

Whither Education? The Long Shadow of Pre-Unification School Systems into Italy's Liberal Age (1861–1911)

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This paper contributes to the literature on the determinants of the expansion of mass schooling and the long-term legacy of educational institutions. Based on a new provincial-level dataset for Italy in the period 1861–1911, we argue that different models of schooling provision adopted by the different pre-unification polities influenced primary-education organizations across macro-regions up to WWI. As a result, school access and the capability to generate literacy given current rates of enrollment differed substantially, with the Northern regions aiming to increase schooling for all, while the Center and the South implemented a more elitist model.

“[...] the improvement and advances made so far concerning [public] schools, more than moral, are material; they satisfy the eye of the inexperienced visitor more than they provide effectively for the intellectual development of the pupils. [...]”

From a Letter of the Ministry of Public Education (Emilio Broglio) to the Prefect and President of the Provincial School Board of Abruzzo Ulteriore II (Aquila). Florence, 18 February 1868, as reported in the *Documenti sulla Istruzione elementare nel Regno d'Italia (Ministero della Pubblica Istruzione 1872)*, first part, p. 33 (our translation).

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We are grateful to the editors of the *Journal*, Dan Bogart and Bishnupriya Gupta, as well as three anonymous referees, for their invaluable comments and suggestions. We wish to thank the participants of the Economic History Society Annual Conference (London, 2017), the XXVI Meeting of the Economics of Education Association (Murcia, 2017), the Italian Economic Association Conference (Cosenza, 2017), the Italian Association for the History of Political Economy Conference (Siena, 2019), and the Conference of *Associazione Italiana di Scienze Regionali* (L'Aquila, 2019). We extend our thanks to Carlo Ciccarelli and Renato Giannetti for providing precious feedback on the first draft of this paper and to Roberto Basile and Carlo Ciccarelli for sharing their data with us. All errors and omissions remain ours. This paper has benefited from financial support by the Swedish Research Council, project 2016-05230, and by PRIN 2017, Prot. 2017YLBYZE, “Lost highway: skills, technology and trade in Italian economic growth, 1815–2018,” and UNIMORE FAR Grant 2014.

Human capital has been a crucial determinant of economic performance, at least since the mid-nineteenth century (Allen 2011; Galor 2011; Goldin 2016).¹ The long-term growth of human skills has gone hand in hand with the rise of public schooling and mass education since the 1850s; yet, whether human capital improved throughout the nineteenth century as a result of milestone school acts fostering public education (Gomes and Machado 2020; Milner 2020; Montalbo 2021) or as a result of favorable economic and demographic trends (Cvrcek 2020) is still contended. Similarly, whether national school acts in the nineteenth century brought about more equity in access to education or simply reinforced existing social and spatial inequality in literacy and schooling continues to be a debated issue (Beltrán Tapia and Martínez-Galarraga 2018; Cappelli and Vasta 2020, 2021). The last decade has witnessed a growing stream of literature on the determinants of educational levels in the past. Contributions have focused on institutions (Palma and Reis 2021), religion (Squicciarini 2020), economic activity (Diebolt, Chapelain, and Menard 2019; Montalbo 2020), demography (Becker, Cinnirella, and Woessmann 2010), and the political economy of schooling (Cinnirella and Hornung 2016; Cvrcek and Zajicek 2019).

This line of research has gained momentum within the recent historiography on the economic development of Italy and its regional divide in the Liberal Age (1861–1911). A’Hearn and Vecchi (2017a) have argued that landownership concentration hampered investments in primary schooling across the regions of Italy, while Felice and Vasta (2015) have highlighted that slow human capital accumulation was mainly due to the country’s decentralized education system, which limited expenditure for schooling in the poorest regions. Altogether, there has been a substantial effort to reconstruct new data on the evolution of mass schooling and literacy (Cappelli 2016) and educational gender inequality (Bertocchi and Bozzano 2016) in the Liberal Age.²

With the exception of historical educational statistics for specific areas and periods reconstructed by historians of education, comprehensive quantitative evidence on the evolution of schooling and human capital in Italy in the first half of the nineteenth century—the decade that preceded the unification of the country—is more limited.³ One exception is the

¹ It is worth noticing that Allen (2011) considers the implementation of a “mass education” system as one of the four pillars of his “standard model” of industrialization adopted by Western countries since the mid-nineteenth century.

² Zamagni (1973) was one of the first economic historians to investigate educational indicators for Italy’s regions in the Liberal Age.

³ See Bianchi (2019) for an overview.

work by Ciccarelli and Weisdorf (2019), who estimate adult literacy from 1821 to 1911, showing that the human capital of men was relatively high in the North of Italy by the time of the country's unification, probably pushed by skill premia, early public-education reforms, and the role played by military schools. Average male adult literacy stood at about 60 percent in the North-West, c. 40 percent in the Center and North-East, and as low as c. 25 percent in the South—while female literacy was much lower everywhere. Importantly, males kept on achieving literacy into their 30s, while women seemed to have achieved literacy before their 20s (Ciccarelli and Weisdorf 2019, p. 12).⁴

The article by Ciccarelli and Weisdorf constitutes an important first attempt to explore the role played by pre-unification conditions in the development of Italy's regions in the Liberal Age. This is an under-researched issue in quantitative Italian economic history. Although this is acknowledged as a crucial aspect, the legacy of pre-unification states on Italian economic development has been explored by a few pioneering contributions concerning state capacity (Dincecco, Federico, and Vindigni 2011), trade (Federico and Tena-Junguito 2014), and innovation (Nuvolari and Vasta 2019). Within this literature, a new contribution by Postigliola and Rota (2021) focuses on human capital, arguing that Napoleonic educational reforms between 1801 and 1815 represented an important positive shock for Italy's pre-unification school systems. According to their estimates, longer political control by the French is associated with higher literacy at the time of unification. To explain this result, Postigliola and Rota argue that education reforms played a role, but other institutional changes brought about important modifications to individual and "collective preferences" concerning education. As the authors write, several reforms introduced stronger incentives for households to acquire education. On the demand side, the dismantling of feudalism and increased access to land implied new incentives to be literate. Similarly, the reforms went hand in hand with growing bureaucracy and, thus, employment opportunities that required literacy. All of this, combined with specific educational reforms that increased school inputs, determined a new equilibrium in the market for education in the Northern regions of Italy.

⁴ The regions of Piedmont, Liguria, and Lombardy were part of what is commonly known as the North-West. The North-East included Venetia and Emilia-Romagna at the time. The Center included Tuscany, Marches, Umbria, and Latium. The South contained Abruzzo, Campania, Apulia, Basilicata, and Calabria. Finally, the Islands were Sardinia and Sicily.

Despite these recent contributions, some important gaps remain. Although their dataset is highly innovative and relevant, Ciccarelli and Weisdorf do not explicitly investigate the relationship among the provision of mass education, contextual factors, and literacy. This is particularly important for women, since they acquired literacy mostly before their 20s, and female literacy followed very different trends across areas of Italy following the unification of the country (Ciccarelli and Weisdorf 2019, pp. 24–25). At the same time, Postigliola and Rota have studied human capital accumulation by focusing on literacy but not inputs into schooling, as their work explores a counterfactual Italy at the time of unification based on the influence of French institutions. According to their estimates, literacy rates in the South would have been up to 70 percent higher in 1861 if they had experienced the same duration of French dominance as the North. However, the authors only speculate as to how the French legacy affected educational developments during the decades following the unification of the country.

In this paper, we contribute to this line of research by focusing on Italy in the long nineteenth century, exploring how pre-unification conditions (c. 1831) affected primary education and literacy in the 50 years that followed the birth of the Kingdom of Italy (1861–1911). To this aim, we build a new comprehensive panel dataset of primary-school and literacy variables for Italy's 69 provinces (1861–1911), including several controls concerning demographic, economic, political, and other aspects. First, we rely on Education Production Functions (EPFs) to analyze what factors contributed to increasing Gross Enrollment Rates (henceforth GER) in primary education and improving school efficacy in transforming enrollments into basic human capital—by measuring the enrollment-literacy gap (GER-LIT Gap) for the same cohort of pupils. Second, we test whether (and if so, why) educational performance across unified Italy is linked to literacy in pre-unification states (pre-1861).

Our results show the existence of two quite different models of public-school investments and organization of educational institutions in the framework of growing school expenditure during Italy's Liberal Age:⁵ the average number of pupils per teacher was larger in the North of the country compared to the South, while the average expenditure per pupil was lower in the former. We interpret this as evidence that, under decentralized primary schooling, provinces in the North-West and North-East aimed at expanding education for all, while local authorities in the South

⁵ Total expenditure for education grew from c. 326,704 (10.37 per school-age child) lire at 1911 prices in 1861 to c. 1,041,766 (24.05) lire in 1901. In 1911, due to substantial state intervention, expenditure reached c. 1,774,000 (38.5) lire.

and the Center followed a more elitist educational model (Galor, Moav, and Vollrath 2009).

According to our panel estimates, increasing class size by one standard deviation (9.3 pupils per teacher) is associated with an increase in the GER equal, on average, to 13.9 percentage points. When school efficacy is concerned, we find that reducing class size by one standard deviation was associated with a reduction in the GER-LIT Gap equal to 6.6 percentage points. Once enrollments are factored in, improving expenditure per pupil would also reduce the GER-LIT Gap: an increase equal to a standard deviation (13.65 lire per pupil) would reduce the gap by 2.3 percentage points. These coefficients are large, given that the standard deviations of the GER and the GER-LIT Gap are, respectively, 37.7 and 17.7 percentage points—thus, school inputs explain a substantial share of the variation in enrollment rates and school efficacy, even when controlling for a wide range of contextual variables.

Furthermore, our results show that pre-unification conditions cast a long shadow on the enrollment rates and school efficacy across the regions of the new Kingdom of Italy. The provinces that were literate in the early nineteenth century were the ones that improved education for all ahead of other areas following unification: increasing 1831 literacy by one standard deviation (11.46 percentage points) was associated with an additional 10.9 percentage points in the GER in 1871. This effect remained strong until 1901, while it faded out in the first decade of the twentieth century, possibly due to growing state intervention offsetting regional inequality. The growth of the GER initially compromised school efficacy, with the latter improving substantially starting in the 1890s.

The paper is organized as follows. In the second section, we briefly describe the evolution of primary education, while the third section presents detailed information about data and sources, and the fourth section illustrates our empirical strategy. The following two sections present our main results: the fifth section deals with the determinants of human capital accumulation and discusses its efficacy, while the sixth section explores the long shadow of pre-unitary institutions on the school system of the Kingdom of Italy. The seventh section concludes.

PRE-UNIFICATION SCHOOLING AND ITALY'S PRIMARY- EDUCATION SYSTEM (1861–1911)

At the time Italy was unified in 1861, none of the pre-unification polities had yet fully embarked on sustained industrialization and economic growth: a substantial share of its labor force was employed in agriculture,

very limited railway and road infrastructure had been built, and extensive poverty and land inequality characterized large areas (Fenoaltea 2011; Toniolo 2013; Felice 2015). Despite its limited economic development, the country was already characterized by regional economic inequality. Available estimates of per-capita GDP show little regional disparities in 1871 (Felice 2013), yet a large divide was already evident in many dimensions, such as natural endowment (A'Hearn and Venables 2013), market potential and literacy (Basile and Ciccarelli 2018), infrastructures (Ciccarelli and Groote 2017), inventive activity (Nuvolari and Vasta 2017), and real wages (Federico, Nuvolari, and Vasta 2019).

Likewise, the pace and timing of educational development largely varied across territories, for example, concerning literacy rates (A'Hearn and Vecchi 2017a) and the gender gap in primary schooling (Bertocchi and Bozzano 2016), by and large favoring the North over the South.

Figure 1 shows enrollment rates and adult literacy rates during pre-unification years (the left-hand-side figure shows the names of pre-unification states).⁶ Large regional inequality was evident at the beginning of the nineteenth century and, as we will see, remained a central feature of Italy's literacy and schooling. While the former Kingdoms of Sardinia and of Lombardy-Venetia—with Lombardy ahead—exhibited enrollment and literacy rates not distant from those characterizing central-European countries (e.g., Prussia), the Center and the South lagged behind.

Indeed, Italy's different pre-unification states pursued varying public-education policies. Most reforms initiated in the eighteenth century marginally addressed primary education, focusing on universities and secondary schooling instead. However, by Italy's unification in 1861, the Kingdom of Sardinia had already established a primary school system heavily based on centralized norms and public funding by the municipalities (Ricuperati 2015). Since the mid-eighteenth century, the Kingdom of the Two Sicilies had also sought to reform education in the context of the Enlightenment (Felice 2013). In the second half of the century, a new tax was imposed on monasteries' income to fund public schools; further attempts at reforming the school system were carried out in the early nineteenth century, but the chronic unavailability of primary-school teachers forced the authorities to keep relying on religious orders. In 1810, primary education was made compulsory, yet school fees kept being charged. Albeit slowly, primary education grew to some extent

⁶ Literacy rates from Ciccarelli and Weisdorf (CW) (2019) refer to 1831. The authors provide 1821 estimates, but they are based on a much smaller sample compared to 1831 and later years. Enrollment rates for the pre-unification years refer to the period between 1821 and 1850, depending on the area concerned.

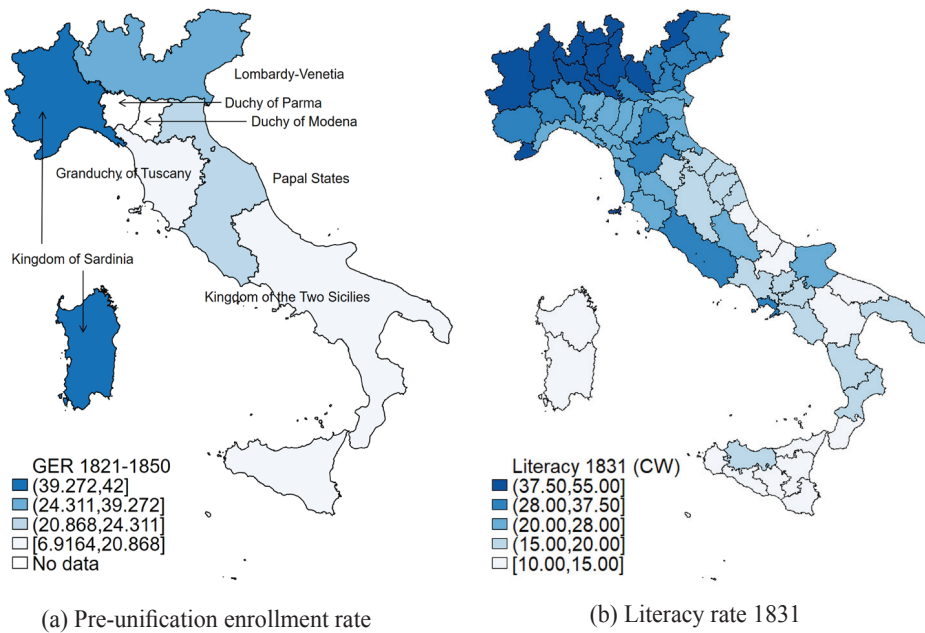


FIGURE 1
LITERACY AND ENROLLMENT RATES IN PRE-UNIFICATION STATES

Notes: Literacy rates in 1831 refer to adult population aged 30–40.
Sources: Data on enrollment rates are taken from Vigo (1971). Literacy rates in 1831 are taken from Ciccarelli and Weisdorf (CW) (2019).

between 1760 and 1815; yet, with the restoration of the absolutist regime of the Bourbons, and the threats to their rule coming from liberal ideas that might have been spread by mass education, primary schooling was permanently relegated to the control of the clergy and private initiatives (Genovesi 1998). In the rest of the peninsula, the Duchies of Modena and Parma, the Granduchy of Tuscany, and the Papal States had begun a process of reform to introduce public primary schooling to varying degrees (Ricuperati 2015).

Concerning schooling—and literacy—the Kingdom of Lombardy-Venetia was split: even though the two regions of Lombardy and Venetia were part of the same kingdom from 1815 to 1859, Lombardy had forged ahead of the rest of Italy and caught up with Piedmont, constituting a high-literacy cluster in North-Western Italy. First, this happened as a result of enlightened school reforms introduced in the Duchy of Milan under Austrian rule (1714–1797). Even though primary schools were initially organized and managed through private initiatives charging tuition fees, the latter were abolished with the introduction of cost-free public education in 1791 (Genovesi 1998). Secondly, Lombardy’s initial educational

development was reinforced by the Napoleonic occupation of the Duchy of Milan and a few provinces further East, which was called the Cisalpine Republic (1797–1815). Male and female public schools were opened in every district of the Republic (Genovesi 1998, p. 29). Such trends were not reversed by the restoration of Austrian rule and the foundation of the Kingdom of Lombardy-Venetia in 1815: primary education was compulsory for children aged between 6 and 12 years, even though each municipal school was under the supervision of the local priest. Despite this development, the region of Venetia had long relied on religious education, and, following its annexation to the Kingdom of Italy in 1866, the problem of agrarian elites hampering investments in public schools slowed the development of mass education into the Liberal Age—at least initially.

The effort to harmonize Italy's education system took place since the very beginning of the unification process (which started during the 1860s and was completed by 1871), when the Kingdom of Italy implemented its first national school act.⁷ Figure 2 displays youngsters' literacy rates in 1871 and 1911, obtained from population censuses.⁸ The regional pattern of literacy rates strongly echoes the spatial distribution of early schooling and human capital in the pre-unification states shown in Figure 1.

A clear picture of the state of the education system in recently unified Italy was depicted by Gerolamo Buonazia in 1868:

*“The conditions of popular education in the different provinces of the Kingdom are characterized by different ways and outcomes of teaching, as well as school traditions conforming to the degree of culture and industriousness of each [pre-unification] country; [...] new methods live side by side with old ones, like secular and religious institutes. There are many ancient and recent reasons explaining this battling of disordered forces, and the waiting for an ordering power that can alleviate the discordant claims, bringing harmony and making them cooperate in for the same purpose.”*⁹

The first comprehensive set of norms was contained in the Casati Law, passed by the Kingdom of Sardinia in 1859 and later extended to the newly annexed areas of the unified country. As far as primary education

⁷ The provinces of Mantua and those belonging to today's Veneto were annexed in 1867, whereas the province of Rome (and Comarca) was annexed in 1871.

⁸ Adult literacy rates (15+) are slightly different in levels, but show the same variation across provinces.

⁹ Quotation translated by the authors (*Ministero della Pubblica Istruzione* 1872). Many state inquiries into the conditions of primary schooling were conducted during the Liberal Age, since national education was a priority of Italy's governments. Gerolamo Buonazia was the spokesman of the inquiry on the condition of Italy's primary-school system commissioned at the end of the 1860s.

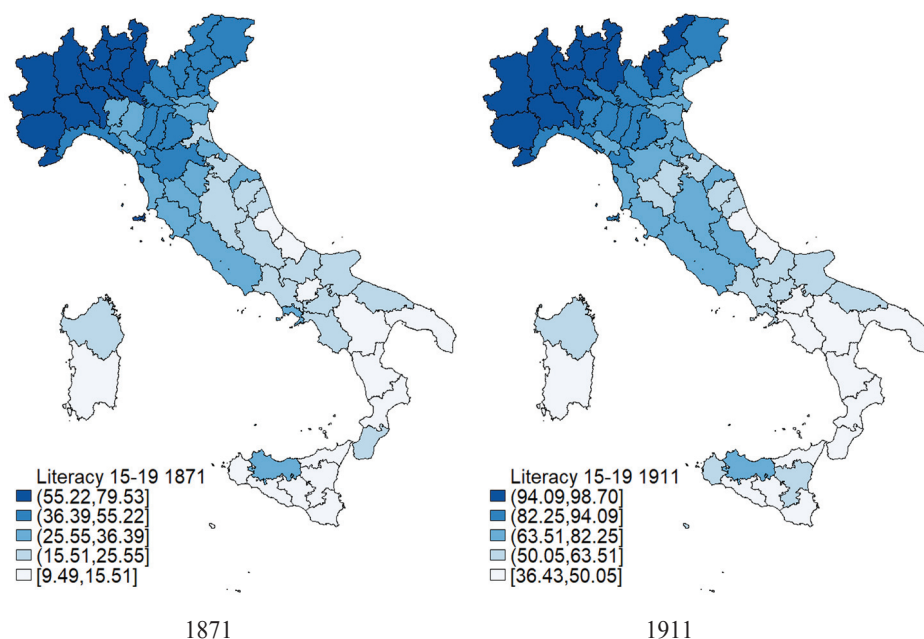


FIGURE 2
LITERACY RATES (AGE 15–19) IN 1871 AND 1911

Notes: Literacy rates (age 15–19) in 1871 and 1911 refer to population aged 15–19.
Source: Census data.

was concerned, the central government set all the formal norms regulating the primary schools. The law stated that primary education had to be provided free of charge for at least two years. Additional two years were compulsory in larger municipalities and where a secondary school had already been established.

Despite a bulk of centralized formal provisions, the funding and management of schooling were fully decentralized: hiring teachers, paying them, building and running schools, and enforcing attendance were responsibilities born by the municipalities.¹⁰ No redistributive mechanism was set up to correct the large regional inequality concerning fiscal capacity and educational investments. This issue was addressed through the Coppino Reform (1877), which introduced (weak) sanctions for missing enrollment and brought compulsory education to three years (up from two), introducing very limited subsidies, which had to be demanded by each municipality.

¹⁰ Decentralized education can be defined as the devolution of school management to lower levels of public administration. Centralization, instead, is the inverse process, that is, a concentration of power in the hands of the central government (Bray 1991). According to this definition, Italy's education system from 1859 to 1911 was very decentralized concerning funding and management, although the norms and curricula were set forth by the central administration.

This set of norms had little effect on human capital accumulation. Due to this, state intervention became more substantial at the turn of the twentieth century, when the Nasi (1903) and Orlando (1904) Laws improved the salaries of primary-school teachers and strengthened their legal position vis-à-vis the city councils, which up to that point could discretionarily lay them off. The actual step toward centralization was taken in 1911, through the Daneo-Credaro Reform: with it, the state fully funded current expenditure on primary education, supported investments for school buildings, and managed directly the organization of primary schooling through provincial school boards. Recent research shows that this reform brought about a positive increase in the pace of human capital accumulation, as measured by municipal-level literacy rates (Cappelli and Vasta 2020).

DATA AND SOURCES

To study how school inputs contributed to literacy in Liberal Italy, and how this relationship was linked to pre-unification conditions, we must first measure inputs into schooling and educational outcomes. Although collecting provincial data for the period that we study is normally very challenging, Italy's historical statistics provide detailed figures on schooling and literacy, as well as other contextual variables. We built a new panel dataset on literacy rates and school inputs at the provincial level (roughly today's NUTS-3) and at ten-year intervals between 1861 and 1911 (mostly corresponding to census years). A detailed description of each variable in our dataset, as well as the related sources consulted to elaborate on it, is included in the Online Data Appendix (Table DA1). We briefly discuss the dataset next. We start with the main education and schooling indices, then describe the geographic, demographic, and socio-economic controls, concluding with the presentation of the early-nineteenth-century variables that we use to explore the legacy of pre-unification states on human capital accumulation in Liberal Italy.

Education and Schooling Variables

We rely on the literacy rate of youngsters (aged 15 to 19)¹¹ and enrollment figures in primary schooling (aged 6 to 10) to obtain our outcome variables. The first dependent variable is GER, defined as the number

¹¹ We focus on literacy for two main reasons. First, it has been extensively used as an index of human capital (Nuvolari and Vasta 2017; Basile and Ciccarelli 2018; Federico, Nuvolari, and Vasta 2019). Secondly, upper-tail human capital indices for Italy's provinces during the Liberal Age are still unavailable. However, one may note that literacy rates (15–19) across provinces correlate strongly with a comprehensive human-capital index calculated by Ciccarelli and Fachin (2017).

of pupils enrolled in primary schooling (regardless of age) as a share of the population of primary-school age. Although the GER is mostly considered an input into schooling within educational studies, we remain agnostic on this aspect and carry out a two-step analysis. First, we investigate what factors were associated with higher GERs across Italy's provinces to assess what factors were associated with the (quantitative) expansion of mass schooling. It is important to note that GER figures are not likely to be biased over time. The cross-province distribution of enrollment rates that we calculate is very consistent over the period that we study (1861–1911).

The second dependent variable is defined as “school efficacy” and is the percentage-point gap between enrollment and literacy rates for the same cohort. Literacy rates are calculated based on the population censuses, separately for boys and girls.¹² To obtain “school efficacy” in every benchmark year, we subtract the literacy rate 15–19 from the first lag of the GER. For example, for 1881, we subtract the literacy rate of those aged 15–19 from the GER of those aged 6–10 in 1871, thus referring to the same cohort and measuring the success rate in producing literacy given previous enrollments.

Among school inputs, we first compute the average class size, that is, the number of pupils enrolled divided by the number of available teachers.¹³ It is worth noting that our index of class size may include pupils outside the formal school-age-requirement brackets, like those older than ten years. Nowadays, a small class size captures high-quality education, and large class sizes are not desirable; yet, in the past, large classes were necessary to rapidly expand education in an attempt to improve literacy rates.¹⁴

We also calculate the density of primary schools as well as the density of Evening and Sunday schools (as the number of schools per square km

¹² Since the unification of Italy in 1861, censuses have specifically inquired about the literacy of the population. More specifically, the question about literacy was asked of the head of the family, who answered for all household members. Considering that the 1891 Census was not conducted due to budgetary reasons, literacy rates (and all census variables) for 1891 are interpolated based on 1881 and 1901 values.

¹³ Today, the OECD differentiates between average class size and the pupil-teacher ratio, the former being the number of pupils enrolled per classroom and the latter being the number of enrolled pupils per teacher (OECD 2021, p. 323). We refer to the pupil-teacher ratio as average class size, given that, in our sources, the number of teachers is virtually equal to the number of schools / classrooms (see, e.g., *Ministero della Pubblica Istruzione* 1872).

¹⁴ As early as the 1830s, Sacchi (1834) discussed the index of class size, referring to primary schooling conditions in the provinces of Lombardy. The coeval observer explicitly argued that the average ratio between pupils and school teachers was not to be understood as a measure of school quality. Instead, it should have been interpreted as a measure of teachers' industriousness, implicitly suggesting the existence of economies of scale. Sacchi notes that class size was typically larger in urban contexts and large cities, whereas it was smaller in more remote places.

in each province), since they were complementary institutes that might have mattered for the development of youngsters' literacy.¹⁵

State inquiries into primary (public and private) and mass education (*Ministero della Pubblica Istruzione* 1865; 1872; 1910; *Ministero di Agricoltura, Industria e Commercio* 1881) provide information on the number of pupils enrolled in primary schools, the number of teachers, the number of primary schools, and the number of Evening and Sunday schools for youngsters and adults (see Table DA1 for further details).¹⁶ Apart from Evening and Sunday schools, we collected information separately for females and males.¹⁷ Including private institutes is important: their share of total primary-school enrollments was quite large in 1861, albeit declining—from c. 15 to about 5 percent at the beginning of the twentieth century. Importantly, the relevance of private schooling as opposed to public education varied substantially across regions (Lupo 2006; Vigo 2017).

Finally, we add expenditure per pupil as an input into primary schooling. This index is calculated by dividing total municipal expenditure by the number of pupils enrolled in (public) primary schooling, and it is reported in constant 1911 lire. Data on primary-school expenditures are available only for public primary schooling. We collected the figures from the municipalities' budgets (*Bilanci comunali*), published by the Ministry of Agriculture, Industry and Trade (*Ministero di Agricoltura, Industria e Commercio* various years), and converted them into 1911 prices by relying on *Serie storiche* (Istat).¹⁸ In principle, once we include all relevant school inputs, no relationship between expenditure per pupil and the capability to produce literacy (given enrollments) should be found. However, expenditure was not only destined for teachers' salaries and school buildings; in 1895, according to the municipalities' budgets, c. 30 percent of total (including current and capital) expenditure

¹⁵ We do not include military schools in our analysis: first, data on military schools are not available at the provincial level and for the whole period; second, and more importantly, although this type of school has been deemed to be important for the literacy of adults (Mastrangelo 2017), it targets (male) conscripts aged 20, while our analysis hinges on the impact of school inputs on the literacy of males and females aged 15 to 19. What is more, although the impact of such schools on discharged male conscripts was large during the 1860s, it declined substantially by the end of the 1880s, probably implying a negligible effect on the whole population (Coccia and Della Torre 2007, p. 37).

¹⁶ In the statistics that we use, a school is defined as a classroom where a group—or different groups—of children are taught by one or more teachers. The sources indicate that the definition did not change in the period 1861–1911 (*Istituto Centrale di Statistica* 1931). The statistics on education only reported data based on a different definition of school for the years 1883/4–1886/7; we did not obtain any information from these.

¹⁷ When primary schools are concerned, they are divided into male schools, female schools, and mixed ones (where both sexes could enroll).

¹⁸ <https://seriestoriche.istat.it/>.

concerned didactic materials, heating, cleaning, and maintenance, that is, the quality of schooling (as argued for today's OECD countries by Barrett et al. 2019). Given the poor state of Italy's primary schools, these features might have had an important residual positive effect on the efficacy of the school system in achieving high literacy, beyond other major school inputs, as witnessed by primary-education inspectors across the country.

Geographic, Demographic, and Socio-Economic Variables

We complement our data by including a broad set of control variables, organized into three groups: geography, demography, and socio-economic aspects. Geography controls include latitude, longitude, average temperature, and average rainfall.

Demographic variables include population density (residents per square km) and a proxy for the dependency ratio (the sum of children aged 0 to 10 and people older than 65 as a share of total residents) to capture potential differences in the age structure of the population. We rely on census figures to obtain these variables. We also collect and compute infant mortality rates to capture hygienic conditions and health within each province, which might have affected both access to schooling and cognitive abilities once in school, thus influencing literacy rates. Infant mortality rates are calculated from vital statistics and are defined as deaths in the age group 0–5 divided by live births.¹⁹

An important aspect linked to schooling and literacy is the rate of outward migration—calculated as emigrants as a share of total residents—since it may have brought about brain drain (or gain) (Spitzer and Zimran 2018). Indeed, c. 30 percent of emigrants were aged between 15 and 20, according to Gomellini and Ó Gráda (2013). Figures on emigrants are obtained from the Yearbook of Italian Migration, *Annuario della emigrazione italiana dal 1876 al 1925* (Commissariato Generale dell'Emigrazione 1926) and from Carpi (1874) for the years 1869–1873. The sources concerning Italy's outward migration might be biased to some extent, since they report passages recorded through passports. Naturally, this may underestimate actual migration abroad, thus not

¹⁹ Deaths in 1901 and 1911 are interpolated due to the availability of regional data only (no provincial figures are available). For live births, each annual figure is centered around the census year but is an average of the annual values of the previous 10 years (e.g., 1863–1870 for 1871). Fewer values are used when the data is not available. For deaths, the moving average includes three years around the census year. Data on population and vital statistics are collected from censuses and *Statistica del Regno d'Italia. Popolazione. Movimento dello Stato Civile* (Ministero di Agricoltura, Industria e Commercio various years).

accounting for the actual impact of migration on the formation of literacy. Due to this potential bias, as well as the fact that internal migration flows are unknown, we add a further index that should capture the impact of both types of migration in each province: for each year, we compare the number of youngsters (aged 15–19) in year t with the number of children (aged 5–9) ten years before (same cohort). Had there been no migration at all, one should observe an index roughly equal to one. If more people emigrated than those who had arrived, the ratio would be smaller than one—and larger than one if a net positive influx of migrants had taken place. The ratio can be easily computed through population censuses. Since the 1911 census was conducted in the summer, a further advantage of including this migration index is the fact that we can control for potential bias in the 1911 literacy rate if, for example, some people selected temporary (seasonal) summer migration in a way that is consistently linked to their human capital, thus potentially affecting the actual value of the ratio between young literates and the population group aged 15 to 19.

Socio-economic variables include the urbanization rate, defined as the share of the provincial population living in cities with more than 30,000 inhabitants (Nuvolari and Vasta 2017); the height of conscripts (males aged 20) organized by birth cohorts, obtained from A'Hearn and Vecchi (2017b) as a proxy for economic well-being—which should correlate positively with literacy rates;²⁰ industrial Value Added per capita, obtained through the ratio between industrial value added figures (Ciccarelli and Fenoaltea 2013) and population data from the censuses (the presence of industries might prompt a more rapid rise of literacy); the share of the labor force employed in agriculture (Missiaia 2014) to proxy for the opportunity cost of educating children;²¹ electoral franchise, represented by the share of adult males (21+) entitled to vote in local (e.g., municipal) elections, since the democratization of local decision-making might have led to more education via pressure on municipal councils, which were

²⁰ Adult height is commonly employed in economic history as a proxy for wealth and living standards around the time of birth, because it provides important information on the stock of nutritional investment and hygienic as well as health conditions. If conscripts aged 20 from a specific province were measured, say, in 1881, their (average) height relative to that observed in other places can be interpreted as the result of prevailing conditions in that province (compared to others) in 1861. See Baten and Blum (2014).

²¹ Missiaia (2014) provides the first attempt at harmonizing this index over different censuses, yet the panel obtained still reflects limited adjustment with respect to the sources. The growth in the agricultural share from 1881 to 1901 is particularly cumbersome. To check if potential measurement bias can affect our results, we drop the 1901 value—associated with a peak in the agricultural share within our period—and use instead a value interpolated between 1881 and 1911. The results remain virtually the same.

in charge of funding and managing primary schooling (Cappelli 2016; A'Hearn and Vecchi 2017a). We also perform other robustness checks by including more controls.

Early Nineteenth-Century Variables

We exploit data on early-nineteenth-century literacy rates (1831), as estimated by Ciccarelli and Weisdorf (2019). Data are based on the back-casting methodology, a procedure in which literacy rates recorded in 1881 and 1911 are projected backward to estimate literacy rates before unification.²² We also discuss the pre-unification class size and educational expenditure (Vigo 1971; Genovesi 1998).

Descriptive Statistics

Our final dataset covers 69 Italian provinces (at 1871 boundaries) for five benchmark years (1871, 1881, 1891, 1901, and 1911), spanning the initial 50 years of the unified Kingdom of Italy. These figures are uncommonly rich for a nineteenth-century country and give us the opportunity to gain new insights into the performance of the Italian education system before more pervasive and coherent education policies were introduced starting in the first decade of the twentieth century. Selected descriptive statistics are reported in Table 1 (see Tables A1-a and A1-b in the Online Appendix for the full list).

Relying on the cohort structure of our dataset, we already uncover an important piece of evidence by comparing the primary GER of the age group 6–10 with the literacy rates of the same cohort ten years later—that is, the age group 15–19. The figures show that, on average, out of 53 pupils enrolled in primary schooling in Italy in 1861, only 34 had become literate by 1871. The same figures in 1911 were 95 and 72 percent, respectively. This discrepancy is partly due to the lack of data on repeaters, as well as attendance rates being normally lower than enrollment rates. This gap grows when adding private enrollments to public ones.²³ Therefore, the correlation between class size and the GER-LIT Gap should be studied with some caution. The GER can be larger than 100 percent due to a high incidence of non-school-age pupils (less than six and more than ten years old). Instead, the literacy rate concerns the same cohort ten years later

²² The authors decided to focus on the literacy rates of the age group 30–40 because, as they explain, male literacy was only fully acquired when older than 30 years.

²³ The GER in private institutes declined from c. 7 percent in 1871 to less than 5 percent in 1911.

TABLE 1
SUMMARY STATISTICS

Variable	1871			1881			1891			1901			1911								
	N	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.				
1871–1911																					
GER-literacy gap	69	18.9	21.4	-10.6	88.4	22.6	18.6	-22.0	98.9	36.2	15.4	8.1	83.1	31.2	13.0	7.0	83.7	22.7	12.4	3.8	65.2
Literacy rate 15–19	69	34.4	19.4	9.5	79.5	42.8	22.2	13.8	88.9	51.5	22.5	19.8	92.6	60.2	23.1	25.6	96.3	72.1	20.0	36.4	98.7
Density of Evening and Sunday schools	69	65.5	57.8	10.7	293.5	73.9	66.1	13.4	391.2	28.8	27.4	2.0	151.1	22.3	24.4	1.4	103.2	49.0	53.0	2.0	258.5
Outward migration rate	69	5.2	9.7	0.1	64.7	4.4	7.7	0.0	43.5	8.2	12.2	0.0	69.2	14.1	14.4	1.5	96.3	17.9	10.7	3.6	68.0
Migration proxy (pop. ratio)	69	88.2	5.0	72.8	102.0	89.9	4.9	75.3	108.1	88.0	4.5	77.0	103.2	86.1	4.7	77.4	102.4	89.1	8.7	57.6	109.7
Lag 1 (1861–1901)																					
GER (total) (L.1)	69	53.3	37.5	8.1	160.7	65.4	36.6	21.4	187.8	87.7	35.5	37.6	171.8	91.5	33.2	46.2	178.2	94.8	30.7	43.2	162.7
Class size (total) (L.1)	69	32.1	7.9	16.9	48.9	36.5	8.6	23.4	61.6	39.7	8.8	22.1	65.5	40.5	7.8	27.2	63.0	42.0	7.4	29.9	62.6
Expenditure per pupil (public) (L.1)	69	28.7	16.1	6.1	95.4	29.7	15.3	8.5	96.2	22.1	7.9	9.5	46.4	25.5	8.5	8.4	49.6	27.9	7.3	14.0	49.4
Primary-school density (total) (L.1)	69	148.4	139.1	19.7	727.0	158.2	143.6	22.2	985.9	231.8	257.1	33.8	1899.6	254.5	270.9	37.9	2093.8	270.4	271.1	41.8	2042.2

Notes: All school inputs, except for the density of Evening and Sunday schools, are lagged by 10 years. This means that, for example, the GER 1871 refers to pupils aged 6–10 enrolled in 1861 who are aged 15–19 in 1871.

Source: See text.

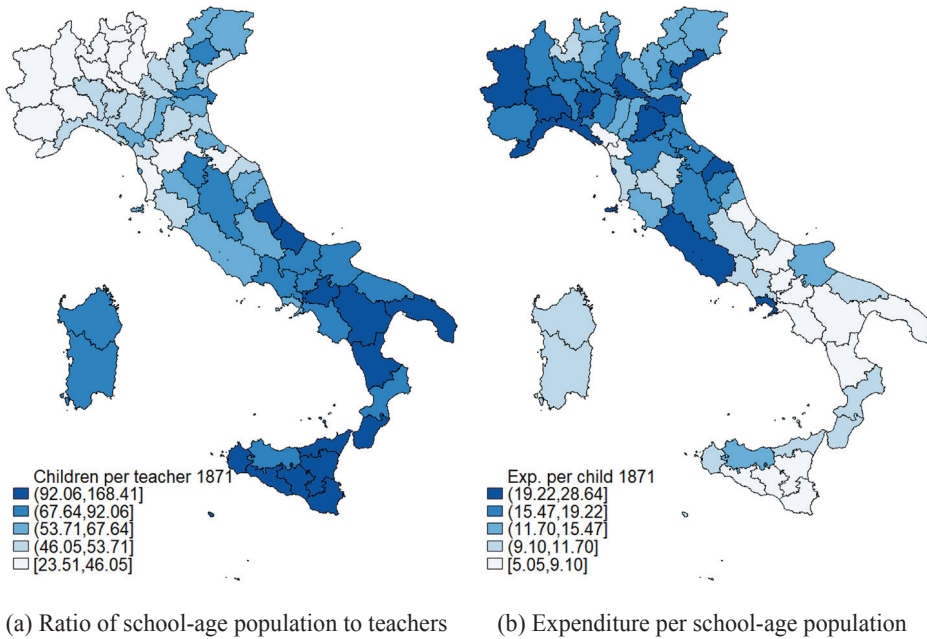


FIGURE 3
SUPPLY OF PUBLIC SCHOOLING: CHILD-TEACHER RATIO
AND EXPENDITURE PER CHILD, 1871

Notes: The child-teacher ratio is measured as the number of children (aged 6 to 10) per primary-school teacher (including private education), while expenditure per child is calculated as municipal (public) expenditure on education per child aged 6 to 10 (in 1911 lire).
Source: See text.

but is naturally capped at 100 percent. It is worth stressing that this is a limitation intrinsic to the sources, since they do not allow a calculation of the Net Enrollment Rate (excluding repeaters) for Italy's provinces in the Liberal Age.²⁴

Figure 3 shows the ratio between the entire school-age population and primary-school teachers (panel a), as well as expenditure divided again by the whole school-age population (panel b). This pattern indicates that the supply of schooling compared to the school-aged population was considerably higher in the North than in the South. For example, on average, each one of the teachers in the provinces of Piedmont covered, potentially, no more than 46 school-age children; the same ratio grew along a North-South gradient to reach peaks of 170 school-age children per teacher in Calabria and Sicily.

²⁴ In 1871, a handful of provinces displayed a negative value of the GER-LIT Gap (which declined to one, Livorno, in 1881). We briefly discuss this result in the fifth section. The GER is above 125 percent in a few provinces; they are all located in the North-West and North-East.

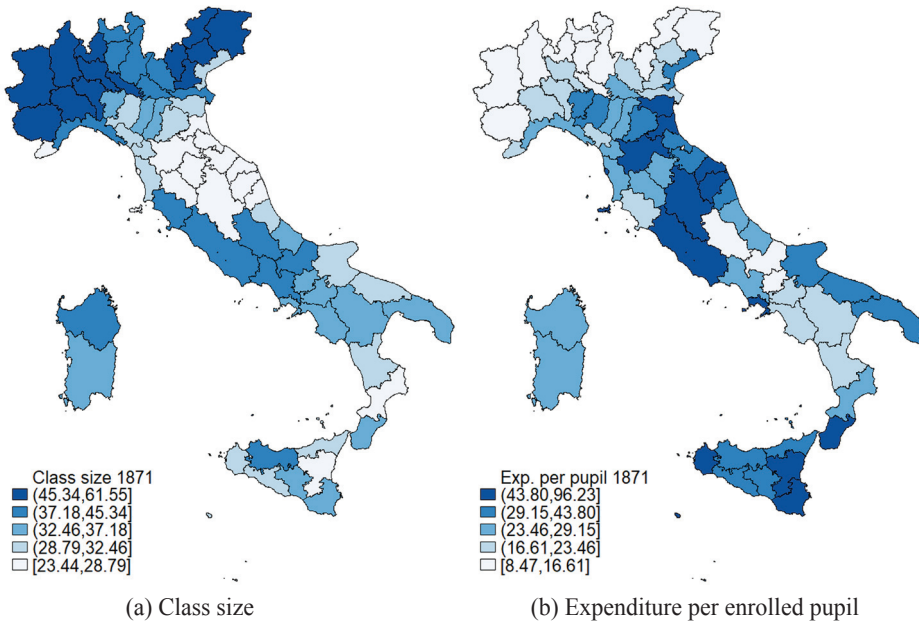


FIGURE 4
SPATIAL DISTRIBUTION OF SCHOOL INPUTS: CLASS SIZE
AND EXPENDITURE PER PUPIL, 1871

Notes: Class size is measured by the number of pupils enrolled in primary schools per teacher (including private education), while expenditure per pupil is calculated as the amount of municipal (public) expenditure on education per pupil enrolled in (public) primary schools (in 1911 lire).

Source: See text.

Yet, in Figure 4, a remarkable result emerges: the South supplied a larger number of teachers and invested more resources, compared to the number of enrolled pupils, than the North. Indeed, while the average class size (pupils per teacher) was as low as 23 in the South in 1871, the same ratio was larger than 45 in all provinces of Piedmont.

These patterns suggest the existence of at least two models of providing schooling across the country: in the Northern provinces, the authorities sought to provide mass education. Instead, in the South, fewer people had access to schooling, yet they were allocated more educational resources. This is somewhat mediated by demand-side variables—something that we consider when we set out to explore whether the two allegedly different models of providing mass education in pre-unification Italy cast a long shadow into the Liberal Age.

EMPIRICAL STRATEGY

Our empirical strategy first focuses on estimating a linear model where the dependent variable is the GER and the regressors are lagged inputs

into schooling—class size, expenditure per pupil, and primary-school density over the territory—to explore the factors associated with the expansion of enrollments, that is, mass schooling. Our models control for the geographic, demographic, and socioeconomic factors presented in the previous sections.²⁵

Secondly, we estimate a similar model to explore whether and to what extent inputs into schooling correlate with school efficacy—the capability to produce literacy given enrollment rates—while controlling for social, economic, demographic, and political factors.

We also expand our benchmark specifications concerning both enrollment rates and school efficacy by including pre-unification literacy rates estimated by Ciccarelli and Weisdorf (2019) as a proxy for educational attainment in the first half of the nineteenth century (1831). We aim at identifying whether a historical legacy stemming from pre-unification regional states might have affected the development of literacy beyond local school inputs and contextual factors.

The models that we employ draw from the literature on Education Production Functions (EPFs), which are an established methodology to explore the effectiveness of schooling in generating learning outcomes, even though most contributions rely on modern data. For example, the seminal article by Card and Krueger (1992) has underlined the positive role of school quality on economic returns to education in the United States. It is worth noting that, recently, Hanushek and Woessmann (2020) have reviewed the economic literature on international educational achievements, given the new availability of international cross-country data. They have confirmed previous findings, which suggest that policies aimed at putting more resources into schooling are unlikely to foster educational outcomes if they are not accompanied by complementary interventions.

By contrast, there is little research investigating the relationship between school inputs and educational outputs from a long-term perspective. Mitch (1984) has estimated the return to male literacy in Victorian England, while, more recently, Schüler (2016) has explored the relationship between school inputs and earnings by using original data on Prussian counties between 1886 and 1891. The present paper is therefore the first study from a historical and long-term perspective to estimate school efficacy by exploring the factors that improved the production of literacy given the existing rates of primary-school enrollment.

²⁵ All data and replication files are available in Bozzano, Cappelli, and Vasta (2022).

Following Schwartz and Zabel (2013), our province's aggregate production function is:

$$Q_{pt} = f_{pt}(SC_{pt}, X_{pt}, SE_{pt}) + \varepsilon, \quad (1)$$

which produces the output Q_{pt} by combining educational inputs (SC_{pt}), province-specific environmental characteristics (X_{pt}), and socio-economic variables (SE_{pt}), for province p and year t .

We assume a linear specification, as follows²⁶:

$$Q_{pt} = \beta_0 + \beta_1 SC_{pt} + \beta_2 X_{pt} + \beta_3 SE_{pt} + \varepsilon_{pt} \quad (2)$$

In the first version of our model, Q_{pt} is represented by the GER. All school inputs, SC_{pt} , included in the regression analysis are measured in the same year, since current conditions affect enrollment decisions immediately. In a second version, Q_{pt} represents school efficacy, which is the GER-LIT Gap (percentage points) where the GER is measured in the previous benchmark year—so that school efficacy concerns the same cohort, as it should. Clearly, since we are focusing on the literacy of the cohort that was in primary schooling ten years earlier, we measure all other school inputs as first lags.

Educational inputs (SC_{pt}) include class size, expenditure per pupil, primary school density, and the density of Evening and Sunday schools, while demographic and socio-economic variables are in SE_{pt} and X_{pt} . In our core estimates, we focus on public-school inputs, since private schooling was rather marginal in Italy during the Liberal Age.²⁷

The estimation of an EPF presents several challenges from a technical point of view, but our dataset allows us to tackle such issues. The most important ones concern omitted variable bias, as well as selection bias and potential endogeneity (Hanushek and Woessmann 2020). We address these issues as follows. First, we consider the omitted variable bias by including a rich and comprehensive vector of controls. Second, thanks to the panel structure of our data, we can employ lagged inputs into the EPF regressions to limit potential endogeneity and reverse causation—although the latter cannot be completely ruled out. Third, since we use provincial figures based on the whole population, the data that we use

²⁶ We explore the potential non-linearity of inputs by including their squared terms. However, according to the tests that we conducted on the significance of such non-linearities, we decided not to include them; their inclusion does not change our main results but makes the reading of the regression output more confusing. Estimates are available upon request.

²⁷ We dedicate a sub-section to a model that does include both public and private schooling inputs (Table 3).

should not be prone to selection and self-selection bias at the individual and school level. By the same token, bias from unobservable differences in individual ability should not be an issue in our regressions since we focus on the aggregate provincial-level measures (Schwartz and Zabel 2013).

We start estimating our two models through panel-data regressions with provinces FE as well as Pooled OLS with macro-regional FE and controlling for an extensive set of correlates. We then estimate the same models with repeated cross-sections to highlight the trends in the relationships that we study. Finally, we further expand our specifications by including pre-unification literacy rates estimated by Ciccarelli and Weisdorf (2019).²⁸ This allows us to identify whether a pre-unification legacy stemming from different models of providing mass schooling can be discerned, even when controlling for the local provision of education by Italy's municipalities in the Liberal Age and independently of contextual factors influencing the demand for schooling.

DETERMINANTS OF SCHOOLING AND SCHOOL EFFICACY

This section presents the results on the relationship between school inputs and the GER, on the one hand, and school inputs and school efficacy, on the other hand. We first discuss the panel-data analysis in Table 2. We regress the GER (Col. (1)) and the GER-LIT Gap (Col. (2)) on all school inputs and controls. Then, we include macro-regional dummies instead of provincial FE to show that most of the variation in the GER-LIT Gap that is estimated to be due to time-invariant provincial features is actually linked to features that are common within macro-regions (Col. (3)). This last model will be later used to focus on the long-term relationship between educational levels in pre-unification areas and the quantity and quality of education in the Liberal Age (1861–1911). Since early nineteenth-century variables are available as sectional data, it is crucial to employ a model with macro-regional dummies instead of provincial FE.²⁹

²⁸ In the cross-section analysis, we apply White-Huber standard errors to deal with potential heteroscedasticity, while in the panel regressions, we always rely on standard errors clustered at the provincial level.

²⁹ Since the relationship between the two dependent variables and the regressors might be influenced by the fact that literacy is capped at 100 percent and the GER is not—the latter can reach more than 160 percent given pupils enrolled beyond school age—we also ran the same regressions, excluding GERs larger than 100 percent. All results remain virtually the same, but expenditure per pupil becomes statistically significant in all benchmark years except from 1911. Similarly, excluding literacy rates above 90 percent does not change the results (see Table A2 in the Online Appendix).

TABLE 2
 PANEL-DATA REGRESSIONS

Panel	(1)	(2)	(3)
Variables	FE GER	FE GER-LIT Gap	Pooled OLS GER-LIT Gap
Class size (total)	1.493*** (0.216)	0.712*** (0.127)	0.611*** (0.114)
Expenditure per pupil (public)	-0.102 (0.115)	-0.165** (0.072)	-0.183*** (0.060)
Primary-school density (total)	0.067*** (0.025)	0.052*** (0.013)	0.055*** (0.020)
Density of Evening and Sunday schools	0.005 (0.015)	0.010 (0.017)	0.025 (0.015)
North-East			-8.922*** (2.452)
Center			-12.232*** (2.836)
South			-16.246*** (3.901)
Islands			-16.571*** (6.096)
Control variables	Yes	Yes	Yes
Province FE (69)	Yes	Yes	No
Year dummies	Yes	Yes	Yes
Macro-region FE (4)	No	No	Yes
Observations	345	345	345
Adjusted R-squared	0.827	0.635	0.787

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: The benchmark macro-region in Column (3) is the North-West. GER-LIT Gap stands for school efficacy. The controls include population density, the urbanization rate, the dependency ratio, infant mortality rate, height, the share of labor force employed in agriculture, industrial VA per capita, the outward migration rate, electoral franchise (the share of people allowed to vote in local elections), and the migration proxy based on population ratios.

Source: See text.

First, we find that a large average class size (enrolled pupils per teacher) was associated with high enrollment rates (Col. (1)). Increasing the class size by 9.3 units (roughly a standard deviation) was associated with an increase in the GER equal to 13.9 percentage points; therefore, substantial economies of scale were pursued in the attempt to expand basic schooling. Similarly, the density of schools over the territory was an important aspect correlated with the expansion of enrollments: increasing the number of primary schools per 1,000 square kms by 239 units (a standard deviation) was associated with an increase in the GER equal to 16 percentage points. However, the coefficient of the density

of Evening and Sunday schools is not statistically different from zero. Likewise, expenditure per pupil was not correlated with enrollment rates. Among the controls, electoral franchise was positively correlated with the expansion of primary-school enrollment rates; population density and the dependency ratio are characterized by a negative coefficient, and those of the other variables are not statistically significant.

Focusing on school efficacy (the GER-LIT Gap), one notices that a reduction in class size equal to a standard deviation (9.3 pupils per teacher) is associated with a reduction in the gap between enrollment rates and literacy equal to 6.6 percentage points (Col. (2)). Once pupils were enrolled, reducing the class size was necessary to improve literacy. The density of primary schools is associated with a larger divide between enrollment and literacy rates; an increase of one standard deviation in the density of schools would increase the GER-LIT Gap by 12.4 percentage points. This suggests that a growing network of schools over the territory was important for a larger number of boys and girls to enroll in primary education, yet the growing quantity of schooling might have compromised its quality—a known issue among policymakers aiming at universal primary education in low-development countries in the last 30 years (Glewwe 2013). Evening and Sunday schools, similarly, were not linked to educational performance given enrollment rates. When school efficacy is considered, rising expenditure per pupil is associated with a reduction in the GER-LIT Gap: an increase in this index by 13.65 lire (1911 prices, i.e., one standard deviation) implies a decline in the gap between enrollment and literacy rates equal to 2.3 percentage points. Among the controls, population density is associated with a reduction of the GER-LIT Gap in every benchmark year, whereas all other controls—except temperature, heights, and the migration proxy (population ratios)—have seldom coefficients that are statistically significant.

To sum up, expanding the quantity of schooling required economies of scale given limited resources. However, for increasing educational outputs, improving the quality of schooling was crucial, which could be pursued by reducing the class size and increasing expenditure per pupil.

We find a positive coefficient for our migration proxy based on population ratios. Since the receiving provinces were the ones characterized by large cities, it is plausible that more internal migration went hand in hand with fewer literate people as a share of the population aged 15 to 19. However, it is worth noting that, although we control for outward migration rates as well as for a proxy of internal migrations, evidence

on the selectivity of migrants is rather limited and still being debated.³⁰ If the most educated people emigrated abroad, the inefficacy problem would be magnified—especially if they were replaced by illiterate immigrants from other areas of Italy. Indeed, if illiterate people moved from Southern to Northern Italy, the measure of school efficacy would tend to be low in the North compared to the South. First, it is worth noting that South-North migration was marginal in the period concerned. By looking at information from the early twentieth century, Federico, Nuvolari, and Vasta (2019) show that most migrants either moved for short distances or migrated abroad. Therefore, one should worry about the selectivity of migrants moving abroad. Since studying migrants' selectivity is a daunting task given that it depends on several factors in both the source regions and destination countries (A'Hearn and Ciccarelli 2021), as well as the large return flows and seasonal movements of Italian migrants in the period concerned, such an analysis goes beyond the scope of this paper. Yet, our evidence suggests a regional pattern of selectivity. A GER-LIT Gap larger in the North than in the South is consistent with the hypothesis of positive selection in outmigration in Northern provinces, and more negative selection in Southern areas. All in all, the complexity of international migration in the case of Italy calls for further evidence on this very relevant issue.

Another issue worth discussing is students' absenteeism, which might explain part of the GER-LIT Gap itself. Absenteeism may be captured by attendance rates. Although we do not have consistent provincial data for the whole period under study, evidence exists on the magnitude of the phenomenon in specific periods. Given our historical sources, attendance rates may be defined as the number of pupils regularly attending classes at the end of the school year as a share of all pupils officially enrolled. Based on data for 1869, we find that 25 percent of pupils enrolled did not attend at the end of spring—mostly because they were working in agriculture (the attendance rate was equal to 75 percent at the national level). Although attendance rates did not vary much across Italy's macro-regions, the lowest attendance rates at that time were found in the North-West (70 percent), where the diffusion of formal enrollment was more

³⁰ The most comprehensive study on this issue is the one by Spitzer and Zimran (2018) using height data, yet this is limited to Italian migrants only who moved to the US in the period 1907–25, thus basically not overlapping with our time frame. A second relevant contribution to this issue is A'Hearn and Ciccarelli (2021), based on the analysis of sex ratios across Italy's districts using the 1911 census. The authors suggest that migrants were negatively selected compared to their population of origin, although they are quite cautious about their findings. For example, they write that selection might have been different for different destination countries, thus calling for more research on this in the future.

rapid yet associated with sporadic participation by the most disadvantaged children.

Finally, we undertake a number of robustness checks to verify whether our baseline panel models in Table 2 are biased by other potential omitted variables, including parental literacy, real wages, high-to-low value added in industry, patents per million inhabitants, and land inequality *c.* 1871 (see Table A3 in the Online Appendix). All results hold.

Although private primary schooling played a minor role in Italy's education system—and a declining one toward the eve of the twentieth century—private education might have still mattered for some population groups, like wealthy families and religious communities, and through the potential preference of wealthy families for private schooling to educate their daughters. Moreover, in some provinces, low public investment in education could be associated with high private enrollment rates.

In Table 3, we compare public and private GERs with public-school and private-school inputs in a panel model with provincial FE and time dummies (Cols. (1)–(2)).³¹ As expected, two distinct patterns emerge: higher public-school enrollment rates were associated with a larger class size and a denser network of schools over the territory. By contrast, economies of scale were not pursued by private institutes—class size was not a significant correlate of enrollment rates. Likewise, a higher number of private schools per square km is positively associated with private GERs, but the coefficient is much smaller than that of public-school density. The two coefficients of school inputs into private education tell a plausible story. Contrary to what happened in public schools, private education essentially targeted a few groups of selected students.

Column (3) tests the same model with the GER-LIT Gap as the dependent variable. Given the nature of this index (both public and private-schooling GERs contribute to literacy and are included in the dependent variable), we consider the different types of education (private vs. public) by computing (i) the ratio of private-education teachers over total teachers and (ii) the ratio of private schools over total schools and including them as regressors (lag 1). The two coefficients are not statistically significant, suggesting that the share of private over total schooling did not affect the capability to produce literacy given enrollment rates—a result that is perhaps to be expected, given that private education was not very common: the national average of private over total enrollments was 6.6 percent in 1871 and 4.3 percent in 1911.

³¹ Unfortunately, we can only measure Evening and Sunday schools concerning public education, like in the case of expenditure per pupil.

TABLE 3
 PANEL-DATA REGRESSIONS, CONSIDERING PUBLIC AND PRIVATE EDUCATION,
 AS WELL AS FEMALES AND MALES, SEPARATELY

Variables	(1) GER (Public)	(2) GER (Private)	(3) GER-LIT Gap	(4) GER (F)	(5) GER (M)	(6) GER-LIT Gap (F)	(7) GER-LIT Gap (M)
Class size (public)	1.638*** (0.172)						
Primary-school density (public)	0.172*** (0.030)						
Class size (private)		0.039 (0.030)					
Primary-school density (private)		0.039*** (0.010)					
Class size (total)			0.927*** (0.128)				
Primary-school density (total)			0.047*** (0.013)				
Private teachers % total			24.933 (21.598)				
Private schools % total			-4.101 (22.541)				
Class size (female)				0.680** (0.301)		0.272** (0.119)	
Primary-school density (female)				0.077*** (0.027)		0.077*** (0.019)	
Class size (male)					0.273*** (0.047)		0.231*** (0.062)
Primary-school density (male)					0.037* (0.021)		0.085*** (0.020)
Expenditure per pupil (public)	-0.096 (0.107)	0.030 (0.023)	-0.162** (0.063)	-0.355*** (0.116)	-0.536*** (0.119)	-0.205*** (0.076)	-0.308*** (0.068)
Density of Evening and Sunday schools	-0.010 (0.016)	0.007* (0.004)	0.009 (0.017)	-0.004 (0.024)	0.023 (0.018)	0.010 (0.021)	0.016 (0.020)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province FE (69)	69	69	69	69	69	69	69
Observations	345	344	345	276	276	345	345
Adjusted R-squared	0.864	0.517	0.651	0.795	0.809	0.533	0.572

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: All models are based on a FE panel-data regression with time dummies. The controls include population density, the urbanization rate, the dependency ratio, infant mortality rate, height, the share of labor force employed in agriculture, industrial VA per capita, the outward migration rate, electoral franchise, and the migration proxy based on population ratios.

Source: See text.

Next, we present results split by gender to investigate whether increasing school inputs was associated with a different change in enrollment rates and school efficacy for boys and girls (Cols. (4)–(7)). The gender educational gap in the Liberal Age is still under-researched, with few exceptions that have shown important differences in educational levels and trends across Italy's macro-regions (Bertocchi and Bozzano 2016; Cappelli and Vasta 2021). Our results indicate that growing enrollment rates for girls were associated with growing class sizes, and this correlation was more prominent than in the case of boys (Cols. (4)–(5)). An increase equal to 10 female pupils per female teacher was associated with an increase in female enrollment rates of about 7 percentage points, whereas the same increase in male schools would be equal to a premium on enrollment rates of about 3 percentage points. A similar difference is found concerning the school-density coefficient. Both results are expected given that female schooling was less common at that time; thus, the same increase in school inputs might have improved access to schooling to a greater extent for females than males (Bloom 2006). Again, the coefficient of expenditure per pupil is negative, confirming that the provinces that witnessed the largest increase in enrollment rates were the ones that spread available resources to a larger number of enrolled pupils.

At that time, the expansion of primary schooling was sustained by a growing number of female teachers and schools (including mixed ones). Starting in the 1870s, the density of female schools converged toward that of male schools, with the exception of the North-West, where parity had already been reached by the 1860s. Our data show that the average female class size rapidly grew toward the end of the nineteenth century, when the male class size had already picked up and was declining (on average). This is consistent with the differences in the magnitude of the coefficients discussed previously: a more rapid expansion of school inputs for females pushed up female enrollment rates from low values, thus explaining the larger marginal impact in the case of girls compared to boys.

No major divide between females and males is visible in the way that class size and school density affected school efficacy (Cols. (6)–(7)). In contrast, the coefficient of expenditure per pupil is larger for boys than girls. A one-standard-deviation increase in expenditure per pupil (13.65 lire per pupil) was associated with a reduction in the GER-LIT Gap equal to 2 percentage points for females and almost 3 for males, suggesting a bias in resource allocation favoring boys over girls in primary education.

To highlight the changing trends in the relationship among the variables that we study, we present cross-section regressions, always including all

control variables, with the GER (Cols. (1)–(5)) and the GER-LIT Gap (Cols. (6)–(10)) as the dependent variables (Table 4). We present the same results for females and males separately in the Online Appendix (Tables A4 and A5, respectively).³² The variation of the coefficients over time highlights an inverse U-shaped pattern in the relationship between class size and the GER, on the one hand, and the density of primary schools and the GER, on the other hand. Initially, growing school inputs (increasing economies of scale in education) are associated with large improvements in the GER. Toward the beginning of the twentieth century, improvements prompted by growing school inputs became smaller. Tables A4 and A5 show that this pattern is the result of a composite effect driven by gender differences.

A PRE-UNIFICATION LEGACY?

So far, our study, stretching from the pre-unification period to the early twentieth century, has highlighted the central role played by local school inputs in expanding enrollments and, at a later stage, improving literacy during Italy's Liberal Age (1861–1911). This is suggestive of persistent differences stemming from the legacy of pre-unification education policies. Figure 5 highlights the early divide in literacy by relying on the dataset on adult literacy by Ciccarelli and Weisdorf (2019). Significant pre-unification differences in literacy existed across the macro-regions of Italy:³³ the Kingdom of Sardinia (Piedmont and Liguria) as well as Lombardy in the Lombardy-Venetia Kingdom led the way, while the Center and (even more) the South lagged behind. This pattern seems to be linked to substantial variation in schooling post-1861, which can be fully appreciated by looking at macro-regional averages concerning two school inputs: class size in public schooling (enrolled pupils per available teacher) and public-schooling expenditure per pupil.³⁴

Class size indicates remarkable disparities in the way that primary education was provided in the pre-unification era: in Figure 6, both the North-West and—to a lesser extent—the North-East exhibit a *large* average class size, whereas the Center as well as the South and Islands show a *small* class size.

These patterns are consistent with the hypothesis that the North had already paved the way toward a model of public mass schooling—relying

³² Enrollment rates separated by gender are not available for our last benchmark year (1911), thus the analysis stops at 1901.

³³ Italy's macro-regions are specified in footnote 4.

³⁴ The evidence based on the density of primary schools is consistent with our argument—not shown for the sake of brevity.

TABLE 4
CROSS-SECTION REGRESSIONS

Dependent Variable:	GER			GER-LIT Gap						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Year	1871	1881	1891	1901	1911	1871	1881	1891	1901	1911
Class size (total)	1.175*** (0.266)	1.530*** (0.220)	1.600*** (0.279)	1.674*** (0.301)	1.185*** (0.293)	0.643** (0.242)	0.652*** (0.231)	0.835*** (0.164)	0.786*** (0.210)	0.679*** (0.209)
Expenditure per pupil (public)	-0.083 (0.151)	-0.062 (0.242)	0.066 (0.192)	0.268 (0.241)	0.055 (0.117)	-0.136 (0.113)	-0.395*** (0.128)	-0.303 (0.183)	0.017 (0.140)	0.193 (0.219)
Primary-school density (total)	0.117** (0.047)	0.099** (0.039)	0.231*** (0.035)	0.188*** (0.033)	0.123** (0.052)	0.104*** (0.028)	0.111*** (0.036)	0.089*** (0.023)	0.093*** (0.023)	0.097*** (0.030)
Density of Evening and Sunday schools	0.047 (0.042)	0.064* (0.036)	0.257*** (0.050)	0.139** (0.052)	-0.022 (0.020)	-0.010 (0.047)	-0.006 (0.044)	0.087 (0.056)	0.173*** (0.037)	-0.022 (0.018)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	69	69	69	69	69	69	69	69	69	69
Adjusted R-squared	0.934	0.947	0.941	0.936	0.817	0.794	0.797	0.834	0.787	0.759

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: In Columns (6) to (10), all school inputs excluding the density of Evening and Sunday schools are lagged by one period (10 years). The controls include latitude, longitude, average temperature, average rainfall, population density, the urbanization rate, the dependency ratio, infant mortality rate, height, the share of labor force employed in agriculture, industrial VA per capita, the outward migration rate, electoral franchise, and the migration proxy based on population ratios.

Source: See text.

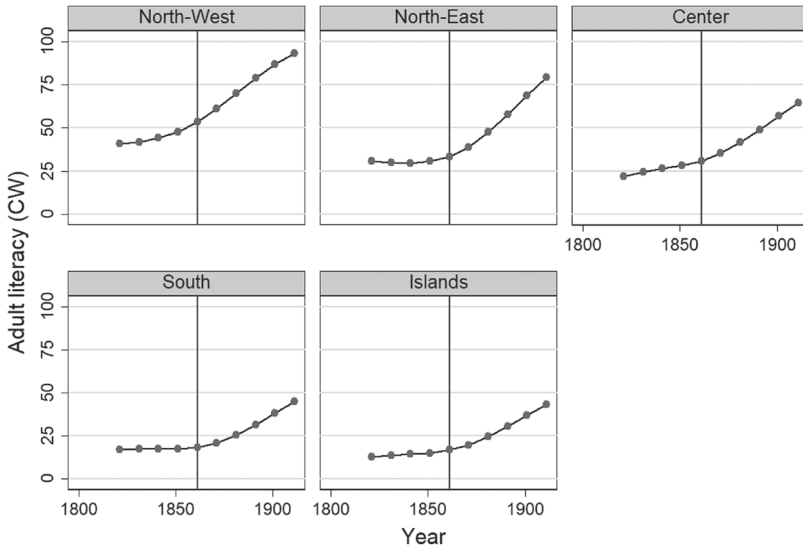


FIGURE 5
ADULT LITERACY IN ITALY'S MACRO-REGIONS, FROM 1831 TO 1911

Note: We rely on literacy rates from Ciccarelli and Weisdorf (CW) (2019). The vertical line marks the unification of Italy in 1861.

Source: See text.

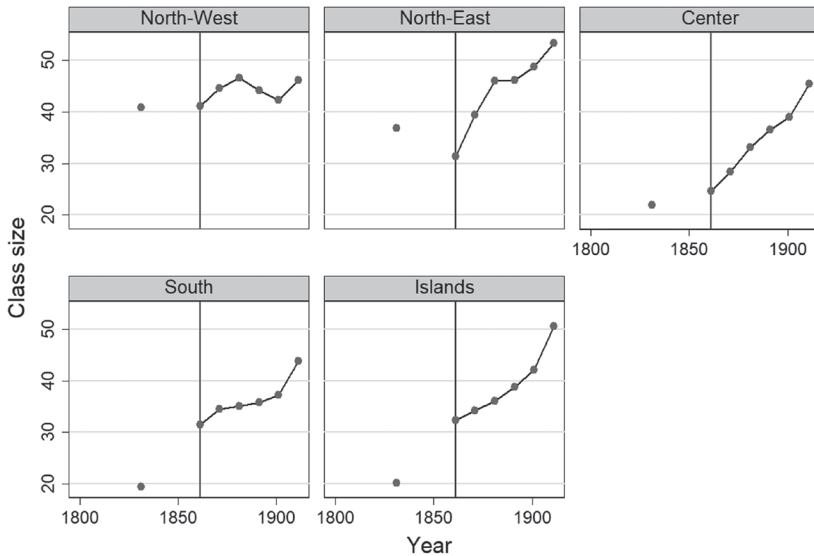


FIGURE 6
CLASS SIZE AMONG ITALY'S MACRO-REGIONS, FROM THE PRE-UNIFICATION ERA TO THE EARLY TWENTIETH CENTURY

Source: See text.

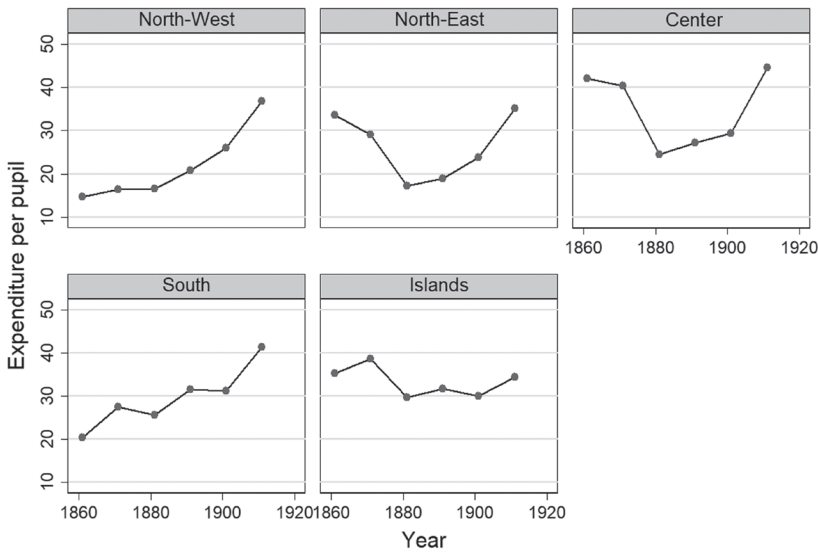


FIGURE 7
EXPENDITURE PER PUPIL ACROSS ITALY'S MACRO-REGIONS, 1861 TO 1911

Source: See text.

on economies of scale in primary education in an attempt to reach most of the population.³⁵ Instead, the Center and the South of the country had not yet abandoned a more elitist view of education based on private institutions, near-zero public education, and a focus on educational grades higher than the primary; as a result, fewer primary-school pupils were taught by more teachers. In the long run, the two areas converged toward a similar class size, the one based on the provision of schooling for all and mass education—under the same national school act—but this process took more than 50 years, holding back convergence in literacy rates across the country.

Figure 7 on educational expenditure per enrolled pupil highlights the same divide. Unfortunately, harmonized data for the pre-unification period are not available, so these results must be taken with a pinch of salt. In 1861, the average expenditure was 15 lire per enrolled pupil in the North-West; all other macro-regions spent more. Two distinct models evolved over time: the Center and the North-East converged with the low expenditure per enrolled pupil that characterized the North-West, a sign of the effort to provide mass education. Instead, the South and Islands are

³⁵ Economies of scale in education that affect average costs across areas are common. Bowles and Bosworth (2002) studied 17 Wyoming school districts in the 1990s, finding that a 10-percent increase in school size decreased the cost per student by 2 percent.

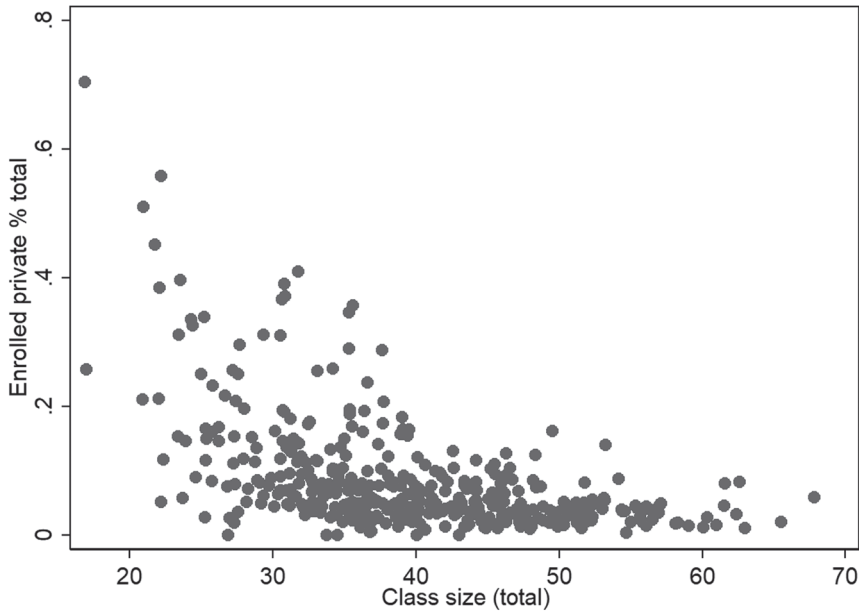
characterized by a higher expenditure per pupil enrolled compared to the North-West.

The intuition that class size and expenditure per pupil can be used as a proxy of preferences or models in the provision of primary schooling is backed up by the relationship between the importance of private education and class size or expenditure per pupil. As Figure 8 shows, a larger share of enrollments in private over total education is associated with a smaller class size (panel a) and a larger expenditure per pupil (panel b).

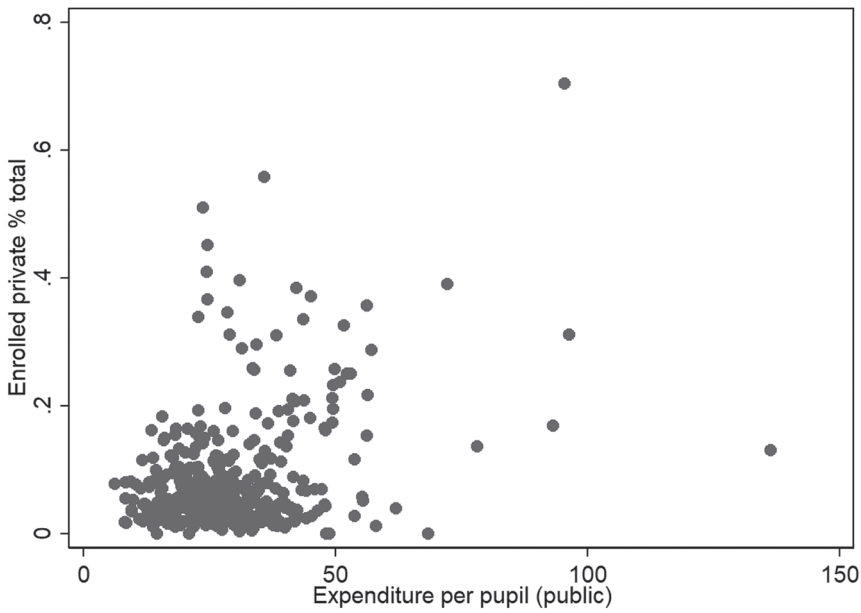
Figure 9 interestingly shows that early movers that adopted a more inclusive model of educational provision reduced considerably gender inequality in literacy, much more rapidly than the Center and the South. The percentage-point gap was reduced to virtually zero in the North-West, and to about five in the North-East. Instead, in the Center and in the Islands, the average gap decreased slightly, yet it remained larger than 10 percentage points, while in the South the gap remained stable and above 20 percentage points. These trends illustrate that the expansion of mass schooling through economies of scale in the North happened with boys first, thus implying an increasing gender gap—before the rise of female education would reduce the gap below the one characterizing the regions relying on a more elitist model of schooling.

We further explore this legacy with a series of regressions with year dummies and macro-regional FE instead of provincial FE, which would otherwise capture any time-invariant effect that varies merely across provinces. We expect to find a link between pre-unification education and post-unification literacy within each macro-region. Since we control for a large set of contextual variables, this would imply that pre-unification states that had adopted an early system of mass education tended to be characterized by higher enrollment rates and, possibly, school efficacy.

Table 5 shows a positive and significant correlation between enrollment rates and pre-unification (1831) literacy (Col. (1)). In Column (2), we interact pre-unification (1831) literacy with the year dummies to explore whether this alleged pre-unification educational legacy persisted over time: in every year considered, the coefficient of the legacy of pre-unification literacy is given by the sum of the 1831 coefficient and the interaction between the latter and the dummy for the concerned year (the excluded year is 1871). For example, in 1881, the marginal effect of pre-unification (1831) literacy was $0.950 + (-0.270) = 0.680$. Therefore, we find pre-unification literacy to have been relevant until the early twentieth century; this marginal effect further declines over time, to the point of becoming virtually zero in 1911.



(a) Class size and private education



(b) Expenditure per pupil and private education

FIGURE 8
PRIVATE EDUCATION, CLASS SIZE, AND EXPENDITURE PER PUPIL, FULL SAMPLE
(ALL YEARS)

Source: See text.

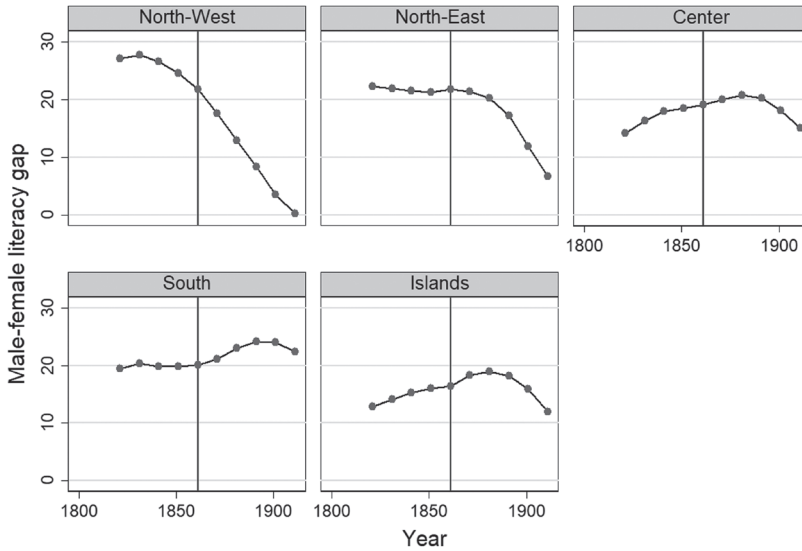


FIGURE 9

GENDER INEQUALITY IN LITERACY: MALE LITERACY MINUS FEMALE LITERACY, 1831–1911

Source: See text.

This is plausible since the previous decade marked the first era of substantial state intervention in matters related to primary schooling (the aforementioned Nasi and Orlando Laws). We also explore whether this legacy was different for girls and boys (Cols. (3)–(4)). The legacy appears to have been more persistent for girls, which resonates with the more prominent effort by local authorities to provide schooling to boys. As Ciccarelli and Weisdorf (2019, fig. 6) have shown, female adult literacy caught up relatively quickly with male literacy in the North-West after unification. The same, though to a lesser extent, happened in the Center and North-East. However, in the South, a substantial gender gap in education remained. This result is fully consistent with our estimates in Column (3): while Central and Southern regions closed the gap in male enrollment rates following unification, the gap in female enrollment rates persisted into the twentieth century.

Finally, we focus on school efficacy and highlight that more literate provinces before unification tended to expand enrollment rates while reducing school efficacy (a larger GER-LIT Gap) (Cols. (5)–(6)). This suggests the existence of two distinct models: an inclusive one aimed at fostering education for all in the North-West and North-East, and a more elitist one elsewhere, particularly in the South. Yet, over time, the net coefficient of 1831 literacy gets smaller, as the areas that expanded

TABLE 5
 PANEL-DATA REGRESSIONS: A PRE-UNIFICATION LEGACY?

Panel Variables	(1) Pooled OLS GER	(2) Pooled OLS GER	(3) Pooled OLS GER (F)	(4) Pooled OLS GER (M)	(5) Pooled OLS GER-LIT Gap	(6) Pooled OLS GER-LIT Gap
Class size	1.345*** (0.136)	1.250*** (0.135)	1.126*** (0.208)	0.117** (0.056)	0.565*** (0.113)	0.590*** (0.117)
Expenditure per pupil	-0.013 (0.077)	0.045 (0.084)	-0.148 (0.108)	-0.275** (0.114)	-0.192*** (0.051)	-0.197*** (0.047)
Primary-school density	0.081*** (0.025)	0.078*** (0.025)	0.092** (0.041)	0.089** (0.036)	0.049*** (0.018)	0.050*** (0.018)
Density of Evening and Sunday schools	0.027** (0.013)	0.002 (0.012)	0.011 (0.027)	0.028 (0.024)	0.009 (0.016)	0.007 (0.017)
Literacy CW 1831	0.598*** (0.148)	0.950*** (0.154)	1.212*** (0.225)	1.052*** (0.147)	0.418*** (0.108)	0.604*** (0.175)
Literacy CW 1831*1881		-0.270* (0.139)	-0.254 (0.208)	-0.248** (0.119)		-0.233* (0.137)
Literacy CW 1831*1891		-0.416*** (0.121)	-0.385* (0.214)	-0.515*** (0.112)		-0.313* (0.170)
Literacy CW 1831*1901		-0.596*** (0.140)	-0.478* (0.254)	-0.746*** (0.134)		-0.437** (0.186)
Literacy CW 1831*1911		-0.991*** (0.208)				-0.139 (0.233)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Macro-region FE (4)	Yes	Yes	Yes	Yes	Yes	Yes
Observations	345	345	276	276	345	345
Adjusted R-squared	0.935	0.941	0.925	0.938	0.797	0.804

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

Notes: Literacy 1831 is from Ciccarelli and Weisdorf (CW) (2019), who have provided such estimates. Class size, primary-school density, and 1831 literacy refer to females and males in Columns (3) and (4), respectively. In all other specification they refer to the total population. In Columns (3) and (4), the number of observations drops to 276 due to schooling data divided by gender being unavailable for 1911. For a full list of controls, see Table 4.

Source: See text.

enrollments early reduced the GER-LIT Gap starting in the 1890s (the North and Center), whereas the South and Islands improved it in the first decade of the twentieth century.³⁶

Our findings resonate with the results offered by Postigliola and Rota (2021), who emphasize the importance of the legacy of French reforms, which improved the quality of schooling and changed “collective preferences” toward more education. Our results suggest that there existed different equilibria of educational provision across Italian macro-regions,

³⁶ The 1911 interaction is not statistically significant, as the aggregate result is dependent on diverse and mixed regional patterns: while school efficacy improved to a large extent in the North-West and North-East, enrollment rates expanded rapidly in the Center. We tested for the different relationship between 1831 literacy and school efficacy over the post-unification years separately for boys and girls, and we found no significant differences.

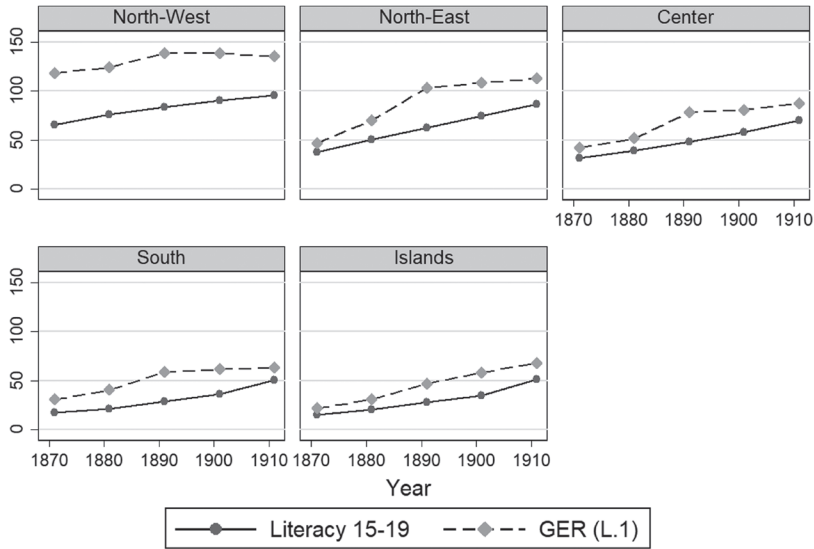


FIGURE 10
THE GER-LIT GAP IN ALL MACRO-REGIONS, 1871-1911

Note: The GER (L.1) is the first lag (-10 years) of the GER variable.

Source: See text.

even if the French reforms did not necessarily translate into quality of schooling during the Liberal Age. We find that the areas most affected by the French legacy first increased enrollment rates by aiming at economies of scale and, only at a later stage, sought to improve the efficacy of schooling in generating literacy. In 1861, the gap between GER and literacy rates for the same cohort was particularly large in the North-West, the area most affected by French reforms (Figure 10).

CONCLUSIONS

Italy represents an ideal case study to explore the relationship between institutions, reforms, and local levels of education in the long run. Thanks to a newly collected dataset, we investigate to what extent school inputs mattered for both the mass expansion of schooling rates and school efficacy in the Liberal Age in the context of growing educational expenditure. By relying on provincial Education Production Functions, we find that two distinct models (equilibria) emerged concerning the provision of primary schooling. The Northern regions of the country relied on economies of scale (large class size and low expenditure per pupil) to increase the quantity of schooling, even if this came at the cost of limited effectiveness, at least until the late nineteenth century. Instead, the Center

and the South implemented a more elitist educational model based on small class sizes and a large expenditure per pupil, resulting in a smaller number of students enrolled compared to the school-age population. We also find that economies of scale were more relevant to increasing female than male enrollment rates. Consistently, the improvement in school efficacy (the reduction of the GER-LIT Gap), which happened in the entire country starting in the 1890s, was driven by the reduction in class sizes and increasing expenditure per pupil, even when controlling for contextual factors associated with the demand for education.

Furthermore, we study the association between pre-unification human capital accumulation, enrollment rates, and literacy in the Liberal Age, thus contributing to a lively debate about the origins of Italy's regional divide. The North was characterized by collective preferences for inclusive education (high literacy and limited private schooling) in the early nineteenth century. In contrast, evidence from the Center and South suggests preferences toward more restricted access to education, which further hampered the transition to mass schooling.

Our results on the existence of a dual system are linked to the literature highlighting different paths to modernization (Felice and Vasta 2015), as well as the existence of two long-lasting distinct institutional contexts ("access orders" à la North-Wallis-Weingast) in the North and the South (Di Martino, Felice, and Vasta 2020). Our evidence also builds on the results by Ciccarelli and Weisdorf (2019), who argue that skill premia and military schools were important forces improving adult literacy, particularly for males. We provide a complementary explanation for the rise of female (and overall) literacy. The more inclusive model of educational provision in the North was the one that allowed women to become literate most rapidly.

A legacy does not mean destiny, though: we show that the link between pre-unification education and literacy faded out over time and that convergence between the North and the South started in the first decade of the twentieth century with limited (but increasing) state intervention, which culminated with the centralization of the school system in 1911 (Cappelli and Vasta 2020). Further research should improve our quantitative knowledge of all levels of education, which is a crucial aspect of Italy's long-term development.

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