statistics of the distributions, such as standard deviation, skewness, and kurtosis. This comparison reveals that students generally achieve higher scores in the Official grading system than in Invalsi assessments, with the latter exhibiting a broader range of outcomes. In Figure 1, the two distributions are represented graphically through a Gauss curve.

Table 1: Descriptive statistics of distributions (198904 obs.)

	Mean	Variance	Min.	Max.
Official Grades 2022 (Avg. Italian and Math)	3.68	0.62	1	5
Official Grades Italian 2022	3.78	0.66	1	5
Official Grades Math 2022	3.57	0.8	1	5
Invalsi scores (Avg. Italian and Math)	2.92	1.15	1	5
Invalsi scores Italian	2.88	1.18	1	5
Invalsi scores Math	2.95	1.39	1	5

Table 2: Descriptive statistics on Avg. Italian and Math votes in the two distributions.

	Official Marks	**Invalsi Scores**
Mean	3.67	2.92
Variance	0.39	1.33
St. Dev.	0.62	1.15
Skewness	-0.07	0.04
Kurtosis	2.82	2.00

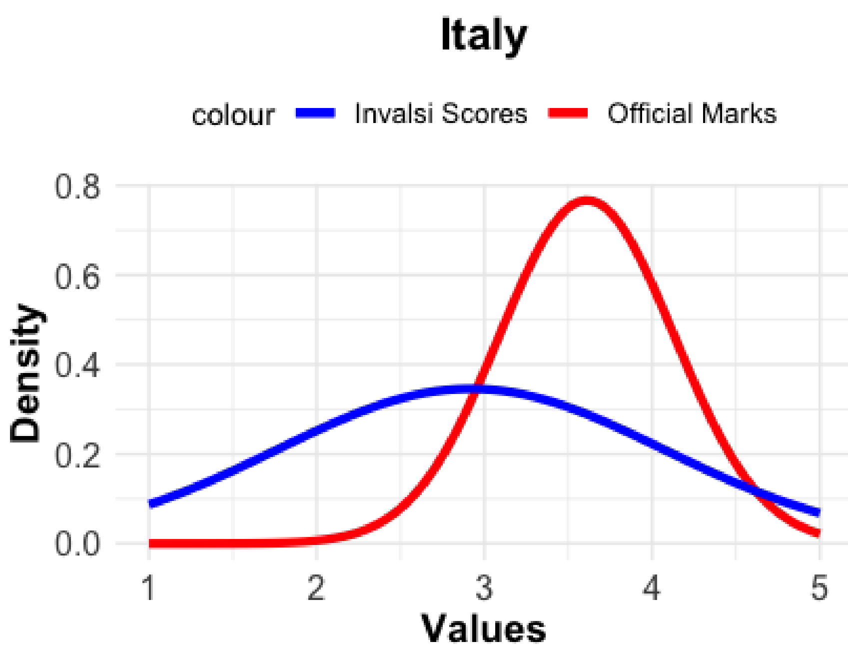

Figure 1: Official Grades and Invalsi Scores distributions in Italy

Through this dataset description, the analysis aims to provide a foundation for rigorous statistical analysis and insight into the academic landscape of 2022, highlighting differences in performance across the two evaluation methods. In order to assess the degree of similarity between them, a Kolmogorov-Smirnov test (KS test) is applied. It is a nonparametric test used to determine the degree of similarity between two sample distributions. It also constructs the cumulative distribution functions (CDFs)and finds the maximum value of the distance (D) between them (Berger & Zhou (2014)).

Figure 2 presents the results of the KS test applied to various educational assessments, comparing CDFs of grades and scores across the two subjects. Panel A compares the distributions of Italian and Math grades, showing a KS distance of 0.164, which suggests a considerable divergence between the two subjects' grade distributions. In Panel B, we observe the comparison between Official Grades and Invalsi scores for Italian, where the KS distance is quite substantial (0.3815), indicating a significant difference in distribution between the two testing methodologies. Panel C offers a similar comparison for Math, yielding a KS distance of 0.3292, which is less than that for Italian but still denotes a noticeable difference in the distribution of grades versus Invalsi scores.

Panel D compares the overall grades to the overall Invalsi scores across both subjects, with a KS distance of 0.3922, underscoring the pronounced inequality between the two types of academic assessments. Lastly, Panel E compares Invalsi scores in Italian and Math, showing no difference in distribution (KS distance of 0). This indicates that, contrary to the official grades, the standardized test scores are distributed similarly across these subjects.
The KS test results highlight the differences between student performances as set by different assessment methods, revealing the potential influence of evaluation type on the distribution of academic outcomes. The substantial differences between the distributions suggest that the assessments may be influenced by distinct factors intrinsic to each assessment method.

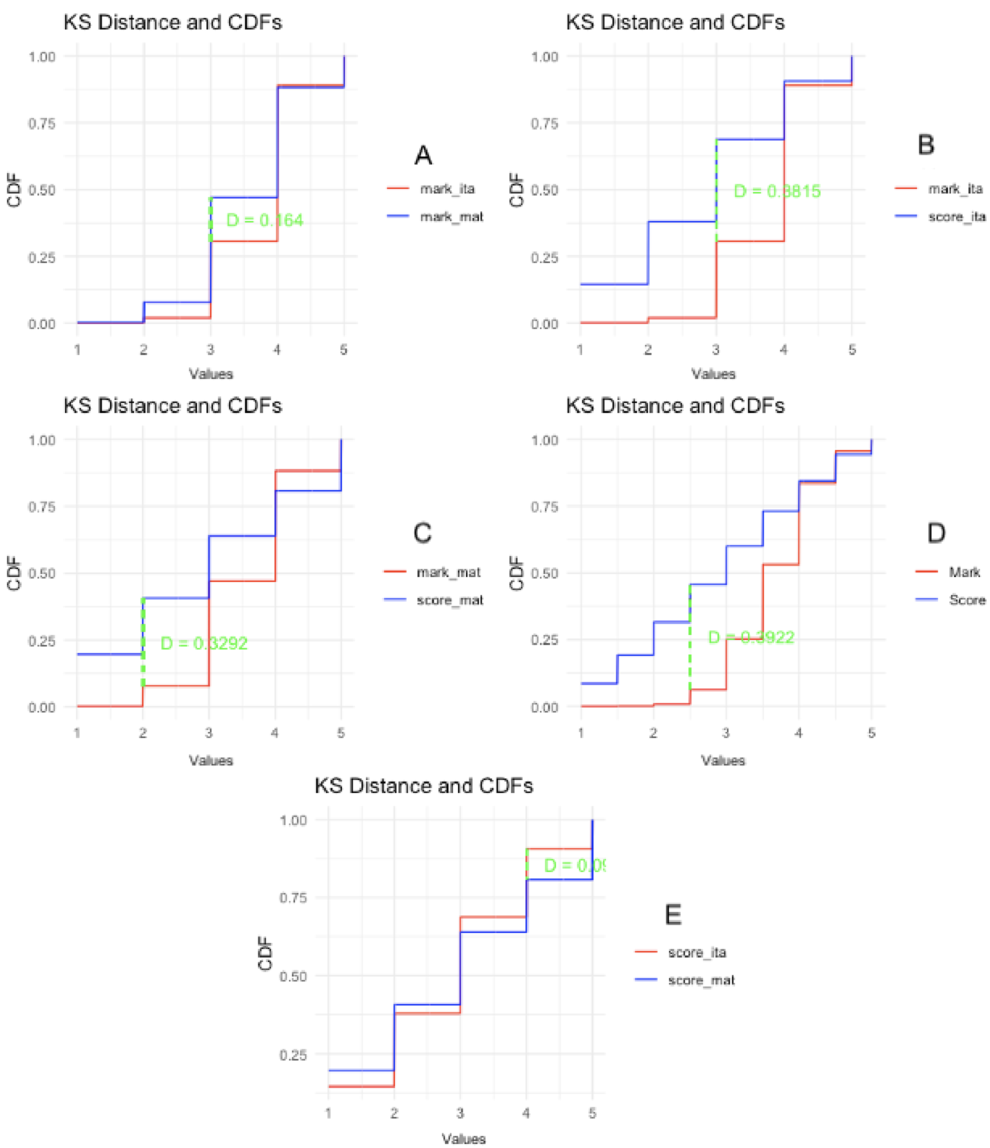

Figure 2: Kolmogorov-Smirnov Test: A)Italian and Math Grades 2022; B) Grades and Invalsi 2022 in Italian; C) Grades and Invalsi 2022 in Math; D) Grades and Invalsi 2022; E) Italian and Math Invalsi 2022

3.1 Circumstances

The analysis takes into account the personal information of students, focusing on variables that reflect the sociodemographic context in which each student is raised—factors beyond their control. Table 3 provides a detailed description of these variables. The categorization of the variables of parental education, occupation, and migrant status follows Palmisano *et al.* (2022).

Table 3: Circumstances

Variables	Categories (no. obs.)		
Gender	Female (106857)	Male (90010)	
Father Education	Primary school (64306)	Upper secondary (97583)	Tertiary education (34978)
Mother Education	Primary school (49025)	Upper secondary (103073)	Tertiary education (44769)
Father Occupation	Blue Collar (125829)	White Collar (71038)	
Mother Occupation	Blue Collar (123844)	White Collar (73023)	
Migrant Status	Italian (191489)	Immigrant (5378)	
Province	20 Italian Regions		

The sample is divided almost equally by Gender, with 106857 female and 90010 male students. When considering parental education levels, the data reveals a more significant number of fathers with upper secondary education (97583) compared to primary (64306) and tertiary education (34978). The trend is slightly different for mothers, where those with upper secondary education (103073) are predominant, followed by primary education (49025) and then tertiary (44769). These figures suggest that a higher percentage of mothers in the dataset have attained at least an upper secondary level of education compared to fathers. Regarding parental occupation, both fathers and mothers are majorly categorized as blue-collar workers, with 125829 fathers and 123844 mothers. This indicates that the majority of the students come from working-class backgrounds. White-collar workers represent a smaller portion of the population, with 71038 fathers and 73023 mothers. About Migrant status, the dataset is predominantly composed of students of Italian origin (191489), with a minority of immigrant students (5378). This significant inequality indicates that the vast majority of the students in the dataset have been socialized within the Italian educational and cultural context, which may have implications for academic performance and the applicability of educational policies. Another information considered in the analysis is the geographic location where the student studies, both regionally (20 regions) and provincially.

In this section some specific features of the circumstances associated with the distributions of Official grades and Invalsi scores are presented. For example, Figure 3 investigates gender inequalities in educational attainments, revealing that females outperform male students with respect to median Official grades in both Italian and Math. The interquartile range for females is thinner in Italian, indicating less variability in performance, whereas, for Math, the variability is comparable between genders. When evaluating standardized scores, the gender gap decreases, suggesting that standardized assessments may mitigate the observed gender differences in regular classroom evaluations.

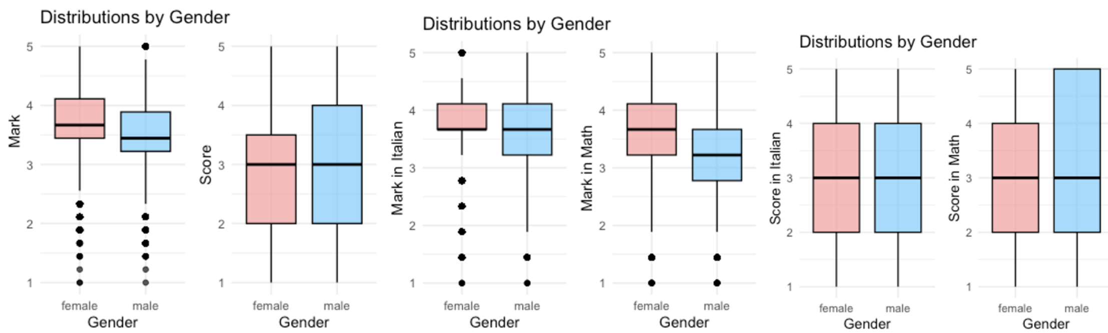

Figure 3: Difference in Official Grades and Invalsi Scores distributions by Gender

Figure 4 highlights the distributions of Official grades and Invalsi scores across two distinct school types: *Liceo* and *Istituto*. It emerges that students attending Liceo generally show a higher median for scores and grades, with a more concentrated distribution of grades (mark), as indicated by the closer interquartile ranges, suggesting a relatively uniform level of achievement. Conversely, the *Istituto* displays a broader dispersion of Official grades, indicating a more varied performance among its students.

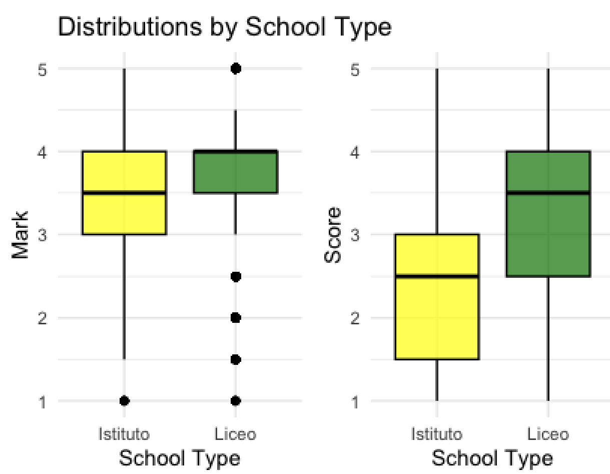

Figure 4: Difference in Official Grades and Invalsi Scores distributions by type of high school

Figure 5 expands the analysis by examining academic outcomes at a regional level, comparing the northern and southern parts of Italy in line with the framework provided by Peragine & Serlenga (2008)[1]. While the median official grades are consistent across both regions, the distribution

[1]The North includes Piemonte, Lombardia, Trentino Alto Adige, Veneto, Friuli Venezia Giulia, Liguria, Emilia Romagna, Toscana, Umbria, Marche, and Lazio, while the South encompasses Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia, and Sardegna. However, in this study, Lazio is excluded from the South.

of Invalsi scores reveals marked differences. The northern regions show a more concentrated range of Invalsi scores, suggesting greater uniformity in academic performance and potentially reflecting standardized assessment practices or more homogeneous educational conditions. In contrast, the southern regions exhibit a wider distribution of Invalsi scores, indicating significant variability in performance that may stem from regional disparities in educational quality, access to resources, or broader socioeconomic factors.

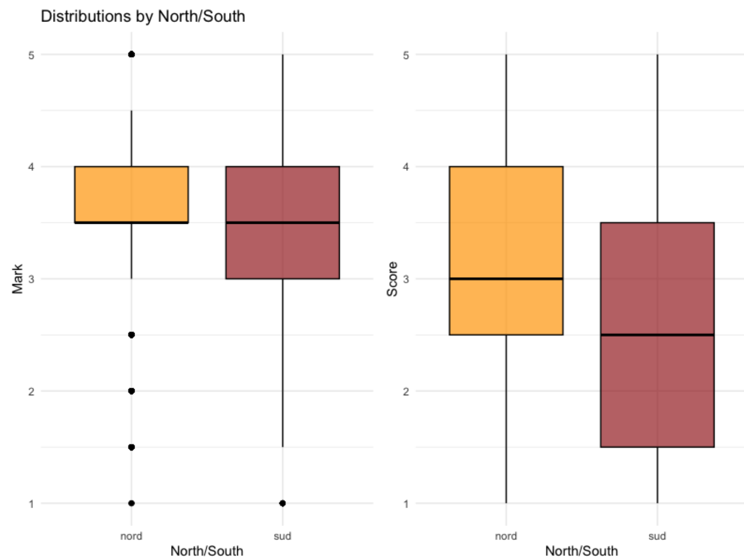

Figure 5: Difference in Official Grades and Invalsi Scores distributions in North and South

Further details on the performance of individual regions are presented in Figures A1, A2, and A3 in the Appendix, which focus on the North, Center, and South, respectively. These figures highlight specific regional trends that contribute to the broader patterns observed in Figure 5. For example, the data reveal that Piemonte and Liguria in the North exhibit a greater disparity between official grades and Invalsi scores, whereas other northern regions, such as Lombardia and Veneto, show a closer alignment between these measures, indicating more uniform academic outcomes. In the Center, Lazio stands out with performance patterns more similar to those observed in the North, displaying a narrower distribution of Invalsi scores and a close alignment with official grades. Other central regions, such as Toscana and Umbria, show slightly more variability in Invalsi scores while maintaining stability in official grades. Meanwhile, the southern regions consistently show a wider range of Invalsi scores compared to official grades, reflecting significant heterogeneity in standardized assessment outcomes. This trend is uniformly observed across southern regions, pointing to systemic challenges that differentiate the South from the other parts of the country.

4 Methodology and empirical Analysis

We carried out three separate methodologies. First, a detailed analysis is conducted to analyze the inequality of opportunity (IOp) in the distributions of official grades, Invalsi scores, and middle school votes. In this way, it is easy to understand how much inequality could be attributable to the individual the opportunity set. Additionally, Shapley's decomposition is implemented to quantify

the average impact of personal circumstances on the inequality of opportunity.
Second, to investigate the existence of systematic differences between Official grades and Invalsi scores, a Blinder-Oaxaca decomposition is employed. It serves to capture what demographic characteristics of students most influence the difference in educational outcomes.
Finally, several OLS regressions are applied to understand what is the role of parental status on academic achievements and to consider the votes taken at middle school by students as predictors of their future academic performances. This methodological approach aims to provide a deeper understanding of educational dynamics and inequalities of opportunity among students.

4.1 Inequality of Opportunity

The Inequality of Opportunity (IOp) theory originated as a critique of consequentialism in normative economics. Indeed, it is based on the idea that in order to achieve an economic outcome or evaluate social progress, it is important to study what mechanism leads to a particular outcome (Rawls (1971); Sen (1980)). Hence, the goal is not to seek equality in the outcomes of individuals but to ensure equality of opportunity to achieve worthwhile individual achievement.
Ideally, no innate barriers should inhibit a person from reaching a certain attainment level (for instance, educational achievement). According to the equality of opportunity principle, every person ought to begin from an identical position, having the same initial set of circumstances, and after that, have the liberty to exert varying degrees of effort. Thus, only inequalities in outcomes that are not the result of different starting points are deemed fair.

In line with this perspective, this paper examines the Inequality of Opportunity in education using a normative ex-ante approach and the parametric method developed by Ferreira & Gignoux (2010). The analysis focuses on students' academic performance in Italian and Mathematics, considering them as the primary units of observation. The study incorporates a range of factors that lie outside a student's control—such as parental education, parental occupation, gender, region of residence, and birthplace—to assess how these predetermined circumstances contribute to disparities in academic achievement. By isolating these influences, the framework seeks to highlight the extent to which unequal opportunities affect educational outcomes.

In the model of this theory, a population of N individuals is examined, where each i has an outcome x_i, which is a combination of circumstances and effort. Let $C = (c_1, .., c_n) \in \Omega$ symbolize the set of circumstances, which are all factors not under individual control, like Gender, Birthplace, and parental education. Meanwhile, let $E = e_1, ..., e_m \in \Theta$ represent a vector of effort, indicating what person can control and for which he is fully responsible. In this framework, individuals are capable of varying their effort levels, but they cannot decide about their circumstances. The unique mix of circumstances and effort determines the outcome x_i for each i within the N population. The function produces this outcome $g : (\Omega \times \Theta) \to \mathbb{R}^+$, which is derived from the interplay of effort and circumstances $x_i = g(c_i, e_i)$. All the outcomes can be represented by a matrix X with dimensions $(n \times m)$. Each row represents a type, identifying a group of individuals with identical circumstances, regardless of their level of effort. Similarly, each column represents a tranche relating to people who exert the same level of effort without considering their initial set of opportunities.

The concept of equality of opportunity is based on two principles: compensation and reward. The former asserts that inequality arising from a different set of opportunities is unfair. Conversely, the latter refers to the idea that varying efforts by individuals under identical circumstances should

be recognized and rewarded accordingly.
These principles manifest in dual interpretations. Specifically, the reward includes a liberal interpretation that individuals of the same type should be rewarded according to their different levels of effort. Alternatively, the utilitarian perspective of reward deems that outcome differences due to varying effort levels are justified. Compensation also develops in two distinct interpretations: ex-ante and ex-post. The ex-ante approach aims to ensure that all individuals must have equal opportunity value a priori from the level of effort exerted. The ex-post approach seeks equality of outcomes considering the same level of effort in the same tranches.
These dual interpretations of both principles are inherently conflicting, especially the ex-post compensation, which is at odds with both the liberal and utilitarian perspectives of reward, as outlined by Fleurbaey & Peragine (2013).

Measuring inequality of opportunity in its ex-ante form can be approached through both parametric (Ferreira *et al.* (2011)) and nonparametric (Checchi & Peragine (2010)) methods. This process involves constructing a counterfactual distribution, denoted as $\tilde{X}$, derived from the original distribution X. An inequality index is applied to both distributions, but the inequality measured from $\tilde{X}$ isolates and reflects the portion attributable to differences in circumstances.
The method used to construct the counterfactual distribution varies depending on the chosen approach. Regardless of the technique, the goal is to group individuals based on comparable sets of circumstances that may influence their access to opportunities. In the nonparametric approach proposed by Checchi & Peragine (2010), $\tilde{X}$ is generated by replacing the observed outcome values for each type with their group average ($\hat{X}$), thereby eliminating within-group variance among individuals who share the same set of circumstances. In contrast, the parametric approach described by Ferreira *et al.* (2011) constructs $\tilde{X}$ by employing an Ordinary Least Squares (OLS) regression. Here, the original outcome distribution (X) is regressed on a set of independent variables representing the circumstances under consideration—such as gender, ethnicity, parental education, or geographic location. The resulting counterfactual distribution reflects the outcomes predicted solely by these circumstances, isolating the effect of factors outside individual control. The parametric method specifically involves performing a linear regression where the outcome variable is explained by a combination of circumstances. The counterfactual distribution $\tilde{X}$ is then computed as:

$$\tilde{X} = \Psi C + \varepsilon \tag{1}$$

A measure of inequality[2] will be applied to the distribution obtained from Equation (1). The inequality revealed by the counterfactual distribution, $\tilde{X}$, indicates absolute inequality of opportunity. Meanwhile, computing the ratio between the value of $\tilde{X}$ with the original distribution X provides the relative inequality of opportunity.

Once the inequality of opportunity is determined, Shapley's decomposition allows for an analysis of the impact of various circumstances. This method is useful because of its features, such as independence of the order of the variables and ensuring that the contributions of the individual components add up to the total effect.

[2]Typically, the Gini Coefficient and Mean Log Deviation (MLD) are the predominant measures used to evaluate inequality. While groups cannot break down the Gini Coefficient, the MLD stands out for its complete decomposability. When utilizing MLD to dissect total inequality, contributions from both opportunities and efforts can be distinguished. Notably, the MLD exhibits greater sensitivity to extreme values compared to the Gini coefficient.

Shapley's decomposition is a technique used to decompose the impact of various factors on an outcome (Shapley). In game theory, it is commonly used to assign each player a value representing their marginal contribution to the overall game. The formula for calculating the Shapley value of a player i, denoted as $\phi_i(v)$, in a cooperative game with n players depends on the importance of player i for each possible subset of players.
The Shapley decomposition is a technique used to decompose the effect of various factors on an outcome (Shapley). In game theory, it is commonly used to assign to each player a value representing their marginal contribution to the overall game.
The general formula for the Shapley value of a player i is given by:

$$\phi_i(v) = \sum_{S \subseteq N \setminus \{i\}} \frac{|S|!(n - |S| - 1)!}{n!}[v(S \cup \{i\}) - v(S)] \tag{2}$$

where: $\phi_i(v)$ represents the Shapley value of player i in the game represented by the characteristic function v. v represents the characteristic function of the game and defines each possible playoff that a subset of players can obtain by cooperating. N represents the set of all players in the game. S represents a subset of players other than i. $v(s)$ represents the total value that the subset S of players can obtain by cooperating. $|S|$ represents the number of players in the subset S. n represents the total number of players in the game.

At this stage of the analysis, the parametric approach is applied, considering as a dependent variable the educational achievements and as regressors all circumstances that can affect an individual's academic performance, including the educational and occupational backgrounds of parents, Gender, Birthplace, and the migration status.

4.2 Blinder-Oaxaca Decomposition

In this paper, the Blinder-Oaxaca decomposition, introduced by Blinder and Oaxaca (Jann (2008)), is applied to study inequality in academic achievement among different demographic groups.

This approach was initially designed to analyze the wage gap between men and women by separating it into a part that can be explained by differences in productivity-related characteristics, such as education or work experience, and a part that remains unexplained by such factors affecting wages. The Blinder-Oaxaca decomposition has also been used in education. For example, it has been applied to measure the gender difference in educational achievements (Biswas & Kundu (2023)) or between rural and urban areas (Lounkaew (2013); Liao *et al.* (2016)), between public and private schools (Kapri *et al.* (2023)).

In the Blinder-Oaxaca decomposition, two distinct groups, A and B, are considered alongside an outcome variable, denoted as Y, and a series of predictive factors X. The focus is on quantifying the inequality in the average outcomes between these groups, represented as:

$$R = E(Y_A) - E(Y_B)$$

Here, $E(Y)$ is the expected value of the outcome variable for each group. Considering a linear model:

$$Y_l = X_l' \beta_l + \varepsilon_l, \quad E(\varepsilon_l) = 0 \quad \text{for} \quad l \in \{A, B\}$$

X includes the predictors, β is the slope coefficients alongside the intercept, and ϵ denotes the error term. The difference in mean outcomes can thus be defined as the variance in linear predictions based on the group-specific mean values of the regressors, formulated as:

$$R = E(Y_A) - E(Y_B) = E(X_A)'\beta_A - E(X_B)'\beta_B$$

This is because:

$$E(Y_l) = E(X_l'\beta_l + \epsilon_l) = E(X_l'\beta_l) + E(\varepsilon_l) = E(X_l)'\beta_l$$

where $E(\beta_l) = \beta_l$ and $E(\epsilon_l) = 0$, by assumptions.

To determine the role of differences in predictors across groups in the total difference in outcomes, the equation can be adjusted as follows (Winsborough & Dickinson (1971); Jones & Kelley (1984); Daymont & Andrisani (1984)):

$$R = \{E(X_A) - E(X_B)\}'\beta_B + E(X_B)'(\beta_A - \beta_B) + \{E(X_A) - E(X_B)\}'(\beta_A - \beta_B) \quad (3)$$

Equation (3) is the decomposition in the perspective of Group B[3]. This breakdown is termed a *threefold decomposition*, partitioning the outcome variance into three elements:

$$R = E + C + I$$

where,

$$E = \{E(X_A) - E(X_B)\}'\beta_B$$

Represents the *endowments effect* the part attributed to the variances of the predictors, and it calculates how the average results would change for group B if it had the same factors as group A.

$$C = E(X_B)'(\beta_A - \beta_B)$$

Component C, called the *coefficient effect*, calculates how the average results for group B would change if the coefficients of group A were used. The last component,

$$I = \{E(X_A) - E(X_B)\}'(\beta_A - \beta_B)$$

serves as an interaction term, acknowledging the concurrent discrepancies in endowments and coefficients between the groups.

To implement the Blinder-Oaxaca decomposition in the educational context, it is first important to consider the typical form of the educational production function:

$$L_i = \beta_0 + \beta' X_i + e_i \quad (4)$$

Where L_i usually denotes the students' educational achievement, but, in this paper, the outcome is the absolute difference between the Official grades and Invalsi scores. X_i represents a set of variables related to the student's socioeconomic background, such as parental education and occupation. e_i is an error component, assumed to be normally distributed (Murnane *et al.* (1981); Beattie *et al.* (1985); Hanushek & Woessmann (2010); Hanushek & Woessmann (2011)). When segregating students into groups based on their characteristics, the inequality in average of the

[3] The decomposition can also be done from the perspective of Group A.

absolute difference between Official grades and Invalsi scores can be expressed as follows:

$$\overline{L_A} - \overline{L_B} = [\beta_A - \beta_B] + [\alpha'_A X_A - \alpha'_B X_B] \tag{5}$$

Where

$$\overline{L_i} = \sum_{j=1}^{N_i} \frac{|\text{Official grades - Invalsi scores}|}{N_i}, \forall i = A, B$$

Adding and subtracting $\alpha'_A X_B$, the formula changes into:

$$\overline{L_A} - \overline{L_B} = [\beta_A - \beta_B] + [X_B(\alpha'_A - \alpha'_B)] + [\alpha'_A(X_A - X_B)] \tag{6}$$

Equation (6) is the Blinder-Oaxaca decomposition, in which $[\beta_A - \beta_B]$ measures how much the mean outcomes differ between the groups, even after considering the variables in the regression model. This difference could come from unobserved characteristics. The second component $[X_B(\alpha'_A - \alpha'_B)]$ highlights differences in the effectiveness with which predictor variables translate into the outcome. For example, if group A demonstrated greater effectiveness in converting inputs given by predictors into the absolute difference in educational achievements, group A's coefficient would exceed that of group B. Therefore, other things being equal, a student in group A would be expected to achieve a lower absolute difference between official and invalid scores than in group B. Finally, the third term $[\alpha'_A(X_A - X_B)]$ is labeled as the *explained* differences due to differences in endowment. Indeed, it measures the impact of the total variability of absolute differences between grades and scores determined by students with different predictors in the same group. The higher the value of this item, the more these characteristics explain a greater part of the variation in test scores. Therefore, the first two components, previously described, are called *unexplained* differences, implying that they arise from factors not captured by the variables considered as regressors.

The analysis focuses on the absolute difference in educational achievements by considering different sets of demographic variables and some predictors: Gender (Males and females), migrant status (Italian and migrant), school type (Liceo and Institute), and finally, by North and South of Italy.

5 Results

5.1 Inequality of Opportunity in Educational Achievements Analysis

The results related to the inequality of opportunity analysis are presented below. Table 4, as Figure 6, showcases the results from the application of the parametric approach in the ex-ante version for the measurement of the Inequality of Opportunity (IOp) in educational achievements: Official grades, Invalsi scores, and Middle school votes.

The findings reveal a range of overall inequality levels, from 0.09 in official Italian grades to 0.27 in Invalsi Math scores, indicating various degrees of educational inequality. The overall inequality is greater in the Invalsi distribution, particularly in Math scores. The same trend occurs in the Official grades distribution, where inequality is greater in Mathematics than in Italian. As far as Middle school votes are concerned, the overall inequality is low at about 12%.

Considering the inequality of opportunity, the trend is a little different. Indeed, Invalsi distribution continues to have a higher relative IOp percentage, highlighting that a significant portion of total inequality, up to 53.0% in average Invalsi scores, derives from unequal opportunities. However, a higher percentage of IOp is observed, especially in Italian. The same occurs in the Official distribution.

Table 4: Inequality of Opportunity (IOp) in Official Grades and Invalsi Scores
Ex-ante version of Parametric Approach (Gini Index)

	Official Italian (2022)	Official Math (2022)	Avg. Grades (2022)	Middle school (2016)	Invalsi Italian (2022)	Invalsi Math (2022)	Avg. Invalsi (2022)
Overall Inequality	0.09	0.12	0.093	0.12	0.23	0.27	0.23
Absolute IOp	0.032	0.028	0.029	0.057	0.121	0.130	0.120
Relative IOp	0.3610	0.2374	0.3144	0.4862	0.5270	0.4895	0.5306

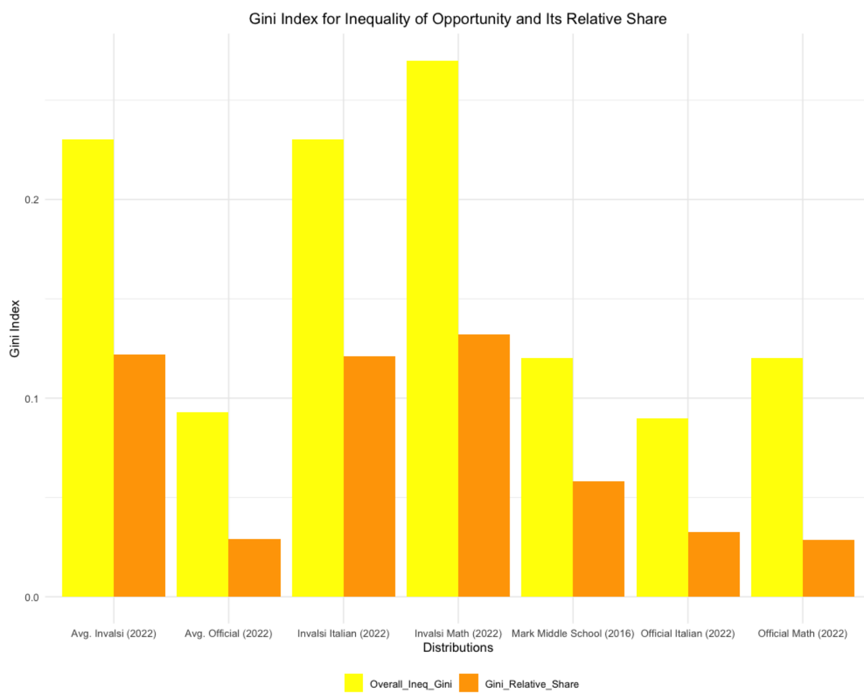

Figure 6: Overall inequality and IOp in Official Grades and Invalsi Scores distributions - Gini Index

Table 5 presents a detailed analysis of the factors influencing academic performance, specifically focusing on Official Grades and Invalsi Scores, using Shapley Decomposition for the year 2022 and Middle schools' data. It examines socioeconomic and demographic variables (including Gender, parental education and Occupation, province, and migrant status), on students' performance in Italian and Math, both in Official grades and Invalsi scores distributions.

A notable finding from the analysis is the evident influence of Gender on Official grades, particularly in Italian (54.43%) and Math (41.70%). By contrast, in the Invalsi scores distribution,

Table 5: Shares of variables' influence in Official Grades and Invalsi Scores
Shapley Decomposition

	Official Italian (2022)	Official Math (2022)	Avg. Grades (2022)	Middle school (2016)	Invalsi Italian (2022)	Invalsi Math (2022)	Avg. Invalsi (2022)
Gender	54.43%	41.70%	50.04%	15.13%	7.17%	11.65%	0.59%
Province	11.73%	22.28%	13.89%	10.25%	42.11%	52.68%	52.63%
Father education	9.38%	8.97%	9.54%	23.32%	15.03%	10.85%	14.06%
Mother education	10.32%	8.35%	9.70%	25.73%	15.22%	10.63%	13.99%
Father occupation	5.38%	6.13%	5.95%	10.87%	6.81%	4.2%	5.87%
Mother occupation	6.04%	8.35%	7.36%	12.85%	10.17%	7.88%	9.87%
Migrant Status	2.72%	4.21%	3.52%	1.84%	3.48%	2.12%	2.98%

the geographical location (Province) emerges as a critical determinant, especially in Math (52.68%) and the average score (52.63%). This indicates substantial regional inequalities in educational outcomes.

Parental education, notably the mother's education, shows a consistent influence across both distributions, albeit more pronounced in the context of Middle school performance (2016). This underlines the lasting impact of parental education levels on children's academic achievements, suggesting a generational transmission of educational values and opportunities.

Interestingly, the occupation of parents, particularly fathers, has a less pronounced yet noticeable effect across all measured academic achievements. This influence highlights the complex interplay between economic stability, job types, and educational support at home.

Although the least influential variable among those considered is migrant status, it still shows an impact on educational performance, especially in formal grades. This underscores that non-Italian students may have language barriers that do not allow for full cultural integration, which may not be as evident on standardized tests.

Overall, this table illuminates the multifaceted nature of academic achievement, revealing the intricate web of personal, familial, and systemic factors that collectively shape educational outcomes. The findings underscore the need for targeted interventions that address these diverse influences to ensure equitable educational opportunities for all students.

Figures 7 and 8 show the results of Shapley decomposition graphically. Specifically, Figure 8 highlights the different findings of the Shapley decompositions computed for the North and the South of Italy. The trend is very similar to that at the National level. The influence of the variables of sex and province appears more pronounced in the northern regions, especially with regard to the distribution of Official grades. On the other hand, in the southern regions, parental education and occupation play a predominant role.

5.2 Blinder-Oaxaca Decomposition

Focusing on the absolute difference between Official grades and Invalsi scores, Table 6 provides an insightful analysis using the Blinder-Oaxaca decomposition to study inequalities in educational achievements across different demographic groups.

Firstly, the gender analysis reveals that females, on average, have a higher inequality between Official grades and Invalsi scores in general, with a noted difference of -0.29. This inequality is further

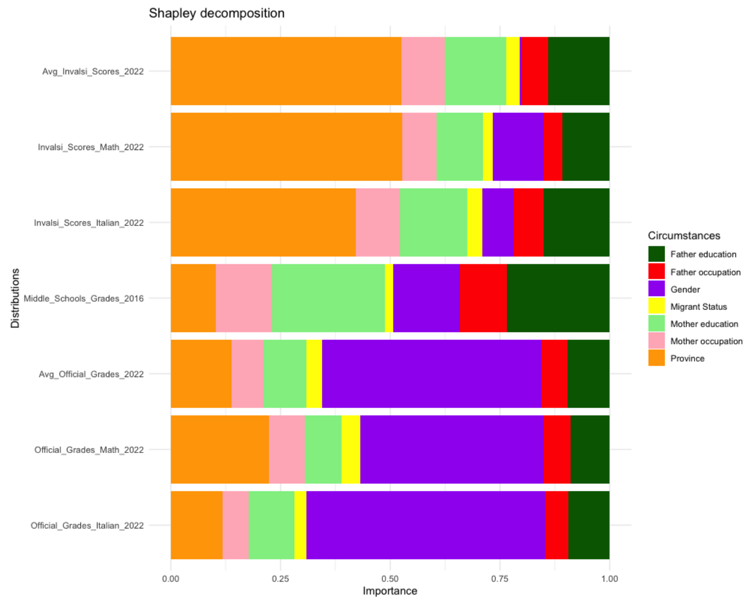

Figure 7: Shares of variables' influence in Official Grades and Invalsi Scores Shapley Decomposition

detailed by the subject, indicating a more pronounced gap in Italian than in Math. The decomposition attributes a significant portion of these differences to unexplained factors, suggesting intrinsic biases that disadvantage females in standardized testing or grading practices.
The comparison between Italian native and migrant students shows migrants performing better in minimizing the difference between Official grades and Invalsi scores. However, regional analysis within Italy (North vs. South) exhibits a stark contrast, with students in the South showing a more significant gap. Both endowment and unexplained factors contribute to these differences, indicating inequalities in educational achievements.

The analysis by type of school *(Liceo vs. Istituto)* presents a considerable gap in the absolute difference between Official grades and Invalsi scores, with students from *Istituto* experiencing less inequality. The significant unexplained component in this difference suggests that the type of school might influence grading standards or preparation for standardized tests beyond what can be attributed to observable characteristics.
Finally, the regional comparison within Italy underscores the geographical divide in education, with students in the South showing a larger gap between Official grades and Invalsi scores than their Northern counterparts. While endowment differences play a minor role, a large portion of this gap remains unexplained, pointing towards systemic differences in educational quality or assessment practices across regions.

Overall, the table underscores the nature of educational inequality, highlighting the role of gender, migrant status, type of school, and regional inequalities in shaping students' academic achievements. The significant unexplained portions of these gaps call for a deeper investigation into the systemic biases and structural inequalities embedded within Italy's educational system.

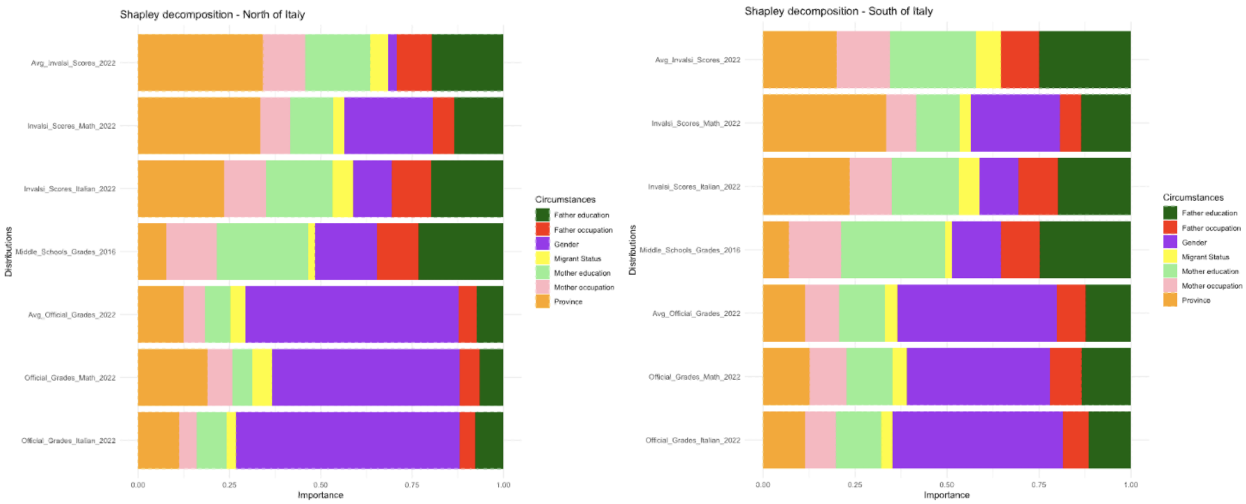

Figure 8: Shares of variables' influence in Official Grades and Invalsi Scores
Shapley Decomposition - North and South of Italy

6 Conclusions

This study investigates the differences between Official grades and INVALSI scores among high school students, focusing on the impact of sociodemographic characteristics.

Our findings suggest a notable difference between these Tests. Indeed, Official grades tend to have a higher mean and lower variability than Invalsi scores, a trend that applies on provincial and regional scales.
In examining the dynamics of inequality and the evolution of the impact of family background through the analysis of educational achievements, an approach based on the Inequality of Opportunity theory is adopted, using an ex-ante parametric method followed by a Shapley decomposition. The results indicate that inequality is more pronounced in the distribution of Invalsi scores than in Official grades, and the circumstances that most influence this inequality vary in gender for Official grades and province for Invalsi scores. At the middle school level, parental education level emerges as the most significant driver of inequality.

Analysis of systematic differences between Official grades and Invalsi scores led to the application of a Blinder-Oaxaca decomposition, the results of which show that, in general, girls perform better, although boys excel in mathematics. Moreover, it is observed that Italian students outperform immigrants, that Liceo performs better than Istituto, and that the gap between grades and scores is less pronounced in northern Italy than in the South.
The study on the impact of parental education and occupation on school performance confirmed the importance of these factors, in line with the findings on inequality and, in particular, Shapley decomposition. It was noted that children of parents with skilled jobs and higher education perform better than those from less advantaged backgrounds.

This trend is also confirmed in the analysis of the gap between official grades and INVALSI scores, with students from more privileged backgrounds showing a reduced gap. This phenomenon is particularly evident in the South of Italy, where the differences between grades and scores are still greater. Contrary to initial assumptions, it appears that the phenomenon of cronyism between teachers and wealthier parents is more prevalent in northern Italy.

In conclusion, this comprehensive analysis clarifies the complex interplay between circumstances such as parental education, gender, geographical differences, and their collective influence on students' academic achievements, with a particular focus on the pronounced educational divide between the North and South of Italy.
This geographic divide accentuates the necessity for policies and interventions that are specifically designed to address the unique challenges and inequality faced by students in the South, aiming to bridge the educational gap across the country.
These insights advocate for a region-specific approach in the development of educational strategies, ensuring that measures are inclusive and tailored to mitigate the multifaceted layers of inequality. Emphasizing the importance of early, targeted support within a broader socio-economic and cultural context, this study calls for a multidimensional and equitable approach in educational planning and policy-making. By addressing these complex interactions and focusing on reducing the regional disparities, we can advance towards an educational system that not only acknowledges but actively works to overcome the barriers to equitable education for all students, fostering a more just and enriched educational landscape across Italy. From an economic perspective, the choice between grades and standardized tests as primary indicators of academic success has significant implications for educational policies and resource allocation. While standardized tests offer valuable insights for cross-sectional analyses and equity assessments, grades provide richer, multidimensional data on individual student trajectories.

Table 6: Blinder-Oaxaca Decomposition Results

	Predicted Mean		Difference	Endowment	Unexplained
Gender	Male (106857 obs.)	Female (90010 obs.)		Male	Female
|Official grade - Invalsi score|	1.11	1.40	-0.29	-0.070	0.244
|Italian: Official grade - Invalsi score|	1.11	1.13	-0.02	-0.094	0.048
|Math: Official grade - Invalsi score|	1.28	1.06	0.22	-0.032	0.277
Migrant Status	Italian (191489 obs.)	Migrant (5378 obs.)		Italian	Migrant
|Official grade - Invalsi score|	1.40	1.11	0.29	0.087	0.240
|North: Official grade - Invalsi score|	1.24	0.96	0.28	0.096	0.204
|South: Official grade - Invalsi score|	1.73	1.36	0.37	0.113	0.302
Type of school	Liceo (77538 obs.)	Istituto (119329 obs.)		Liceo	Istituto
|Official grade - Invalsi score|	1.24	0.92	0.32	-0.018	0.407
Italy	North (73061 obs.)	South (123806 obs.)		North	South
|Official grade - Invalsi score|	1.28	0.91	0.37	0.012	0.353

References

Babcock, Philip. 2010. Real costs of nominal grade inflation? New evidence from student course evaluations. *Economic inquiry*, **48**(4), 983–996.

Beattie, Bruce R, Taylor, Charles Robert, & Watts, Myles James. 1985. The economics of production.

Berger, Vance W, & Zhou, YanYan. 2014. Kolmogorov–smirnov test: Overview. *Wiley statsref: Statistics reference online.*

Biswas, Puja, & Kundu, Amit. 2023. Gender Discrimination in Education Expenditure in Public Primary Schools in Rural India Among Religious Groups: An Oaxaca–Blinder Decomposition Analysis. *Pages 43–54 of: Gender Inequality and its Implications on Education and Health: A Global Perspective*. Emerald Publishing Limited.

Carneiro, Pedro Manuel, & Heckman, James J. 2003. Human capital policy.

Checchi, Daniele, & Peragine, Vito. 2010. Inequality of opportunity in Italy. *The Journal of Economic Inequality*, **8**, 429–450.

Checchi, Daniele, & Peragine, Vitorocco. 2005. *Regional disparities and inequality of opportunity: the case of Italy*. Tech. rept. IZA Discussion Papers.

Daymont, Thomas N, & Andrisani, Paul J. 1984. Job preferences, college major, and the gender gap in earnings. *Journal of Human Resources*, 408–428.

di Statistica (Istat), Istituto Nazionale. 2022. *Rapporto SDGs 2022. Informazioni statistiche per l'Agenda 2030 in Italia*. Salvo diversa indicazione, tutti i contenuti pubblicati sono soggetti alla licenza Creative Commons - Attribuzione - versione 3.0.

Ferreira, Francisco HG. 2001. Education for the masses? The interaction between wealth, educational and political inequalities. *Economics of transition*, **9**(2), 533–552.

Ferreira, Francisco HG, & Gignoux, Jérémie. 2010. Inequality of opportunity for education: Turkey. *Equity and growth in a globalizing world*, 1–26.

Ferreira, Francisco HG, & Gignoux, Jérémie. 2014. The measurement of educational inequality: Achievement and opportunity. *The World Bank Economic Review*, **28**(2), 210–246.

Ferreira, Francisco HG, Gignoux, Jérémie, & Aran, Meltem. 2011. Measuring inequality of opportunity with imperfect data: the case of Turkey. *The Journal of Economic Inequality*, **9**, 651–680.

Fleurbaey, Marc, & Peragine, Vito. 2013. Ex ante versus ex post equality of opportunity. *Economica*, **80**(317), 118–130.

Gamboa, Luis Fernando, & Waltenberg, Fábio D. 2012. Inequality of opportunity for educational achievement in Latin America: Evidence from PISA 2006–2009. *Economics of Education Review*, **31**(5), 694–708.

Gärtner, Holger, & Heine, Johanna-Helen. 2020. Educational Performance in Germany and Italy: A Comparative Perspective. *European Educational Research Journal*, **19**(4), 378–396.

Hanushek, Eric A, & Woessmann, Ludger. 2010. Education and economic growth. *Economics of education*, **60**(67), 1.

Hanushek, Eric A, & Woessmann, Ludger. 2011. The economics of international differences in educational achievement. *Handbook of the Economics of Education*, **3**, 89–200.

Heckman, James J, Stixrud, Jora, & Urzua, Sergio. 2006. The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor economics*, **24**(3), 411–482.

INVALSI. 2023. *Rapporto INVALSI 2023*.

Jann, Ben. 2008. The Blinder–Oaxaca decomposition for linear regression models. *The Stata Journal*, **8**(4), 453–479.

Jones, Frank L, & Kelley, Jonathan. 1984. Decomposing differences between groups: A cautionary note on measuring discrimination. *Sociological Methods & Research*, **12**(3), 323–343.

Kapri, Kul Prasad, Ghimire, Shankar, & Dulal, Rajendra. 2023. Public vs. Private Education and the Labor Market Disparities in Nepal: Evience From the Blinder-Oaxaca Decomposition. *The Journal of Developing Areas*, **57**(3), 263–276.

Lavy, Victor. 2008. Do gender stereotypes reduce girls' or boys' human capital outcomes? Evidence from a natural experiment. *Journal of public Economics*, **92**(10-11), 2083–2105.

Liao, Pei-An, Chang, Hung-Hao, Wang, Jiun-Hao, & Sun, Lih-Chyun. 2016. What are the determinants of rural-urban digital inequality among schoolchildren in Taiwan? Insights from Blinder-Oaxaca decomposition. *Computers & Education*, **95**, 123–133.

Lounkaew, Kiatanantha. 2013. Explaining urban–rural differences in educational achievement in Thailand: Evidence from PISA literacy data. *Economics of Education Review*, **37**, 213–225.

Ministero dell'Istruzione. 2021. *Principali dati della scuola – Focus Avvio Anno Scolastico 2021/2022*. I dati pubblicati sono patrimonio della collettività e possono essere utilizzati citando la fonte.

Murnane, Richard J, Maynard, Rebecca A, & Ohls, James C. 1981. Home resources and children's achievement. *The Review of Economics and Statistics*, 369–377.

Neal, Derek A, & Johnson, William R. 1996. The role of premarket factors in black-white wage differences. *Journal of political Economy*, **104**(5), 869–895.

OECD. 2023a. *Education at a Glance 2023*.

OECD. 2023b. *OECD Economic Outlook, Volume 2023 Issue 1*.

Palmisano, Flaviana, Biagi, Federico, & Peragine, Vito. 2022. Inequality of opportunity in tertiary education: evidence from Europe. *Research in Higher Education*, 1–52.

Peragine, Vito, & Serlenga, Laura. 2008. Higher education and equality of opportunity in Italy. *Pages 67–97 of: Inequality And Opportunity: Papers From The Second Ecineq Society Meeting.* Emerald Group Publishing Limited.

Peragine, Vito, Lagravinese, Raffaele, Palmisano, Flaviana, & Intini, Vito. 2015. Inequality of opportunity for educational achievement in Arab Region: Evidence from PISA 2006–2009–2012. *UN-ESCWA Working Paper.*

Rawls, John. 1971. Atheory of justice. *Cambridge (Mass.).*

Sen, Amartya. 1980. Description as choice. *Oxford Economic Papers*, **32**(3), 353–369.

Shapley, Lloyd S. 1951. Notes on the n-person game—ii: The value of an n-person game.

Spence, Michael. 1973. Job Market Signaling. *The Quarterly Journal of Economics*, **87**(3), 355–374.

Turčínková, Jana, & Stávková, Jana. 2012. Does the attained level of education affect the income situation of households? *Procedia-Social and Behavioral Sciences*, **55**, 1036–1042.

Winsborough, HH, & Dickinson, Peter. 1971. Components of negro-white income differences. *Proceedings of the Social Statistics*, **25**(34), 35–44.

Appendix

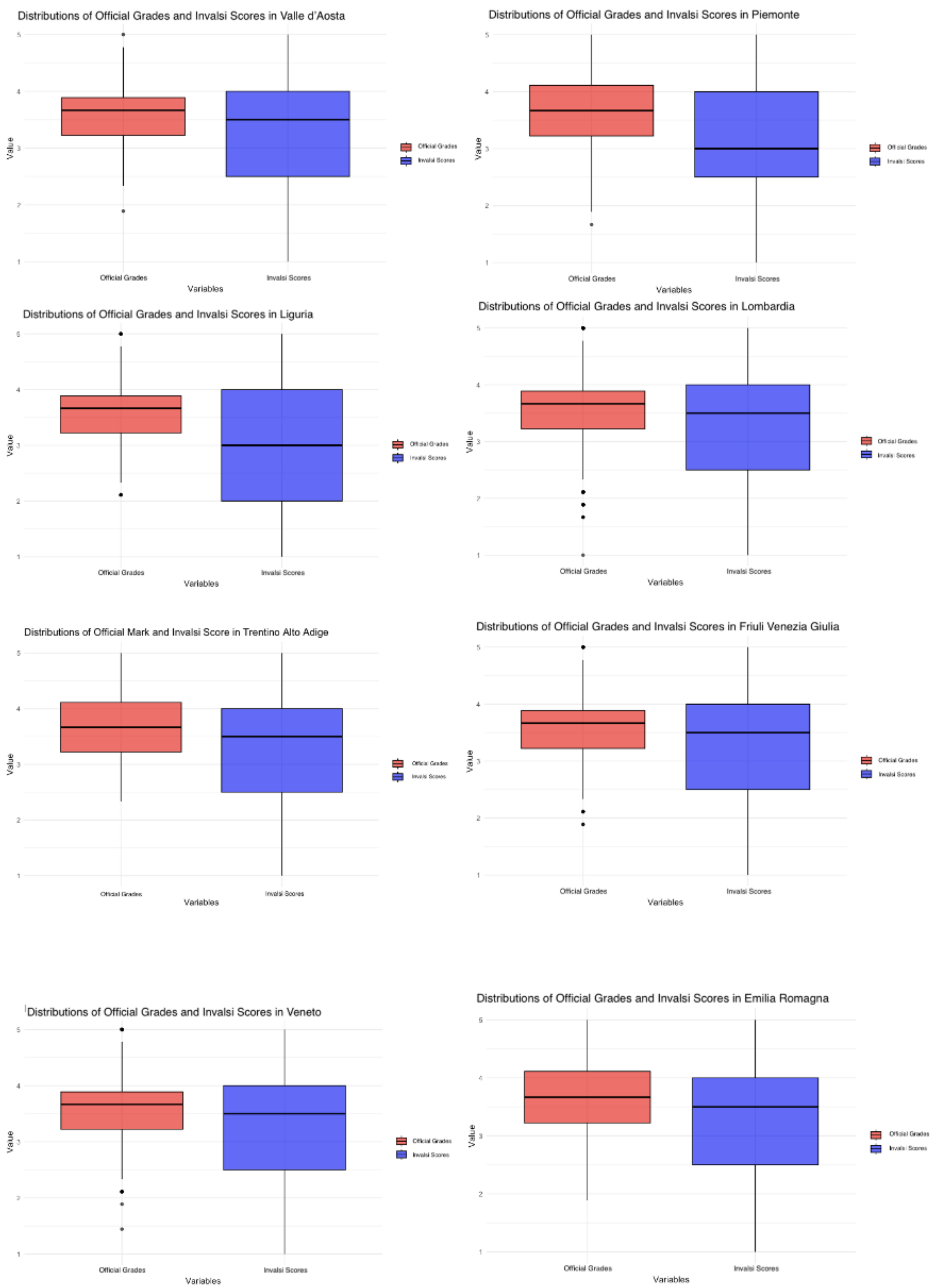

Figure .A1: Difference in Official Grades and Invalsi Scores distributions in Northern Regions of Italy

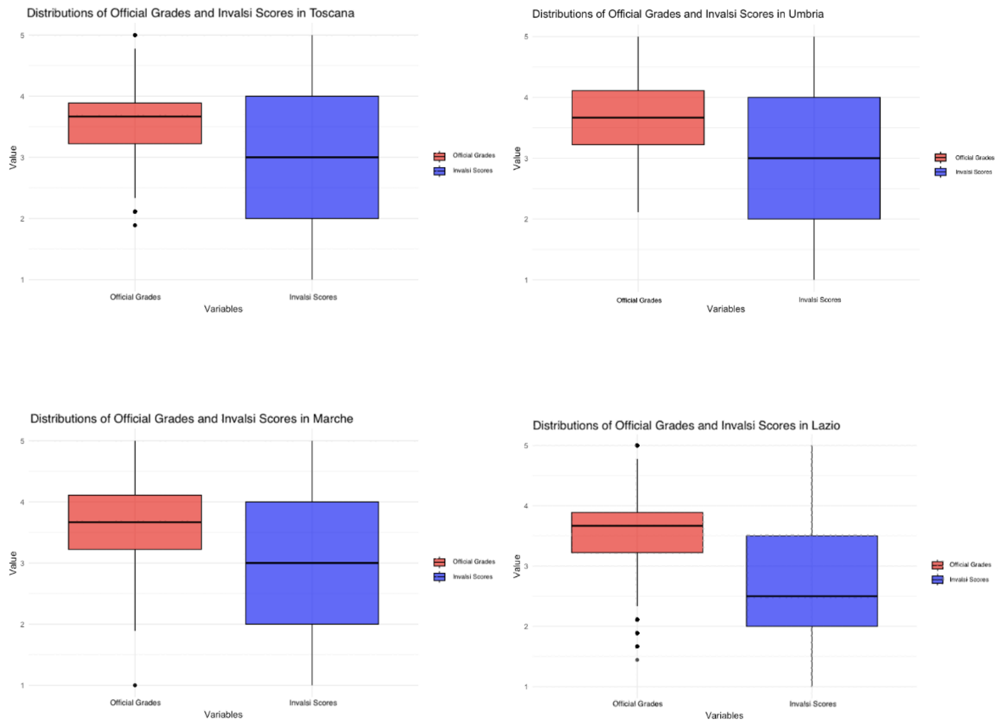

Figure .A2: Difference in Official Grades and Invalsi Scores distributions in Center Regions of Italy

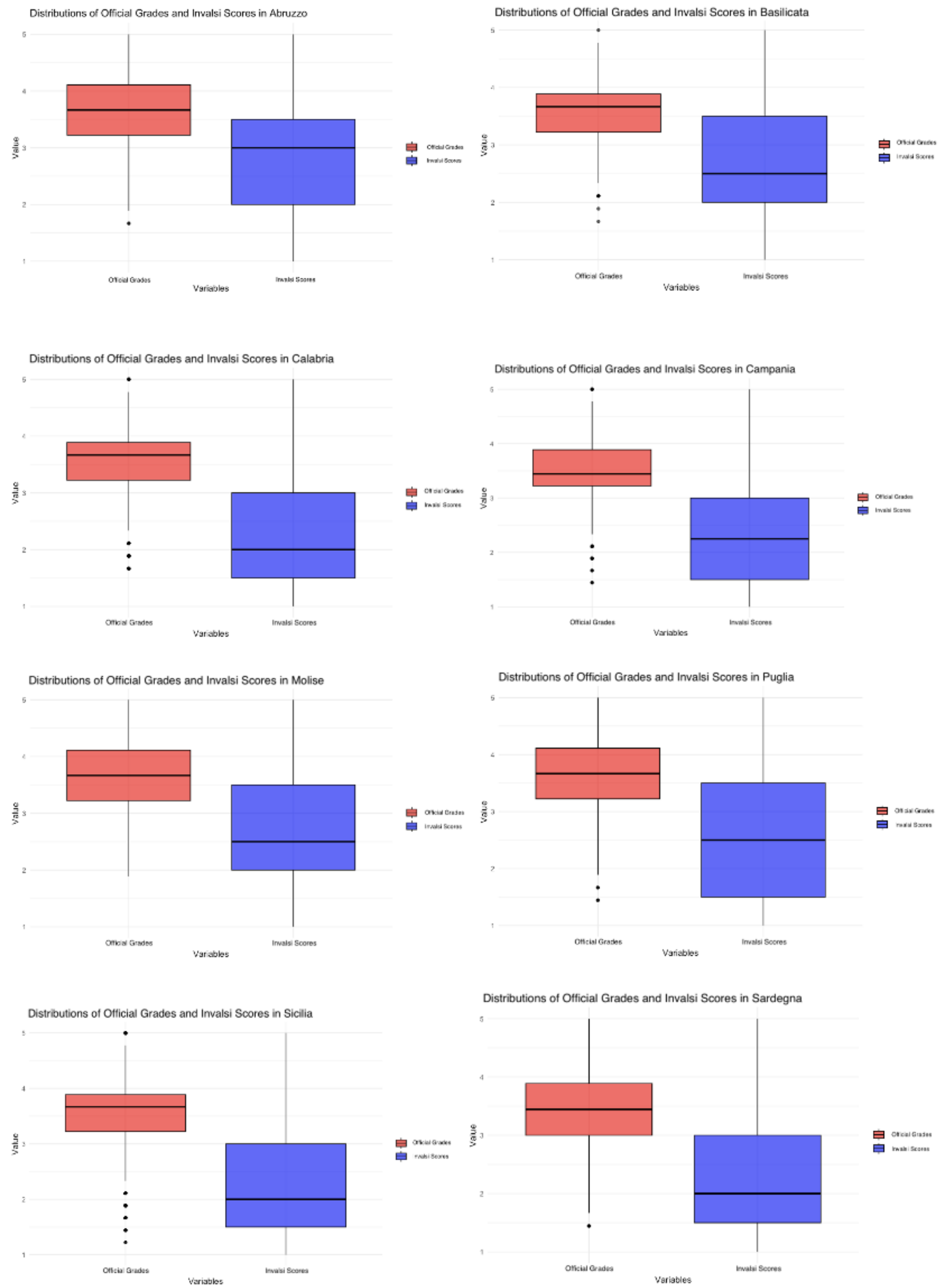

Figure .A3: Difference in Official Grades and Invalsi Scores distributions in Southern Regions of Italy