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Does private education pay off?

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Abstract

Education plays a crucial role in promoting innovation, entrepreneurship, and equal opportunities in society, acting as a "social elevator." However, an inequitable educational system can perpetuate inequalities, leading to significant social consequences. This paper examines two mechanisms through which schooling systems may generate or reinforce inequalities: private schooling and school composition. Earlier studies often suggested that private schooling, particularly government-dependent private schools, had a positive impact on student achievement. However, more recent research has challenged this view, highlighting the importance of contextual factors such as school composition and socio-economic background. Building on these findings, our analysis explores how the advantages attributed to private schools are shaped by the demographic profiles of their students. Using data from the OECD Program for International Student Assessment (PISA) 2015 and employing an education production function, we assess the effects of private schooling and school composition on student performance. Our findings contribute to the growing body of research questioning the comparative advantage of private schools, demonstrating that their perceived superiority often arises from the socio-economic advantages of the students they enroll, rather than the quality of education provided. The study also reveals significant variations across countries, underscoring the urgent need to address the segregation issues linked to private school networks.

JEL Classification I21 · I24 · I28 · J24 · H52

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1 Introduction

Education was not the central focus of Börje Johansson's research. However, he consistently maintained a keen interest in how education and human capital drive innovation, entrepreneurship, and regional development and growth (Johansson et al. 2007). He viewed a highly educated and skilled workforce as a fundamental driver of firms' engagement in research and development (R&D) (Johansson and Lööf 2008). Moreover, highly educated and skilled individuals generate the knowledge spillovers that facilitate the absorption of new knowledge, leading to the generation and diffusion of innovation both within and across regions (Andersson and Johansson 2008). Johansson also explored the relationship between education systems, skill formation, and human capital accumulation, studying the impact of educational policies—such as access to quality schooling, vocational training, higher education, and lifelong learning—on individual skill acquisition and regional development (Karlsson and Johansson 2006).

Given that much of his research centered on Sweden, Johansson was acutely aware that education is crucial for promoting equality of opportunity in society, serving as both a source of wealth and a "social elevator" (Johansson et al. 2015). This awareness also led him to recognize that a flawed educational system can stifle innovation and perpetuate inequalities (Johansson et al. 2015). This paper, celebrating Börje Johansson's work, aims to explore how the quality of education and the composition of school populations can generate significant inequalities that may hinder innovation and entrepreneurship.

Earlier studies often suggested a positive impact of private schooling on student outcomes, but more recent research has taken a more critical stance. For instance, Ward (2018) finds that socio-economic background plays a critical role in shaping performance, challenging the notion of an inherent private school advantage. This paper builds on such findings, analyzing data from PISA 2015 to explore how school composition mediates the relationship between school type and student performance.

To achieve this, we first argue that variations in the quality of education provided by different types of schools can, in some cases, compromise education's role as a social ladder. In particular, the division between public and private schooling is significant, as the dominant view is that private schools—due to the advantages and privileges they confer on their pupils—can "become a major dimension of inequality alongside occupation and wealth" (Dronkers and Robert 2008: 573). If private schools offer superior education compared to public institutions, wealthier parents can provide their children with better educational opportunities. However, it is worth noting that the prevalence of private education varies by country. For example, while private schooling is relatively limited in Norway, it has become more widespread in Sweden, especially after the implementation of a 1992 law that provided public funding to private schools. These independent schools, or *friskola*, now represent nearly one-fifth of primary and secondary educational institutions in Sweden. This study examines the role of private schools, their quality compared to public schools, and the different populations they attract across a wide range of countries.

Second, the composition of a school's population raises questions about its impact on student learning and achievement. If the composition of a school influences student performance, it highlights the problem of segregation within schools. However, it is possible that certain students, based on their individual characteristics, may perform similarly regardless of whether they attend a public or private school. This suggests that while school segregation is a prominent issue, its direct impact on average performance may be limited.

The third part of this analysis will explore the simultaneous influence of school type and school composition on student performance. This analysis will help determine whether private schools offer any real advantages. Since we anticipate that private schools enroll more privileged populations, the analysis will reveal whether these schools possess a comparative advantage beyond simply enrolling "better students."

This threefold analysis uses data from the OECD Program for International Student Assessment (PISA) 2015 survey. The identification strategy relies on multiple ordinary least squares (OLS) regression models, controlling for background characteristics of 15-year-old students. The results demonstrate that although students in private schools perform better, the comparative advantage of private schools is fundamentally related to the socio-economic characteristics of their students, rather than the quality of education offered.

Following this introduction, the next section reviews the scholarly literature on the subject and explains how our analysis differs from previous work. The third section examines the mechanisms through which school type and population composition affect student achievement. The fourth section outlines the empirical strategy used to test the hypotheses. The fifth section presents the results, and the final section discusses these findings and explores their policy implications.

2 Does variation in schooling affect future life prospects?

Education has garnered considerable attention due to its implications in fields such as social justice, equality of opportunity, human capital, economic growth, development economics, and labor economics. Among the vast array of studies on education, researchers have sought to explain students' educational outcomes through education production functions. While individual characteristics and familial background undoubtedly impact students' performance, a substantial body of research has also explored the influence of school characteristics and institutional features of countries on educational achievements (Hanushek and Wößmann 2011). This article focuses on the impact of public versus private schools and school composition effects. This section provides an overview of the main findings and policy implications from previous studies.

It has been widely argued that variations in schooling systems, particularly those that create high levels of segregation, can significantly affect students' life prospects

(Hirtt et al. 2014). One fundamental driver of inequality in opportunities is the school system itself. The balance between publicly and privately operated schools—and, in some cases, private but publicly financed schools—represents a key source of inequality later in life. In European countries, the socio-economic status of students in private schools is consistently higher than that of students in public schools, confirming the presence of segregation (Hirtt et al. 2014). However, the socio-economic gap between private and public schools does not appear to be wider in countries with a higher percentage of private (independent or dependent) schools. When private schools educate a larger share of the population, they tend to serve a broader range of social groups.

The divide between public and private schooling can also be an important factor in children's academic performance. Vandenberghe and Robin (2004), for example, compared the impact of private versus public schools using three evaluation methods and instrumentalizing the "private" variable by the size of the city where the school is located to address potential endogeneity issues. Their results did not consistently show a systematic advantage for private schools. In contrast, Dronkers and Robert (2008) found that school composition is a critical variable in explaining students' educational attainment, while also observing a positive impact of government-dependent private schools on student scores across the 22 OECD countries analyzed.

Expanding the discussion to the national level, West and Wößmann (2010) observed that, on average, students tend to perform better in mathematics, science, and reading in countries with a higher proportion of privately operated schools. These outcomes were achieved with lower educational expenditures. Wößmann (2006) conducted two types of analysis to explore the impact of public operation and public funding on educational achievement. The first specification examined the average performance of students across countries, considering the share of public funding and publicly managed schools. The results indicated that countries with higher public funding, but private management tend to perform better overall. The second specification focused on school-level performance, showing that public funding had a positive impact; while, public operation had a negative impact. Fuchs and Wößmann (2007) similarly concluded that privately managed schools generally outperform public schools, though they did not account for school composition in their analysis.

The potential advantages of private schools also have policy implications for initiatives like school choice and voucher programs. Lamarche (2008) evaluated the impact of a voucher program in the USA that allowed public school students to attend private schools. He acknowledged that Milton Friedman's proposal to use vouchers to improve education quality was based on the idea that private schools are more productive than public schools, though this remains highly controversial (Lamarche 2008: 576). The program's findings showed heterogeneous effects depending on students' initial achievements. Similarly, Lara et al. (2011) found small or statistically insignificant impacts of vouchers for private education in Chile.

Although earlier research generally suggested that private schools outperform public schools, more recent studies have begun to question this perception. Agasisti and Zoido (2018), for example, used international benchmarking with PISA 2012

data to explore school efficiency. They emphasized that differences between private and public school efficiency often hinge on how selection bias and socio-economic factors are addressed (Agasisti and Zoido 2018). Likewise, Aparicio et al. (2017) used a Malmquist-type index to compare the performance of different types of school ownership, finding that private schools do not consistently outperform public schools when socio-economic variables are considered.

While Vandenberghe and Robin (2004) and Dronkers and Robert (2008) considered the effects of private schools, they did not extensively address school composition. However, school composition has been central to debates on equality of opportunity since Coleman (1968) highlighted its importance for student achievement. Families and students select schools based on socio-economic and other factors, making it difficult to attribute performance differences solely to school type (Delprato and Chugur 2018). This complicates comparisons between public and private schools. Additionally, factors such as competitive pressure, administrative autonomy, staffing practices, and accountability are likely to influence student outcomes and may explain some of the performance differences observed in PISA test scores across subjects like mathematics, reading, and science (Ward 2018).

Some authors have questioned the validity of school composition effects, suggesting that these findings may result from misspecification in one-level analysis (Nash 2003; Harker and Tymms 2004). They argue that the positive impact of school composition may be due to the variable capturing individual characteristics of the students. Nevertheless, other research has consistently found a major influence of school composition, with students in schools that have larger proportions of socially disadvantaged students experiencing lower overall academic achievement (Perry et al. 2022). Dumay and Dupriez (2007) found that the composition effect remains significant even when controlling for students' initial achievements, though they noted the importance of accounting for students' academic backgrounds to avoid overestimating the effect. Lauder et al. (2010), who tracked students over a four-year period, similarly argued that school composition explains a significant portion of student progression. Gorard and Siddiqui (2019: 12) also found that "pupils do worse in schools with clusters of disadvantage" due to the lower quality and quantity of resources in these schools (Perry et al. 2022).

Recognizing the importance of composition effects, other scholars have sought to explain the underlying mechanisms behind these impacts. Dumay and Dupriez (2007) demonstrated the relationship between school composition and teachers' expectations; while, Brault et al. (2014) showed that composition influences performance through these expectations. Liu et al. (2015) argued that school processes partly explain compositional effects on students' outcomes. Opdenakker and Van Damme (2001) highlighted the links between school processes and school composition, showing that including composition controls reduces the coefficients for school process variables, as the combination of school composition and processes explains much of the variation between schools. They also found that composition can hinder the implementation of improvement programs.

What is clear is that focusing on school composition will help clarify the complexities of the public–private school performance debate. Earlier studies often suggested a performance advantage for private schools, particularly regarding academic

achievement. However, recent research has provided a more nuanced picture. Studies such as Ward (2018) now question the extent of this advantage once socio-economic factors, including school composition, are considered. Consequently, research results vary depending on the context and methodology, showing no uniform consensus on the superiority of private over public schools. Building on a similar empirical framework as Dronkers and Robert (2008), we evaluate whether private government-dependent and private independent schools have a systematic impact on students' performance, beyond their advantage in school composition (Hirtt et al. 2014). To do so, we use the 2015 PISA database, encompassing data from over 70 countries.

3 Private versus public schools and the school composition effect

Before conducting the empirical analysis, let us explore the potential mechanisms through which school composition can affect student achievement and how private schools may (or may not) deliver better results—and, consequently, better opportunities—than public institutions.

3.1 Mechanisms behind the school composition effect

Previous research has sought to understand the mechanisms driving the significant effect of school composition on student achievement. Liu et al. (2015) confirmed this influence by analyzing the 2003 PISA data, identifying school climate factors as key mediators linking school processes and composition. Another channel through which the composition of the student population can affect performance is through teachers' expectations, as highlighted by Brault et al. (2014). They found that school composition significantly influences teachers' expectations, with teachers often lowering expectations for disadvantaged students. Furthermore, Brault et al. (2014) demonstrated a positive correlation between higher teacher expectations and student achievement. Their analysis confirmed that school composition impacts student outcomes through teachers' expectations.

In conclusion, while the full extent of the compositional effect remains partly unexplained, it is mediated by school climate and teachers' motivation.

3.2 Mechanisms behind the performance of public schools

Theoretical explanations for the determinants of student performance have not kept pace with the extensive empirical studies on the subject. Bishop and Wößmann (2004) provided theoretical insights into the impact of school autonomy versus centralization. They conceptualized the educational system as a principal–agent network and identified two categories of inefficiencies: inefficient resource utilization and misallocation of resources across functional categories. To minimize these inefficiencies, tasks should be efficiently distributed among different actors. Bishop and Wößmann argued that while school autonomy allows

decisions to be made at the level where the best information is available, it also introduces the possibility of local opportunistic behaviors. They concluded that tasks like setting budget sizes, monitoring efficiency, and defining standards should be centralized, while decisions related to teacher hiring, pedagogical methods, material purchases, and staff management should be left to the autonomy of individual schools. Empirical evidence supports this theory (West and Wößmann 2010; Fuchs and Wößmann 2007; Wößmann 2003).

Wößmann (2006) distinguished between funding and operation, aiming to identify the respective strengths of the public and private sectors in both areas. Public sector involvement in operations allows for the inculcation or control of beliefs and cultural values; while, public funding enables effective school choice for credit-constrained families. He argued that private school operations encourage innovation and efficient cost management; while, private funding increases school accountability.

Dronkers and Robert (2008) first argued that private schools—whether government-dependent or independent—are more likely to require financial contributions from parents, thus attracting students from different socio-economic backgrounds. This must be controlled for to avoid attributing the impact of private schools solely to the initial advantage of students. They also presented two reasons why private actors might be better at providing public goods than public institutions: (1) Private schools are more vulnerable to competition and, therefore, have stronger incentives to prioritize educational quality, and (2) private schools have more flexibility to improve the education they provide. Additionally, private schools often have greater autonomy in managing their institutions, resulting in different teaching and learning conditions. Management boards and teachers in private schools are also more likely to interact and communicate informally, fostering a positive school climate and enhancing students' educational achievement.

The theoretical framework and empirical evidence lead to two key conclusions. First, it is important to differentiate between private operation and private funding, as emphasized by Dronkers and Robert (2008) when distinguishing between "private independent schools" and "private government-dependent schools." The former refers to privately operated and funded educational institutions; while, the latter denotes privately operated but predominantly publicly funded schools. Second, the theory of school autonomy suggests that private government-dependent schools are the most efficient type of institutions. In this model, budget size and standard setting are typically defined at the public level; while, the school retains independence in areas like personnel management and teaching methods.

4 The education production function

Based on the literature and theory, we test the following three hypotheses:

H_1 Private schools—including government-dependent private schools—should be more efficient than public schools.

In this context, 'efficient' refers to the ability of private schools to deliver higher student performance outcomes (as measured by PISA scores in mathematics, reading, and science) compared to public schools, while using a comparable or lower amount of educational resources. The hypothesis will assess whether private schools achieve superior results after controlling for socio-economic background and school composition.

H_2 There should be a positive relationship between school composition and students' performance.

H_3 Both school composition and school type should affect children's performance in standardized tests.

The effect of private schools may be diminished by the influence of school climate. Dronkers and Robert (2008) demonstrated that school climate partly explains the advantage of private institutions. Similarly, Liu et al. (2015) showed that school composition is mediated by the better conditions experienced by more privileged student populations. This finding is particularly relevant to our research, as it suggests that the performance differences between private and public schools may be driven, in part, by the socio-economic composition of their student populations. These compositions shape teachers' expectations and interactions with students. If teachers in schools with more disadvantaged populations tend to lower their expectations, this could contribute to lower student outcomes, regardless of the type of school. This underscores the importance of accounting for school composition when assessing the comparative performance of private and public schools, as it highlights the role of internal school dynamics rather than institutional characteristics alone.

However, according to Bishop and Wößmann (2004), government-dependent private schools should still be more efficient due to the benefits of decentralization, which allows decisions to be made where the relevant information is available. Thus, there should still be a positive effect of government-dependent private schools beyond the compositional effect.

We test these three hypotheses across six different specifications. Initially, we examine the average influence of private schools and school composition across countries to observe global tendencies and leverage greater variance. However, the effect of private schools is likely to vary between countries. Therefore, we will also run regression analyses by country to capture country-specific effects.

4.1 Overall analysis

Through five different specifications, we assess the average effect of school type and school composition on students' performance within each country in the dataset. The empirical method employed is a multiple OLS regression with country fixed effects. To address the potential endogeneity of the private variable—as students

attending different types of schools may differ ex ante—we control for students' socio-economic backgrounds.[1]

First, let's define what is meant by private schools. In the 2015 PISA questionnaire, public schools are defined as schools managed directly or indirectly by a public education authority, government agency, or governing board appointed by the government or elected by public franchise. Private schools are defined as schools managed directly or indirectly by non-government organizations, such as churches, trade unions, businesses, or other private institutions. Private schools thus refer to privately operated schools. The questionnaire also collects information on the sources of funding for the educational institution, allowing us to differentiate between private government-dependent schools and private independent schools. The first specification focuses on the contrast between private and public institutions. Note that all specifications (1) to (5) include country fixed effects, and the standard errors are robust and clustered by countries.

$$\text{score}_{i,s,c} = \alpha_0 + \beta_1 \text{private}_{s,c} + \gamma_{j_1} X_{j_1,i,s,p} + \delta_{j_2} S_{j_2,s,c} + C_c + \epsilon_{i,s,c} \tag{1}$$

The $\text{score}_{i,s,c}$ variable represents the score on the 2015 PISA test in mathematics, reading, and science for student i, in school s, in country c. The variable of interest here is the binary variable private, which equals one if the school is privately operated. The coefficient β_1 captures the potentially systematic difference in students' scores between private and public institutions. C_c represents the country fixed effect, and the remaining variables are control variables. $X_{j_1,i,s,p}$ is a vector of student controls, including gender, mother tongue, age at which the student started primary school (ISCED 1), immigration status of the parents, highest level of education attained by the parents in years of schooling, computer ownership at home, an index for cultural possession in the house, and the number of books at home. The variables $S_{j_2,s,c}$ contain information on the schools, such as student-to-teacher ratio, size of the place where the school is located, school size, average class size, and indicators of the school climate (Hanushek and Wößmann 2011; Wößmann 2003; Dronkers and Robert 2008; Vandenberghe and Robin 2004). The number of books at home is a strong proxy for the educational, social, and economic environment in children's homes (Wößmann 2003), and Schuetz bet al. (2008) validate its use by showing that the correlation between household income and the number of books owned is consistent across countries. The index for cultural possession is an OECD indicator included in the 2015 PISA database, computed based on children's responses about the presence of books of poetry, classic literature, works of art, or books on art, music, or design at home (OECD 2017).

[1] While our identification strategy uses multiple ordinary least squares (OLS) regression models and controls for key background characteristics, including socio-economic factors, we acknowledge that this approach may not fully address the issue of endogeneity. Omitted variable bias remains a potential concern, as unobserved factors may influence both student outcomes and school choice. Some scholars studying PISA data have addressed these challenges using other methods, such as instrumental variable (IV) approaches and matching techniques. Future research could further strengthen the identification strategy by employing these methods to mitigate endogeneity and provide more robust estimates of the effect of private versus public schooling on student performance.

For the second specification, we include the distinction between publicly financed private and privately finance private schools (Dronkers and Robert 2008). Public funding of private schools may expand the choice of less well-off families toward privately managed institutions. The private variable is divided into government-dependent private schools and independent private schools. Government-dependent private schools refer to privately operated educational institutions that receive at least 50 percent of their funding from the government, while independent private schools are privately operated and financed.

$$\text{score}_{i,s,c} = \alpha_0 + \beta_1 \text{priv\_gov}_{s,c} + \beta_2 \text{priv\_indep}_{s,c} + \gamma_{j_1} X_{j_1,i,s,p} + \delta_{j_2} S_{j_2,s,c} + C_c + \epsilon_{i,s,c} \tag{2}$$

In the third specification, we focus on school composition by computing the mean ESCS index of all other students attending the same school as student *i*. The ESCS index (index for economic, social, and cultural status) is provided in the PISA database and is based on the highest occupational status of the parent, the highest level of education of the parents, and home possessions. The ESCS index is a standard measure with a zero mean, where one point represents one standard deviation across OECD countries (OECD 2017).

$$\text{score}_{i,s,c} = \alpha_0 + \beta_1 \text{school\_comp}_{s,c} + \gamma_{j_1} X_{j_1,i,s,p} + \delta_{j_2} S_{j_2,s,c} + C_c + \epsilon_{i,s,c} \tag{3}$$

The fourth specification adds both school type and school composition to examine the role of private schools in comparable school and study environments.

$$\begin{aligned} \text{score}_{i,s,c} = {} & \alpha_0 + \beta_1 \text{private}_{s,c} + \beta_2 \text{school\_comp}_{s,c} \\ & + \gamma_{j_1} X_{j_1,i,s,p} + \delta_{j_2} S_{j_2,s,c} + C_c + \epsilon_{i,s,c} \end{aligned} \tag{4}$$

The fifth specification is the most comprehensive, allowing us to observe differences between government-dependent private schools and independent private schools for comparable mean socio-economic levels.

$$\begin{aligned} \text{score}_{i,s,c} = {} & \alpha_0 + \beta_1 \text{priv\_gov}_{s,c} + \beta_2 \text{priv\_indep}_{s,c} + \beta_3 \text{school\_comp}_{s,c} \\ & + \gamma_{j_1} X_{j_1,i,s,p} + \delta_{j_2} S_{j_2,s,c} + C_c + \epsilon_{i,s,c} \end{aligned} \tag{5}$$

4.2 Analysis by country

Next, considering that the effects of the variables of interest may change in specific national contexts, we run the last specification for each country. Therefore, for each country in the dataset, we conduct the following regression analysis:

$$\begin{aligned} \text{score}_{i,s} = {} & \alpha_0 + \beta_1 \text{priv\_gov}_s + \beta_2 \text{priv\_indep}_s \\ & + \beta_3 \text{school\_comp}_s + \gamma_{j_1} X_{j_1,i,s} + \delta_{j_2} S_{j_2,s} + \epsilon_{i,s} \end{aligned} \tag{6}$$

Here, the scores in mathematics will be explained as the results are remarkably similar across the three different subjects, ensuring clarity and conciseness.

Table 1 Summary statistics

	All Schools	Public	Private			Difference
			All	Gov-dep	Independent	(Private–Public)
Score math	470.41	465.05	493.03	502.38	484.09	27.97***
Score read	472.70	467.29	495.51	502.35	488.98	28.22***
Score science	476.27	471.19	497.75	502.49	493.22	26.56***
School composition	−0.25	−0.32	0.06	−0.17	0.28	0.38***
Observations	326,659	264,094	62,565	30,582	31,983	

Variables of interest by types of schools

*** p-value under 1%, ** p-value under 5% and * p-value under 10%

5 Data and descriptive statistics

5.1 *PISA* database

This analysis employs the PISA 2015 database, which contains standardized test scores in mathematics, reading, and science from a representative sample of 15-year-old students across 35 OECD and 37 non-OECD countries. The survey, designed by the OECD, ensures the comparability of results among countries. Data were collected through questionnaires administered to students and school principals, followed by standardized tests. The test scores were then standardized with a mean score of 500 and a standard deviation of 100 for OECD countries (OECD 2017).

The PISA 2015 database also includes valuable information about students, their home and family backgrounds, and school-related factors such as institutional features, school climate, and teachers' qualifications. New data are collected every three years, with the selection of relevant survey information based on expert advice and previous literature. Additionally, PISA has developed its own indexes and aggregated measures, such as the ESCS (Economic, Social, and Cultural Status) index and cultural possession indexes, as discussed in the previous section (OECD 2017). The PISA database provides the most comprehensive internationally comparable information on education.

6 Summary statistics

The database comprises 326,659 students from 12,195 schools across 61 countries. Initially, it included over 500,000 students from 68 countries, but some countries were excluded due to missing values for specific variables. For this reason, Sweden, Israel, and Albania were dropped from the sample. In the case of Belgium, the database only includes German-speaking and French-speaking schools because Flemish schools did not specify their school type.

Table 1 presents the means of the main variables of interest categorized by school type. The last column shows the mean difference between private (privately operated) and public schools, along with its significance level. The full version of the table, which includes all variables analyzed, can be found in Online Appendix II. The results indicate that scores in mathematics, reading, and science are consistently and significantly higher in private schools compared to public schools. Table 1 also reveals that scores in government-dependent private schools tend to be higher than those in independent private schools. On average, students in private schools come from more advantaged socio-economic backgrounds than those in public schools, with the mean ESCS index in private schools being 0.4 standard deviations higher. This difference is statistically significant.

The student population in government-dependent private schools appears to be significantly less privileged than that in fully privately funded schools. The control variables (see Online Appendix II) also show significant mean differences between the two school types, except for the percentage of female students. These differences underscore the importance of controlling for these characteristics. For instance, an important proxy for students' socio-economic and cultural backgrounds is the number of books in the home. Public schools report that 41% of students have fewer than 25 books at home, compared to 33% in private schools. These mean differences highlight the expected socio-economic differences between public and private institutions. To better understand this dynamic, we examine the mean ESCS index by school type in each country.

Figure 1 displays data for a series of EU countries (plus the UK), ranked by the percentage of private schools. It also shows the average ESCS index gap between public and private schools for each country. In almost all countries considered—except for the Netherlands and Italy—the mean ESCS index is higher in private schools, and in many cases, considerably higher. A higher percentage of private schools does not necessarily correlate with a wider gap, which makes sense since countries with a larger percentage of private schools tend to include a broader range of students. The countries with the highest levels of socio-economic segregation between private and public schools in the EU are Bulgaria and Greece, with an average ESCS index gap of approximately 1. Spain follows closely, with

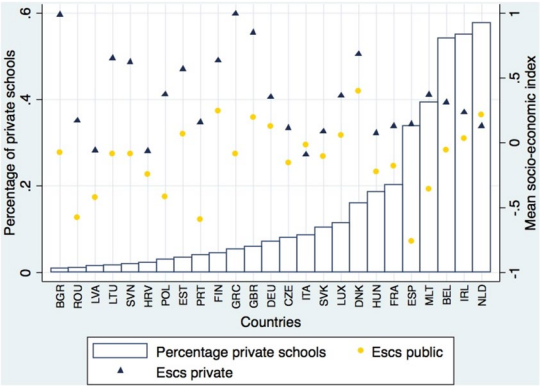

Fig. 1 Mean ESCS index by type of school and percentage of private schools in EU countries (plus UK)

an average difference of 0.88 in the mean ESCS index between private and public schools.

Figure 2 presents the same information for a more diverse group of non-EU countries included in the analysis. Although there is greater variation compared to the previous figure, the overall trend remains the same: students in public schools generally come from less privileged backgrounds than those in private schools in nearly all countries. The exceptions are Algeria, Costa Rica, Taiwan, and China (Hong Kong). In some countries, there is no significant difference between the socio-economic status (ESCS) of students in private and public schools. This is the case in Iceland, Norway, Vietnam, Korea, and Indonesia, where the ESCS gap between private and public schools is almost non-existent.

Notably, Norway and Iceland have minimal school composition gaps between private and public schools, and their average ESCS indexes are relatively high compared to other countries. Asian countries show a limited socio-economic composition gap between the two types of schools. In Vietnam, China (Beijing, Shanghai, Jiangsu, Guangdong, Macao, and Hong Kong), Indonesia, Taiwan, Japan, and Korea, the ESCS gap ranges from − 0.05 to 0.34 points. Singapore is a notable exception in Asia, with a larger gap of 0.68 points.

Finally, the widest gaps are observed in Latin America. In Mexico, Brazil, Uruguay, the Dominican Republic, Colombia, Peru, and Chile, the differences range from 1 to 1.40 points. Costa Rica stands out on the continent, where the average ESCS of public schools is slightly higher than that of private schools.

Based on this evidence, since private and public schools tend to enroll diverse types of students, it is important to assess the degree of overlap between the two. Figure A.1 in Online Appendix II shows the distribution of the mean ESCS by school type. While the means are distinguishable, there is evident overlap between the two distributions.

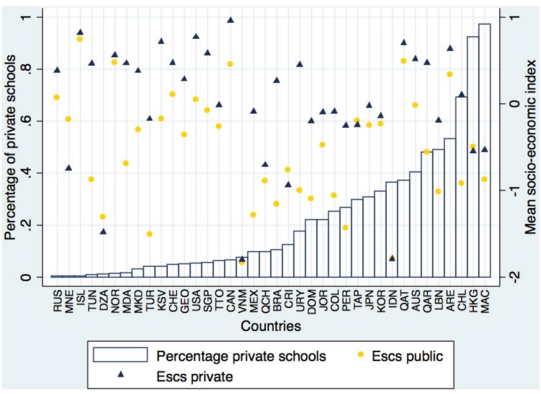

Fig. 2 Mean ESCS index by type of school and percentage of private schools (outside EU)

7 Empirical results

In this section, we present the results from the specifications discussed in Section III. We begin by providing an overview of the average effect of school type on student performance across countries, followed by an examination of the specific results within each country.

7.1 Overall analysis

Table 2 displays the results for Eq. (1) in columns (1), (2), and (3). For a detailed table containing all control variables, please refer to Table A.2 in Online Appendix III. Across all three subjects, private schools show a significant positive correlation with students' educational achievements. This translates into a 2.5% increase in mathematics and science scores and a 2.9% increase in reading scores, given that the mean score for the entire sample ranges from 470 to 476 points, depending on the subject.

However, when controlling for students' socio-economic background, the increase in scores associated with attending privately operated schools becomes more modest. Additionally, specification (1) explains between 41 and 46% of the total variation in the sample.

The complete table in Online Appendix III (Table A.2) reveals interesting trends. On average, girls perform better than boys in reading, while boys tend to excel in science and mathematics. Starting school between the ages of 4 and 7 has a significantly positive connection with children's performance compared to starting primary school at age 3. However, starting school after age 8 negatively affects student performance. Being schooled in a language different from one's mother tongue reduces student scores, with this effect being nearly twice as large for reading and science

Table 2 OLS estimates of the effect of the type of school on students' scores. Math, reading and science

	(1) Math	(2) Read	(3) Science	(4) Math	(5) Read	(6) Science
Private school	11.63*** (4.355)	13.51*** (4.480)	11.77** (4.435)			
Private gov-dependent				0.940 (3.284)	3.411 (3.270)	2.042 (3.377)
Private independent				19.80*** (5.481)	21.23*** (5.647)	19.22*** (5.561)
Control var. student	Yes	Yes	Yes	yes	Yes	Yes
Control var. school	Yes	Yes	Yes	Yes	Yes	Yes
Control school climate	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	326,659	326,659	326,659	326,659	326,659	326,659
R-squared	0.464	0.419	0.407	0.465	0.420	0.408

Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

compared to mathematics. This aligns with the fact that mathematics requires fewer language skills.

Parental education levels also have a positive effect on student achievement. Interestingly, the immigration status of the mother has a slightly significant positive connection with reading scores, while the father's immigration status does not seem to affect outcomes. This discrepancy may be attributed to the diverse range of countries included in the analysis, where the impact of parental immigration status differs between more and less developed countries. Therefore, examining this coefficient across such a wide variety of contexts may not be meaningful. Further country-level analysis reveals that the coefficient for parental immigration status is consistently significant, though its direction varies across countries.

The number of books at home is another significant and strong predictor of student performance. Children with more than 100 books at home score approximately 50 points higher on average compared to those with fewer than 10 books. This represents an advantage of over 10%, supporting Wößmann's (2003) finding that the number of books at home is a reliable proxy for a child's socio-economic and cultural background.

In terms of the cultural possession index, children from families that prioritize arts and culture tend to perform better on average. Additionally, students with access to a computer at home score significantly higher than those without. Among school characteristics, students perform better when the student-to-teacher ratio is lower, and those attending schools in larger towns or cities tend to achieve higher results. The size of the school has a small but positive effect on scores. Interestingly, class size also has a positive correlation with exam scores, as long as class sizes remain below 35 students.

School climate also plays a role. Disruptions caused by student truancy, skipping classes, or lack of respect negatively affect performance, while issues related to drugs and bullying appear to have no significant effect. Regarding teacher responsibility, if principals report that learning is disturbed by unprepared teachers, this leads to lower student outcomes. However, negative climate factors such as teachers being too strict or resistant to change do not seem to negatively affect performance; in some cases, the relationship is even positive.

When comparing publicly and privately financed public schools, columns (4) to (6) of Table 2 show that attending a government-dependent private school does not significantly raise student scores. However, attending private independent schools leads to approximately a 4% increase in results. Given Dronkers and Robert's (2008) findings on the positive impact of government-dependent private schools on student performance, we suspect that the lack of significance in our results may be due to controlling for school climate variables. To evaluate this, we reran the first and second specifications without controlling for school climate. These results, found in Table A.3 in Online Appendix III, show that controlling for school climate partially mitigates the positive effect of private schools. The connection between private independent schools and reading and science scores remains significantly positive. These findings partly confirm Dronkers and Robert's (2008) conclusion that the advantage of private schools is partially due to better school climates. However, our results contradict the first hypothesis from

past research, as we also expected a clearer influence from government-dependent private schools, which we did not observe.

In estimating regression (3), we analyze how school composition affects student performance, as shown in Table 3. For the estimated coefficients of all control variables, please refer to Table A.4 in Online Appendix III. Table 3 reveals that school composition significantly and substantially influences student performance. Increasing the mean ESCS (Index of Economic, Social, and Cultural Status) of a school by one point (equivalent to one standard deviation among OECD countries) results in an average increase of approximately 44 points in a student's score—an increase of nearly 10% from the average score. These results confirm the second hypothesis presented in Sect. 4.

Regarding control variables, the coefficients remain relatively stable, with a slight decrease in the magnitude of the coefficients for family background variables that favor student performance. The coefficient for the student-to-teacher ratio is no longer significant. Specification (3) explains between 44 and 50% of the total variation in the sample.

Finally, as demonstrated in Figs. 1 and 2 of Sect. 5, private schools tend to enroll students from more favorable socio-economic backgrounds. Therefore, we include both school composition and school type in the regression, following specification (4). A summary of the results can be found in Table 4, and the estimated coefficients are in Table A.5 in Online Appendix III. According to the estimations, the coefficients for private schooling are no longer significant. Conversely, the coefficient for school composition remains significant and substantial. This suggests that when the socio-economic composition of the school is considered, private schools do not outperform public schools.

In the fifth specification, which distinguishes between various sources of funding for private schools, we find that neither independent private schools nor government-dependent private schools show better performance compared to public schools with similar socio-economic indices. An interpretation of the results in Table 4 is that private and public schools themselves do not significantly shape

Table 3 OLS estimates of the effect of school composition on student's scores. Math, reading and science

	(1) Math	(2) Read	(3) Science
School composition	43.14*** (2.606)	44.72*** (2.738)	43.39*** (2.728)
Control var. student	yes	yes	yes
Control var. school	yes	yes	yes
Control school climate	yes	yes	yes
Country fixed effect	yes	yes	yes
Observations	326,659	326,659	326,659
R-squared	0.498	0.455	0.441

Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 4 OLS estimates of the effect of the type and composition of the school on students' scores. Math, reading and science

	(1) Math	(2) Read	(3) Science	(4) Math	(5) Read	(6) Science
Private school	−1.656 (4.312)	−0.179 (4.338)	−1.579 (4.402)			
Private gov-dependent				−3.017 (3.172)	−0.678 (3.233)	−1.949 (3.288)
Private independent				−0.512 (5.953)	0.240 (6.158)	−1.268 (6.141)
School composition	43.43*** (2.768)	44.75*** (2.835)	43.66*** (2.904)	43.24*** (2.883)	44.68*** (2.889)	43.61*** (3.005)
Control var. student	Yes	Yes	Yes	Yes	Yes	Yes
Control var. school	Yes	Yes	Yes	Yes	Yes	Yes
Control school climate	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	326,659	326,659	326,659	326,659	326,659	326,659
R-squared	0.498	0.455	0.441	0.498	0.455	0.441

Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

exam performance. Instead, what really seems to matter is the socio-economic composition of the school.

Following Dronkers and Robert (2008), we perform the same test as before, removing the controls for school climate. The estimated coefficients are shown in Table A.6 in Online Appendix III. Removing these variables does not affect the significance of the coefficients for private schools. These results contradict the third hypothesis based on existing research. While Dronkers and Robert (2008) emphasized the importance of controlling for school composition, they still found a positive impact of government-dependent private schools. However, in our analysis, when controlling for school composition, there is no longer any advantage to attending any type of private school.

This result is robust, as the coefficient for school composition remains unchanged across specifications (3), (4), and (5). Furthermore, comparing Table 4 and Table A.6 in Online Appendix III, we observe that part of the link between school composition and exam results is that a higher average socio-economic level in a school contributes to a better school climate.

In conclusion, the above analysis suggests that the socio-economic composition of the school is a better predictor of performance and institutional quality than whether the school is public or private. However, these effects are likely to vary across countries. Therefore, we now estimate regressions for each country.

7.2 Analysis by country

Table 5 presents the estimations of country-specific regressions. A notable finding is that school composition is consistently significant and positive in all countries

Table 5 OLS estimates of the effect of the type and composition of the schools on student's scores by country. Scores in Mathematics

Country	Priv. Dependent	Priv. Independent	School Comp	R^2	N	Share priv. dependent	Share priv. independent
Algeria	49.102***	50.976***	24.669***	0.243	3,455	0.008	0.003
Argentina	32.646***	17.282	34.217***	0.540	1,094	0.286	0.193
Australia	−5.497***	6.293**	39.413***	0.294	10,290	0.274	0.129
Belgium (Fr)	20.226***	–	24.559***	0.509	2,136	0.542	0
Brazil	4.651	21.659***	28.068***	0.332	10,147	0.004	0.101
Bulgaria	–	−12.886	74.213***	0.460	4,984	0	0.010
Canada	32.279***	22.372***	19.522***	0.224	14,701	0.025	0.040
Chile	3.233	7.341*	33.844***	0.473	5,511	0.428	0.264
China (B-S-J-G)	48.525***	−4.835	56.559***	0.393	9,002	0.008	0.090
China (Hong Kong)	−9.102**	–	40.619***	0.321	4,520	0.922	0
China (Macao)	−9.910	−33.339**	31.903***	0.264	4,221	0.834	0.139
Chinese Taipei	−51.638***	−53.081***	74.133***	0.408	7,071	0.058	0.239
Colombia	−14.421***	10.703***	33.651***	0.327	8,212	0.063	0.191
Costa Rica	16.109***	2.474	24.814***	0.280	5,598	0.022	0.103
Croatia	8.909	0.000	80.670***	0.389	5,200	0.023	0.001
Czech Republic	−7.788**	−46.758***	72.087***	0.524	5,921	0.071	0.009
Denmark	4.394	17.846**	11.519***	0.287	4,881	0.140	0.020
Dominican Republic	−6.574	−7.029*	35.040***	0.374	2,780	0.039	0.180
Estonia	−14.953**	−31.469***	46.904***	0.237	4,761	0.027	0.008
Finland	6.809	–	34.912***	0.220	5,179	0.044	0
France	2.323	6.439	53.707***	0.521	4,382	0.136	0.066
Georgia	8.406	32.853***	30.076***	0.305	3,577	0.014	0.037
Germany	−0.307	0.000	69.505***	0.493	3,496	0.066	0.006
Greece	–	6.445	41.252***	0.301	4,550	0	0.054
Hungary	−10.598***	4.875	66.020***	0.563	4,671	0.163	0.022
Iceland	24.686	–	9.408	0.187	2,775	0.005	0
Indonesia	−11.260***	−16.276***	47.087***	0.430	4,462	0.220	0.142
Ireland	11.064***	5.152	19.563***	0.300	4,429	0.524	0.026
Italy	−5.073	−21.907***	66.152***	0.343	7,345	0.064	0.022
Japan	−53.274***	−38.317***	118.001***	0.459	6,091	0.035	0.272
Jordan	−19.145**	−2.799	23.719***	0.214	5,027	0.004	0.217
Korea	1.800	12.686***	64.625***	0.334	5,303	0.221	0.107
Kosovo	115.191***	36.383***	26.692***	0.262	3,584	0.007	0.035
Latvia	19.001*	−1.145	20.009***	0.225	4,227	0.007	0.008
Lebanon	−45.937***	5.443	33.212***	0.339	1,981	0.009	0.481

Table 5 (continued)

Country	Priv. Dependent	Priv. Independent	School Comp	R^2	N	Share priv. dependent	Share priv. independent
Lithuania	18.401**	21.159*	45.143***	0.280	5,856	0.013	0.004
Luxembourg	−20.796***	20.556**	48.420***	0.448	4,443	0.091	0.024
Macedonia	0.000	16.418*	44.535***	0.302	3,304	0.007	0.024
Malta	16.438	30.434**	38.764***	0.300	2,294	0.231	0.162
Mexico	–	−9.541***	24.702***	0.238	6,250	0	0.098
Moldova	−47.593**	30.599***	23.207***	0.239	4,014	0.003	0.014
Montenegro	–	0.000	92.228***	0.318	5,093	0	0.005
Netherlands	6.494**	0.000	74.207***	0.549	2,174	0.577	0.000
Norway	−12.601	–	9.093*	0.196	3,865	0.014	0
Peru	26.899***	12.485***	26.152***	0.395	5,890	0.022	0.245
Poland	17.110*	25.854**	28.282***	0.264	3,842	0.020	0.010
Portugal	−9.493	6.631	21.775***	0.278	5,263	0.008	0.032
Qatar	17.917**	15.710***	76.234***	0.483	9,212	0.018	0.353
Romania	–	1.969	60.270***	0.402	4,691	0	0.011
Russian Federation	15.584	−25.053*	33.243***	0.138	5,172	0.002	0.002
Singapore	23.292**	−71.605***	58.385***	0.377	4,865	0.018	0.036
Slovak Republic	−2.962	–	51.506***	0.445	5,816	0.104	0
Slovenia	−20.220***	–	92.962***	0.427	5,155	0.020	0
Spain	−3.703	−6.356	16.127***	0.274	5,548	0.283	0.057
Switzerland	−5.648	−47.700***	49.372***	0.418	4,636	0.021	0.027
Trinidad and Tobago	10.490	−49.464***	80.074***	0.526	2,819	0.040	0.022
Tunisia	–	−54.019***	36.628***	0.364	3,390	0	0.008
Turkey	−23.244**	−53.473***	50.019***	0.436	5,425	0.006	0.035
United Arab Emirates	−28.817***	1.399	58.564***	0.399	9,002	0.014	0.518
United Kingdom	13.794***	1.828	47.752***	0.306	7,912	0.017	0.043
United States	–	−21.406***	26.169***	0.285	4,524	0	0.053
Uruguay	–	2.936	36.155***	0.397	5,124	0	0.177
Vietnam	–	−33.628***	37.847***	0.332	5,516	0	0.075

Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

except one (Iceland). In contrast, the link between private schools and exam performance varies across countries, with some showing no effect and others displaying positive or negative correlations.

In this section, we provide general observations on the potential effects of private schools across countries and then focus on school composition, drawing comparisons with Figs. 1 and 2 from Sect. 5.

First, Table 5 reveals significant variation in schooling systems across countries, making it challenging to draw general conclusions about the impact of school type on

student scores. Out of the 63 countries in the sample, only 16 show a positive and significant correlation between private government-dependent schools and student scores. These countries are geographically diverse and have varying percentages of private government-dependent schools, making it difficult to pinpoint the factors driving the premium associated with this type of school. However, once we control for school composition, the advantage of private schools primarily stems from the socio-economic characteristics of their student populations. In 37 out of 63 countries, private schools do not show a positive advantage over public schools in terms of student scores when controlling for school composition.

Next, we examine the role of school composition and its potential association with segregation induced by private schooling, comparing the findings with Figs. 1 and 2. Iceland is the only country where school composition does not seem to affect exam performance. In Norway, school composition has a relatively small and marginally significant effect. It is worth noting that these two countries have minimal differences in the average socio-economic status of private and public schools, as shown in Fig. 2. Denmark, on the other hand, shows weak but highly significant effects of socio-economic segregation on student outcomes, where a one-point increase in the socio-economic index corresponds to an average score increase of 11.52 points.

As Fig. 2 indicates, Asian countries (excluding Singapore) show no or limited socio-economic segregation between private and public schools. However, the positive and significant coefficient of school composition suggests that some form of socio-economic segregation still influences student scores, independent of school type. Italy and the Netherlands exhibit a similar pattern, with no significant difference in average school composition between private and public schools (Fig. 1). Nonetheless, the positive, significant, and substantial connection between school composition and student performance implies the presence of segregation unrelated to school type or differences in schooling systems.

Conversely, Latin American countries show wide disparities in average school composition between private and public schools (Fig. 2). The positive and significant coefficient of school composition indicates that the type of school in these countries likely generates segregation and inequalities in educational outcomes and future opportunities. This pattern also holds for Greece and Bulgaria, the two European countries with the largest socio-economic gap between the two school types.

In Belgium, private government-dependent schools exhibit a higher socio-economic composition, as seen in Fig. 1. Combined with the positive and significant coefficients for school composition and private schools, this suggests that students attending these schools enjoy significant advantages compared to those in public schools.

8 Discussion and policy implications

8.1 Discussion of the results

Previous research has generally reported a positive and significant impact of private schools on student performance (e.g., Dronkers and Robert 2008; Wößmann 2006; Fuchs and Wößmann 2007), attributing this advantage to factors such as better school

climate (Dronkers and Robert 2008) and decentralized decision-making (Bishop and Wößmann 2004). To some extent, our findings support these conclusions, showing that attending a private school, on average, increases educational achievement. We also observe that students attending independent private schools perform better than those in government-dependent private schools. School climate is identified as a crucial factor contributing to the comparative advantage of private schools.

However, while it is well-established that student performance is closely tied to socio-economic background, this paper makes a distinct contribution by illustrating that the advantages attributed to private schooling often disappear when accounting for school composition. After considering the socio-economic composition of the school population, the advantage of private schools is primarily driven by the higher socio-economic status of their students, rather than the mechanisms described in the literature (e.g., Jacobs and Wolbers 2018).

Moreover, when examining countries individually, we find that the influence of different types of schooling on exam outcomes varies, highlighting the diversity of educational systems and institutional effects. Additionally, the relationship between socio-economic segregation and school type varies across countries, suggesting that in some countries, composition effects are highly correlated with school type, while in others, segregation effects are independent of school type. In this regard, our findings align with recent studies that demonstrate the diminishing effect of school type on student performance once socio-economic background and school composition are considered (Sakellariou 2017; Delprato and Chudgar 2018). These results challenge the traditional narrative of private school superiority and underscore the need for more nuanced policy discussions regarding school choice and educational equity.[2]

Overall, our research reveals that, once school composition is accounted for, significant differences in performance between private and public schools largely disappear. This is consistent with recent research emphasizing that socio-economic background is a decisive factor in shaping student outcomes, often overshadowing the effect of school type (Agasisti and Zoido 2018; Jacobs and Wolbers 2018). This suggests that the perceived advantage of private schools is not due to superior educational quality, but rather to the socio-economic profile of their student populations. This finding is consistent across the majority of the 63 countries studied, underscoring the importance of school composition in explaining cross-national differences in student performance and challenging the assumption of inherent private school superiority.

However, three limitations of these results should be considered. Firstly, previous studies have discussed the systemic effects of private schooling (Wößmann 2006;

[2] However, beyond the central tendency that we study in this paper, it would be valuable to examine the performance distribution more comprehensively, particularly at the extremes. Future research could employ quartile estimates or Recentered Influence Functions (RIFs) to explore whether the impact of private versus public schooling differs for the lowest and highest performing students. These methods would offer a more granular view of how educational inequalities manifest across the performance spectrum, potentially revealing differential effects for students at the tails of the distribution.

Fuchs and Wößmann 2007; West and Wößmann 2010), suggesting that the presence of private government-dependent schools may have a general influence on average scores in a country by increasing competition and improving overall school performance. This may explain the insignificant coefficients for government-dependent private schools compared to public schools in countries with a relatively high share of these institutions. For instance, countries like Denmark, France, Korea, Slovakia, and Spain have between 10 and 28% of private government-dependent schools, yet our estimations show no significant positive effect. However, in Belgium and the Netherlands—where more than 50% of schools belong to this category—there is still a positive and significant association. This highlights the need for caution in concluding that private government-dependent schools have no influence on outcomes, as there may be positive systemic effects in certain countries beyond the composition effect.

Secondly, the composition effect has been a topic of debate, with some authors suggesting it reflects the fact that similar students with unobservable characteristics tend to end up in the same schools (Nash 2003; Harker and Tymms 2004). While a substantial body of literature demonstrates the influence of school composition on student performance, it also acknowledges the risk of overestimating this component if not controlling for a child's initial ability or academic background (Dumay and Dupriez 2007; Dupriez 2010). Although we have controlled for many individual characteristics, including a child's academic background by accounting for the age of starting primary school, it is possible that unobservable characteristics could lead to a slight overestimation of the role of school composition in exam performance.

Thus, while the findings of this paper demonstrate the significance of school composition in shaping student outcomes, further analysis is required to establish a solid empirical foundation for discussing the broader implications of segregation, particularly regarding innovation and entrepreneurship. Future research could investigate how educational segregation, driven by socio-economic disparities, influences long-term outcomes such as students' capacity for innovation and entrepreneurial success. By examining how unequal educational opportunities affect skills critical for innovation and entrepreneurship, a stronger link between school composition and these socio-economic outcomes can be established.

Finally, the simplicity of our identification method, which relies solely on multiple OLS regression, should be acknowledged. To establish causal relationships between school type and school composition, it would have been preferable to use an exogenous shock or panel data to track students over time, allowing for better control of initial performance. Unfortunately, the available PISA data do not allow for such analysis. Vandenberghe and Robin (2004) attempted to use city size as an instrument for school type, but this instrument lacks theoretical justification and was found to be weak in our testing, yielding no meaningful results in the first stage. Consequently, we relied on OLS analysis. While our results are robust in terms of associations, caution must be exercised in interpreting them as causal explanations.

8.2 Policy implications

Inequalities in student performance become unfair when they are correlated with characteristics such as gender, socio-economic background, or immigration status (Hirtt et al. 2014). The significant composition effect identified in our study suggests that education is failing to serve as a social elevator, as similar students tend to cluster in the same schools, favoring privileged students (Xuan et al. 2019). Addressing the mechanisms through which school composition affects student performance is crucial. Achieving a highly equal society—such as in the case of Nordic countries—would mitigate the damaging composition effect, reduce the uneven returns of formal education, and significantly contribute to increasing innovation and fostering entrepreneurship (Johansson et al. 2007). However, this requires an efficient public education system, conditions mostly found in Nordic countries but rare elsewhere.

One potential source of segregation identified in our study is the higher socio-economic and cultural index among students attending private schools compared to public schools (see Table A.6 in Online Appendix I). This disparity is particularly pronounced in private independent schools, as shown in Figs. 1 and 2. Exploring why wealthier families choose private schools is essential. While financial contributions required by private schools may exclude poorer families, this mechanism may not apply to government-dependent private schools, where families can generally enroll their children without financial constraints. In such cases, the preference for a "better" school composition can be partially explained by the school choice debate.

School choice has arguments in its favor, such as enhancing parental freedom and fostering competition among schools, leading to improved average performance. However, its relationship with inequalities is ambiguous. While school choice can help avoid geographical segregation, it may also increase socio-economic and cultural segregation, as similar parents are attracted to the same schools. Ensuring equal opportunities should be the guiding principle of school allocation policy. However, the assumption that geographical school allocation places everyone on equal footing is naive. Wealthier parents can choose whether to live near good schools or opt for expensive private schools (Musset 2012).

School choice may seem like a solution to ensure equal treatment and opportunities for all families, but effective choice is not guaranteed. Parents with similar backgrounds tend to enroll their children in similar schools, leading to self-exclusion by parents from more modest backgrounds who fear exclusion for their children. This may explain why parents from wealthier backgrounds tend to choose private schools more often. Moreover, evidence suggests that poorer parents exercise school choice less frequently, partly due to a lack of information, and instead enroll their children in the nearest school (Musset 2012). Therefore, school choice could increase social diversity in schools, but only with careful policy design that focuses on students from lower socio-economic backgrounds.

Another source of segregation highlighted by Dumay and Dupriez (2006) is how school structures shape inequalities among students. They distinguish between integrated and differentiated schooling systems. Integrated systems maintain a common educational program for a longer period, with fewer optional courses and limited grade retention. Differentiated systems, by contrast, divide students into different

tracks early on and readily retain students. Integrated systems are more egalitarian, allowing schools more time to compensate for initial socio-economic and cultural disparities among children. Early segregation based on performance perpetuates inequalities, as it punishes students for their socio-economic backgrounds rather than selecting based on abilities.

Nordic countries have the most integrated schooling structures, while countries like Germany, Hungary, the Netherlands, and the Czech Republic divide students into tracks as early as age 12 or even earlier. This could explain the high coefficients on the school composition variable for these countries in Table 5. Most other European countries have a mix of integrated and differentiated systems. Importantly, schooling inequalities are primarily influenced by country-specific schooling structures rather than by societal inequalities (Dumay and Dupriez 2006).

Identifying these sources of segregation emphasizes the role of schooling structures and institutional features in addressing inequalities. By designing effective educational policies, policymakers can work toward a fairer schooling system. One approach to mitigate the impact of school composition on student achievement is to address these sources. For instance, well-designed school choice policies can maintain the positive systemic effects of private government-dependent schools while mitigating their segregation effects. This can be achieved by incentivizing schools to enroll "disadvantaged" children through budgetary rewards or implementing quotas. School choice policies must also be accompanied by school seat allocation mechanisms, as each school has a fixed number of seats, and not all first choices can be accommodated. Allocation algorithms could prioritize a certain quota of students from lower socio-economic backgrounds, increasing diversity within schools.

In the short term, offering better opportunities directly to disadvantaged children could be a solution. Our analysis suggests that school voucher policies, despite limited evidence of their positive impact (Musset 2012; Lamarche 2008; Lara et al. 2011), could provide a positive composition effect for disadvantaged children. Additionally, Chetty et al. (2016) find a significant and long-term positive correlation between neighborhood vouchers and future earnings. Such policies should target young children, as the benefits for those under 13 outweigh the disruptive costs of moving. Offering vouchers to low-income families, enabling them to enroll their children in private or wealthier neighborhood schools, could increase diversity and provide better educational opportunities for the beneficiaries.

Moreover, the current system is creating social polarization and future inequalities. Students from disadvantaged backgrounds and poorer areas face significant barriers to acquiring the necessary skills to become entrepreneurs, innovate, or move to places with greater opportunity (Johansson et al. 2003). They can become trapped in areas with limited opportunities and narrow career prospects (Rodríguez-Pose and Ketterer 2020), which can foster discontent (Rodríguez-Pose 2018). The differences in performance among students are mostly related to their family background rather than the type of school they attend. Hence, except for a few highly egalitarian countries, school segregation has significant consequences for student performance and perpetuates inequalities.

The higher average socio-economic and cultural index (ESCS) of private schools underscores their role in promoting segregation. However, the goal is not

to eliminate private schooling (independent or government-dependent), but rather to address the issue by providing options for all families. Achieving this would not only make our societies fairer but also more effective by ensuring that talent critical for driving innovation and entrepreneurship is not wasted (Karlsson and Johansson 2006).

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