ISSN 2279-9362

Research
Education
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Dalit Contini, Marina Della Giusta, Maria Laura Di Tommaso, Daniela Piazzalunga

No. 703
December 2023

Carlo Alberto Notebooks

www.carloalberto.org/research/working-papers

The Covid-19 Pandemic: Learning Loss and Educational Inequalities in Italy

Dalit Contini[a], Marina Della Giusta[b], Maria Laura Di Tommaso[c], Daniela Piazzalunga[d]

[a] University of Torino

[b] University of Torino, University of Reading, and IZA

[c] University of Torino, Collegio Carlo Alberto, and Frisch Center for Economic Research

[d] University of Trento, IZA, and FBK-IRVAPP

Abstract

This chapter examines the impact of school disruptions caused by the Covid-19 pandemic on learning losses in Italy. Amongst high income countries, Italy entered the pandemic with a relatively low degree of technological preparedness and experienced very long school closures (a total of 38 weeks of full or partial school closures). Using standardized assessment for the entire population of students in grade 2, 5, 8, and 13, this chapter provides a detailed picture of learning losses, comparing a cohort never exposed to the pandemic (2019) and the cohort that completed school in 2021, controlling for students' achievements 3 years before. Results indicate that Italian students have suffered significant learning losses, with higher grades and lower-skilled students experiencing the largest losses. Moreover, while we find no differences between children from different backgrounds within schools, the learning loss is largest in schools attended by students from lower socio-economic backgrounds.

JEL Classification: I21, I24, I18

Keywords: Covid-19; school closure; learning loss; cognitive and non-cognitive skills; standardised tests; inequality

1. Introduction

Italy was the first country in Europe to be hit by the Covid-19 pandemic, and has one of the highest excess mortality adjusted for population size together with Britain, Spain, Belgium and Portugal (The Economist, 2021). The first cases of Covid-19 were registered on 22 February 2020 in Italy, two months after official records of the outbreak in China, and strict social distancing and restrictions were put into place soon afterwards. From 24 February, first in Lombardy and Veneto (two of the most populated regions in the North) and soon after in all regions, nurseries, pre-schools, schools and universities were closed and remained closed until the end of the school year in June 2020 to prevent and reduce the diffusion of the virus. Schools did not reopen at all and there were no recovery programmes during the summer of 2020 unlike in other European countries. Overall, primary and lower secondary schools in Italy remained closed from March 2020 until the end of the 2019–2020 academic year, one of the longest periods of school closures in Europe during the so-called first wave (13 weeks against a European average of 10).

Upper secondary schools were also closed for very long stretches of the 2020–21 academic year while efforts were made to maintain primary schools open as much as possible, although local situations, determined sometimes partial closures also for primary schools and individual circumstances, meant both pupils and teachers were at times in quarantine and had to move to distance learning. From November 2020, upper secondary schools were in distance learning mode across the country and in high contagion areas that included also the last two years of middle schools. From January 2021, between 50 and 75 per cent of teaching was back in person, again with the exception of high contagion areas.

The Italian context in relation to this chapter exhibits specific characteristics that hold significant relevance. Already prior to the pandemic, Italy faced challenges in terms of both digital skills and the availability of suitable infrastructure for distance learning. Indeed, Italy had one of the lowest Digital Economy and Society Index (DESI) scores among European Union countries, with a limited proportion of households with fixed broadband connections and individuals possessing basic software skills (European Commission, 2020). Additionally, teachers in Italy exhibited low proficiency in information and communication technology (ICT) and had limited experience in blended and technology-enhanced teaching methods (Bertoletti et al., 2023; European Schoolnet, 2012; OECD, 2018). Furthermore, Italy faced one of the highest rates of children lacking access to individual and school learning resources in Europe (Blaskó et al., 2022).

The Italian school system is organised as follow. Children enrol in compulsory school at age 6 and primary school lasts for five years (Grade 1 to Grade 5). They then enrol in lower secondary school at age 11 where they complete three further grades (Grade 6 to Grade 8). Both primary and lower secondary are compulsory, comprehensive and free of charge and all follow the same national curriculum. At the end of Grade 8 pupils take a national examination after which tracking occurs. Students can either choose among

different types of upper secondary schools that last for five further years (Grades 9-13) and can broadly be described as general (Lyceums – which prepare for University Education), Technical or Vocational, or three-year regional vocational education and training (*formazione professionale*). Compulsory education lasts ten years and therefore it includes also the first two years of upper secondary school or vocational training.

General education courses encompass various types of lyceums, with the most academically oriented options being the humanistic lyceum and the scientific lyceum. Additionally, there are other lyceums that specialize in areas such as foreign languages and social sciences. The primary objective of lyceums is to furnish students with a strong cultural foundation and to equip them with the necessary competencies to continue with higher education (Eurydice, 2023). Technical schools, on the other hand, combine general education with technical subjects (or business subjects), aiming to provide students with a solid background in these areas and prepare them for technical or administrative careers requiring specific skills. Vocational schools focus on providing students with vocational training geared towards entry-level positions in various low-skill occupations. Upon completion of five years of schooling and successfully passing a national examination, students obtain a high school diploma. Although students from any educational track have access to university, there exists a clear gradient across different tracks both in terms of the likelihood of enrolling in and completing a university degree (Contini and Salza, 2020).

So far, a few studies have attempted to estimate the loss of learning associated with the Covid-19 pandemic in Italy. Contini et al. (2022) is the only study investigating the immediate effects of the pandemic, focusing on Grade 3 for the Piedmont region for the first lockdown (spring 2020) and making use of directly administered tests. Using data from the national standardised tests administered by the National Institute for the Evaluation of the School System (INVALSI) for 2021, other studies address the impact after one full year of the pandemic (as of May 2021). Borgonovi and Ferrara (2023) use difference-in-difference methods for Grades 5 and 8 and Contini et al. (2023) use difference-in-difference methods for Grades 13; Bazoli et al. (2022) use matching and consider Grades 2, 5, 8 and 13 but do not control for prior achievement, and Battisti and Di Maggio (2023) consider Grades 5, 8 and 13 and treat all grades together. In this chapter, we mainly build on Contini et al. (2023), but extend the analysis to all grades (Grades 2, 5, 8, and 13), while focusing mostly on average differences and differences by prior achievements. We complement the analysis by investigating the impact of Covid-19 by school average socio-economic background, which provides interesting inputs on the effects of the pandemic on inequality.

The European Union has launched an unprecedented stimulus package, known as the Next Generation EU, to support post-pandemic recovery, including a budget for school renovations and specific projects that we describe in Section 4. These measures should help students at different stages of the school career to recover from the learning losses

caused by the pandemic. However, past research suggest that the effects of shocks persists in the long term, and learning recovery is easier said than done. Indeed, as subsequent learning builds on previous concepts which cannot be simply skipped – especially so in math – it is difficult to accelerate learning (Fahle et al. 2023). Moreover, students completing school in 2021 (in Grade 13 in our analysis) have now entered university or the labour market and will not benefit from these measures and could suffer from the long-term effects of learning loss in both contexts.

2. National Administrative Data

This chapter utilises data from the national standardised tests administered by the National Institute for the Evaluation of the School System (INVALSI), which evaluate students' skills in reading and comprehension (Italian) and in maths.[1] Today, tests are administered to the entire population of Italian students in Grades 2, 5 (end of primary school), 8 (end of lower secondary school), 10 and 13 (end of upper secondary school), to about 500,00 students per grade.[2]

Standardised tests were first introduced for primary and lower secondary students in 2009, with several adjustments and refinements over the years. Since 2009, the tests have been conducted yearly for Grades 2, 5, and 8. As of 2011 they have also been conducted for Grade 10, and since 2019 for Grade 13. Due to the pandemic and school closures, in 2020 there were no tests for any grade; in 2021, INVALSI tests took place regularly with the exception of Grade 10, which was not administered; since 2022, all tests have been resumed. Since 2018, the tests are computer based for students in lower and upper secondary school.

For a long time, INVALSI tests have not been horizontally equated. Standardised tests have the same questions, and thus the same level of difficulty, for students in a given cohort in a given grade. Obviously, different tests are administered to students in different grades; moreover, different tests are administered to students in the same grade in different years, to avoid cheating and practice effects. This means that without equating the tests, it is not possible to directly compare the results of students in different cohorts, because one test may be slightly easier or more difficult than the other. To equate tests, anchoring – i.e., introducing some equivalent questions in tests – has been deployed in

[1] For grades 5, 8, 13, there are also standardised tests in English, assessing listening and reading skills. However, these tests have been introduced in the school year 2020-21, meaning that it is not possible to evaluate the impact of the pandemic on English skills, due to the lack of a control group and of prior skills.
[2] As mentioned above, upper secondary schools in Italy are classified into broad tracks: scientific lyceums, classical and other lyceums, technical and vocational tracks. Considering the very different level of preparation in math of students in different tracks, in Grades 10 and 13 the mathematics test has a common part and a specific part that varies between tracks. On the contrary, the reading test in Grades 10 and 13 is the same across all the different tracks.

INVALSI tests for all school grades since 2019, making it possible to have grade-specific scores in a common metric and to assess changes in results over time.

To assess the causal impact of the pandemic, for students enrolled in each grade (2, 5, 8, 13) we compare students' test scores in 2021 ("Covid cohorts", who experienced one full year of intermittent school closure) with the scores of the cohort in the same grade in 2019 ("pre-Covid cohorts", who did not experience any school closure). We also control for initial abilities measured 3 years before (2018 for the Covid cohort, and 2016 for the pre-Covid cohort). Indeed, thanks to the longitudinal nature of the survey, it is possible to link students' test scores for each grade with their own test scores in the previous grades, and thus control for initial skills.[3] For Grade 13, we control for test scores in Grade 10; for Grade 8, we control for test scores in Grade 5; for Grade 5, we control for test scores in Grade 2. Only for students in Grade 2 in 2021 initial skills are not available by construction. Table 1 details the structure of the data.

Table 1. Structure of the data employed in the analyses

PRE-COVID COHORT (CONTROLS)						**COVID COHORT (TREATED)**					
		Outcomes – 2018/19						**Outcomes – 2020/21**			
		Grade 2	Grade 5	Grade 8	Grade 13			Grade 2	Grade 5	Grade 8	Grade 13
Prior skills – 2015/16	None	X				**Prior skills – 2017/18**	None	X			
	Grade 2		X				Grade 2		X		
	Grade 5			X			Grade 5			X	
	Grade 10				X		Grade 10				X

Notes: INVALSI started equating tests since 2019. For this reason, the outcomes (test scores in grade 5, 8, and 13) are horizontally equated, whereas prior skills, regarding assessments administered before 2019, are not.

As tests have been equated since 2019, the tests used to retrieve the initial skills are not horizontally anchored. A more thorough discussion can be found in Contini et al. (2023).

Results from the tests are harmonised by INVALSI using a Rasch model and standardised to have mean 200 and standard deviation 40. We then rescale the score to have mean 0 and standard deviation 1. In addition to scores obtained in the standardised test, INVALSI collects information on teacher's marks in Italian and mathematics at the end of the first term, students' socio-demographic characteristics, and family background. The set of variables includes age, gender, migratory background, parents' level of education and occupation, ESCS (the Economic, Social and Cultural Status index), and geographic area.

[3] To measure learning gains across different grades, one would also need vertically equated tests. As of today, INVALSI tests are not.

The final dataset consists of all students who took both assessments (Italian and maths) in both grades – i.e., the outcome and prior tests – who did not repeat a school year in between nor dropped out of the school system. A few students were thus excluded because they were absent from one of the two assessments or because it was not possible to merge data with initial skills.

3. Learning loss: methodology and results

3.1 Empirical methodology

The starting point is the standard education production function model (Hanushek, 1979):

$$Y_{1ij} = \alpha_0 + \alpha_1 Y_{0ij} + \alpha_2 X_{ij} + \delta_j + e_{ij} \quad (1)$$

where Y_{1ij} is the score in standardised test in mathematics or reading of child i in school j; X_{ij} is a vector of socio-demographic controls including age, gender, migratory background, parental education and occupation; Y_{0ij} is a vector of prior skills measured at the time of the previous assessment (3 years before), including both standardised assessment and teachers' marks in Italian and math. δ_j are school fixed effects interpretable as the schools' value-added and e_{ij} is a normally distributed error term.

To assess the average impact of the pandemic on children's learning, we use a difference-in-differences model comparing achievements of children in the pandemic cohort (Covid cohort) with those of children in the pre-pandemic cohort (pre-Covid cohort):

$$Y_{1ikj} = \beta_0 + \beta_1 C_k + \beta_2 Y_{0ikj} + \beta_3 X_{ikj} + \delta_j + e_{ikj} \quad (2)$$

C_k is a dummy variable equal to 1 if the child is in the Covid cohort k and 0 otherwise. α_1 is the coefficient of interest, ideally capturing the causal effect of being in the Covid cohort rather than in the pre-Covid cohort on achievement, given previous achievement in mathematics and Italian. The underlying assumption is that, conditional on prior abilities, the performance of children in the Covid cohort would have been the same as the pre-Covid cohort had the pandemic not occurred. We estimate this model for all grades assessed in the school year 2021 with tests anchored to those in 2019, i.e. for Grades 5, 8 and 13.

If the goal is to estimate the causal effect of the pandemic, controlling for prior achievement is important because initial skills may vary across cohorts for reasons unrelated to the pandemic itself (Werner & Woessmann 2023). Nevertheless, to provide descriptive evidence on the extent to which test scores varied before and after the pandemic, we also estimate a version of model (2) that excludes prior achievement Y_0, for Grades 2, 5, 8, and 13.

Besides average effects, we estimate heterogeneous effects from two perspectives. First, we analyse whether the pandemic has hit differently children with different prior achievement (equation 3). Second, we analyse whether the impact between schools with different socio-economic composition, measured with the school average ESCS, varies (equation 4).

$$Y_{1ikj} = \gamma_0 + \gamma_1 C_k + \gamma_2 Y_{0ikj} + \gamma_3 X_{ikj} + \gamma_4 C_k Y_{0ikj} + \delta_j + e_{ikj} \quad (3)$$

$$Y_{1ikj} = \theta_0 + \theta_1 C_k + \theta_2 Y_{0ikj} + \theta_3 X_{ikj} + \theta_4 Z_j + \theta_5 C_k Z_j + r_j + e_{ikj} \quad (4)$$

where Z_j is the school average ESCS (computed in 2021) and r_j are regional fixed effects. The coefficients of interest are those of the interaction terms, capturing the extent to which the effects of prior abilities and school socio-economic composition varied before and after the onset of the Covid pandemic.[4]

3.2 Results

The average effect of the pandemic on children's performance in Italian and mathematics across grades is described in Table 2. For each grade, we provide results relative to two specifications: the first includes socio-demographic controls and school fixed effects; the second, corresponding to model (2), also includes prior ability measures. The only exception is Grade 2, where there is no prior achievement measure to use as a baseline. Estimates without prior ability are reported in columns (1), (2), (4) and (6), and estimates with prior ability in columns (3), (5), and (7).

This table shows two main findings. First, in primary and lower secondary school the loss is much greater in mathematics than in Italian. This result is consistent not only with the international literature on the effects of the Covid-19 pandemic, but also with existing evidence on the summer learning loss, instructional time, and the effects of other extreme events (see Betthäuser et al. 2023). As pointed out by the authors, it is plausible that parents are better prepared to help children with reading rather than math and that outside activities – such as reading for pleasure – more easily improve children's skills in reading. It is also tenable that such an effect disappears in upper secondary school, when standardised tests include more formal questions on the structure and stylistic choices of a text rather than mere comprehension.

[4] A possible limitation of this strategy is that pre-tests were not horizontally equated. Thus, two children with the same score in different cohorts have the same relative position within their cohort distribution but may not have the same absolute performance. To analyse heterogeneous effects relative to socio-demographic groups, Contini et al. (2023) proposed a different strategy, which consists of analysing the changes in the relative positions of each group before and after the Covid -19 school closures, given its prior relative position. Since the results end up being quite similar, to avoid introducing technicalities in the formalization and interpretation of the results, we stick here to the standard model.

Table 2. Effect of the Covid-19 pandemics on children's learning across grades

Variables	**Grade 2** (1)	**Grade 5** (2)	**Grade 5** (3)	**Grade 8** (4)	**Grade 8** (5)	**Grade 13** (6)	**Grade 13** (7)
				Italian			
Covid	0.079***	0.049***	0.009**	-0.076***	-0.092***	-0.356***	-0.406***
	(0.005)	(0.004)	(0.004)	(0.002)	(0.002)	(0.004)	(0.003)
R-squared	0.149	0.141	0.393	0.183	0.553	0.417	0.586
				Math			
Covid	0.001	-0.136***	-0.185***	-0.163***	-0.188***	-0.329***	-0.381***
	(0.005)	(0.004)	(0.004)	(0.003)	(0.002)	(0.004)	(0.003)
R-squared	0.161	0.148	0.398	0.198	0.564	0.497	0.660
Observations	782,352	758,047	758,047	855,793	855,793	618,226	618,226
Initial abilities	No	No	Yes	No	Yes	No	Yes
Socio-demogr. Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors clustered at the class level in parentheses. * p<0.10, ** p<0.05, *** p<0.01. Socio-demographic controls include age, gender, parents' level of education and occupation, and school fixed effects. Initial abilities are controlled for in columns (3), (5), and (7) and include INVALSI test scores and teachers' marks in math and Italian.

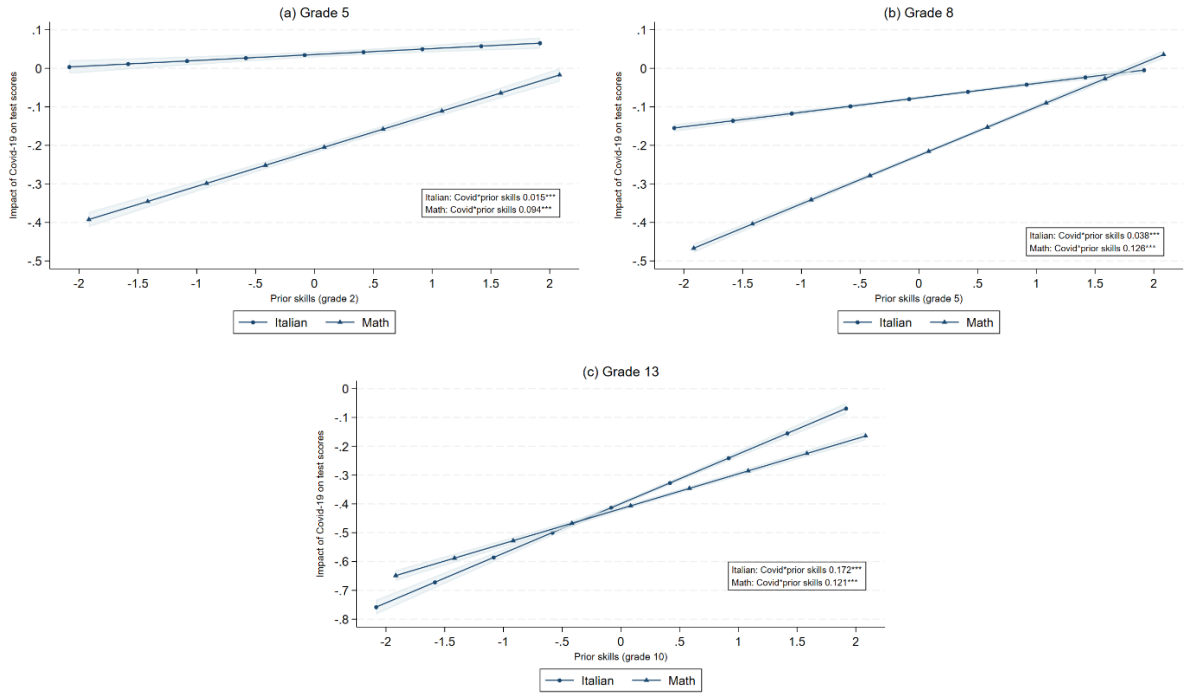
Second, the loss increases steeply with grades. According to our analyses, children in Grade 2 do not experience any loss in mathematics and even gain in Italian. Note however that this effect is unconditional on prior skills, and in later grades the negative effects of the pandemic increases when controlling for prior skills; moreover, also in Grade 5 it appears a positive effect in Italian in estimates unconditional on prior achievements, but it virtually disappears when we control for initial achievements. In Grade 5, there is no evidence of changes in Italian but a significant loss in mathematics (-0.185 standard deviations). In Grade 8, we find a moderate reduction in Italian and a large reduction in mathematics (-0.09 and -0.19 s.d., respectively). The loss becomes impressive at the end of high school, in Grade 13, where it reaches 0.38-0.40 standard deviations in both areas. This means that, *ceteris paribus*, students in the Covid cohort achieved an average achievement level that was 0.4 standard deviations lower than that of the previous cohort. This effect is similar to the size of the raw gap observed at this stage between students with and without parents with a tertiary education degree, or to half of the raw difference in math test scores between students in the scientific and technical tracks.

One reason for this pattern can be attributed to the fact that high school students experienced a much longer period of school closure compared to middle school children and even more so compared to primary school children. Another possible explanation is that the severe restrictions imposed during lockdowns and school closures led to an enormous change in the social environment of young people, and strongly affected mental health and socioemotional development. Research has shown that the prevalence of prominent symptoms of depression and anxiety developed during the pandemic was highest among adolescents (Racine et al. 2021). It is also possible that parental involvement in supporting distance learning was high for youngest students but

comparatively low for older ones, as parents were struggling to combine home working with supervising homework (Biroli et al., 2021).

On the effects by prior achievement (see Figure 1, estimated with model 3), we observe larger negative effects for the children who were low achievers to begin with. This result is consistent with previous findings (Borgonovi and Ferrara, 2023 for middle school and Contini et al. 2023 for high school).[5]

Figure 1. Impact of Covid-19 on test scores: heterogeneous effects by prior skills, grade 5, 8, and 13



Notes: 95% confidence intervals based on standard errors clustered at the class level. The results are bases on a parametric estimate of model 3, which includes the effect of Covid-19 and an interaction term between being in the Covid cohort and prior skills. Prior skills are the INVALSI standardized assessment in the corresponding subject, 3 years before the outcomes (e.g. Italian test scores for Italian and math test scores for math). All specifications include socio-demographic controls (age, gender, parents' level of education and occupation), and school fixed effects. Full results are available from the authors upon request. * p<0.1, ** p<0.05, *** p<0.01.

In terms of inequalities, the existing literature on Italy reports that gender disparities reduced in both Italian and mathematics and at all school levels, except for primary school math (Contini et al. 2022, Borgonovi and Ferrara 2023). Moreover, no evidence was

[5] Instead, the result differs from the findings of Contini et al. (2022), who used different data to examine the effect for the first closure in spring 2020 in Grade 5, according to which those who lost the most in math were those with low-educated parents who were previously higher achievers.

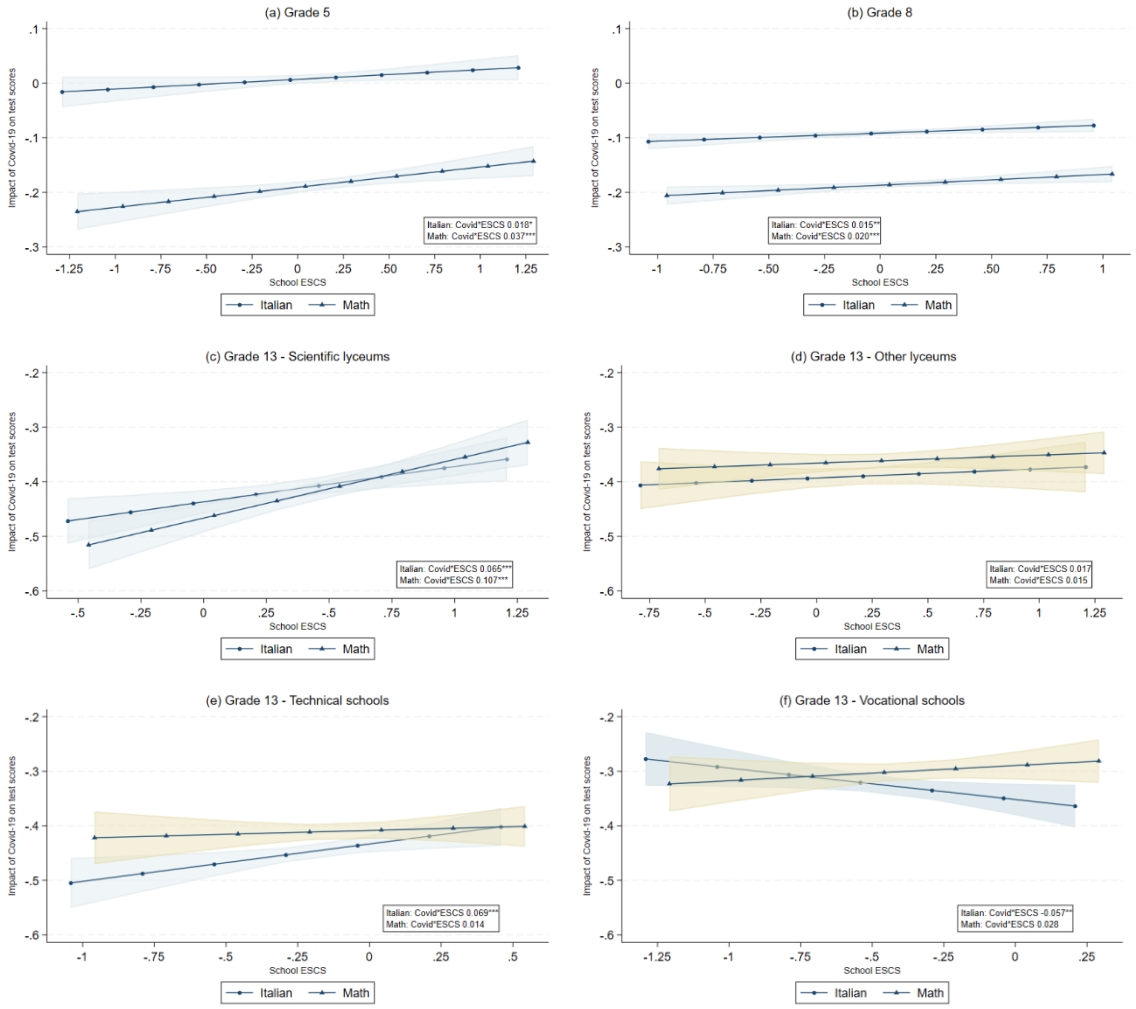
found on the existence of differential effects by socio-economic background at the individual level (Bazoli et al. 2022, Contini et al. 2022 and 2023, Borgonovi and Ferrara 2023, Battisti and Maggio 2023). In contrast to descriptive comparisons of the proficiency levels attained (INVALSI 2021), according to which the share of underachieving learners increased more among children from socio-economically disadvantaged backgrounds, none of the above studies found a widening of learning gaps between social groups, even with different measures of social background.[6]

This finding is in contrast with the results in the international literature reported in different papers and processed in meta-analyses (Betthäuser et al., 2023, Patrinos et al., 2022), according to which social inequalities have widened during the pandemic years. Although the reason for this specificity remains to be understood, we can speculate that even if parents with greater cultural resources had the means to better compensate for the shortcomings of distance learning, many of them were affected by work rhythms (including working from home) that were significantly more intense than before, making it difficult to effectively support their children because of employment obligations (a similar reflection has been made by Fahle et al. 2023). This effect may have been amplified by the low level of ICT skills among the population in Italy before the pandemic shock (European Commission 2020).

To explore the role of contextual factors in the impact of the pandemic on children's learning, we introduced a variable capturing the socio-economic context of the school, interacted with the Covid treatment variable (model 4). Figure 2 describes the results: on the x-axis are the mean school ESCS, on the y-axis the average learning loss in standard deviations (at the mean of the other explanatory variables). In Grades 5 and 8, the negative impact of the pandemic decreases with the socio-economic level of the school. The situation in Grade 13 is more varied. The gradient is particularly high in scientific lyceums, especially for mathematics. We find no heterogeneity in Other lyceums, and in Technical and Vocational schools for math. Instead, we find an effect in the opposite direction for Italian in Vocational schools. To interpret the figures, let us take the case of mathematics in Scientific Lyceums: we observe an average loss of 0.52 standard deviations for the students in the least advantaged schools and an average loss of 0.33 for those in the most advantaged schools. The difference is clearly considerable.

[6] The results of the analyses of average scores and of discrete achievement levels are not contradictory. If underachievers are defined as scoring below a certain (low) threshold, then since high SES children score higher on average than low SES children, the proportion of underachievers will increase more among the latter, even though on average the two groups have experienced the same loss.

Figure 2. Impact of Covid-19 on test scores: heterogeneous effects by school socio-economic status, grade 5, 8, and 13 (by tracks)



Notes: 95% confidence intervals based on standard errors clustered at the class level. The results are based on a parametric estimate of model 4, which includes the effect of Covid-19 and an interaction term between being in the Covid cohort and the average schools ESCS (Economic, Social and Cultural Status) at the school level (without controlling for school fixed effects but adding dummy variables for regional effects). Significant interactions (* p<0.1, ** p<0.05, *** p<0.01) have bluish confidence intervals, non-significant interactions have khaki ones (Grade 13, Other lyceums: Italian and math; Technical and Vocational schools: math). Full results are available from the authors upon request.
"School ESCS" identifies the average socio-economic context at the school level and it is standardized at the student level (mean 0, st. dev. 1). It may vary across the different figures, because for each grade and track it ranges from around the bottom 1% to the top 99% of average school ESCS (extreme values are excluded). It can be noticed, for instance, that the average school ESCS is much higher in Scientific lyceums (range: -0.5 to 1.25) than in Technical and especially Vocational schools (range: -1.25 to 0.25).

In sum, while there are no differences between children of different backgrounds *within* schools, we do find differences *across* schools, as the learning loss is generally largest in schools attended by students of lower socio-economic background (conditional on

regional effects and the school track in Grade 13). This could be because better teachers may self-select into more advantaged schools (Barbieri et al. 2011) or because teachers in advantaged schools were operating in an environment more conducive to benefiting from distance learning. It could also be that parents with higher socio-economic status are able to exert more control over the use of school resources and particularly exercise voice in decisions pertaining for example to the amount of resources devoted to support distance learning.

Similar results were found by Maldonado and De Witte (2021) for Belgium and by Fahle et al. (2023) for the United States. According to the latter, learning losses were greater in low-income and minority districts. Among districts, the loss was greater in high-minority and high-poverty districts. Within districts, however, there were no substantial differences between advantaged and disadvantaged students. The authors suggest that the mechanisms driving the losses operate at the district or community level, rather than at the household level, although no specific characteristics were identified as the primary channel.

4. Policies to support the educational sector

Since March 2020, schools received funding to improve digital tools for distance learning and technical support (Camera dei Deputati, 2022). This measure allowed schools to adapt quickly, but it also highlighted the lack of digitalisation of Italian schools, teachers and pupils. A budget was given to schools to provide free digital equipment (PCs, tables, internet connection) to poorer students. At the same time, the Ministry of Education allocated funding for the digital training of teachers (Ministerial Decree n. 187, 26 March 2020). According to survey data collected by Carlana and La Ferrara (2021), by the end of the school year most of the teachers were providing synchronous online classes. In addition, the government allocated a special budget for the renovation of school buildings to ensure physical distance during the school year and for school staff to reduce the disruption caused by teacher contagion.

In the summer of 2020, no remedial measures were taken to support student learning. In the following school year, the government finally funded face-to-face teaching projects to reduce learning deficits, especially in primary and secondary schools in disadvantaged areas. Projects were submitted by schools and then approved, although actual implementation varied widely from school to school. To the best of our knowledge, there is some evidence that the schools that applied for funding were the schools that were better equipped in terms of human resources.

Conversely, large amounts of resources have more recently been devoted to the education sector as part of the European Recovery programme (called PNRR in Italy) in June 2022: 20 billion euros have been set aside for education, of which 13 are for upgrading existing infrastructure to make it more sustainable in emissions and energy use as well as

modernise it. The aim is furnishing schools with the necessary tools for the modernisation of the education system as is described in the Schools 4.0 plan,[7] which includes constructions/upgrades of conventional classrooms (Next generation classrooms - the plan foresees turning 100K traditional classrooms into connected classrooms) and dedicated spaces for digital learning (Next generation labs) to accelerate the digital transition of Italian schools. Special attention is devoted in the plan also to strengthening STEM education with a particular focus on female students, and on enhancing language skills among both students and teachers, partly through the expansion of the Erasmus+ programme. The training of teachers is planned to take place through three Teaching and Learning Centres and three Digital Education Hubs, and there is also a dedicated line of funding for 500 PhD students in subjects related to the environment and digital fields.

The most ambitious part of the process concerns the building of 212 new schools (with a budget increased from 800 to 1189 million euros) for which a public tender took place in 2022 and an expert commission of educationalists and architects selected winners. Two of the experts, Andrea Gavosto and Raffaella Valente from Fondazione Agnelli, commented in an article in the press on 15/3/23 that although the projects themselves are really ambitious and promising, there are serious dangers in their realisation that stem from the combination of needing to respect EU recovery fund deadlines with the inadequacy of existing administrative resources and processes that are putting much of the PNRR at risk in other areas too (Gavosto and Valente 2023). Italy has experienced not only an historically cumbersome and intricate institutional structure with overlapping competencies that make action difficult, but also a public sector hiring freeze for more than two decades (Pedaci et al. 2020). The same issue affects the modernisation and digitalisation of school's programme for which large amounts of expenditure (up to 260K euros per school) have been set aside, but which schools themselves are finding difficult to spend and risk devoting to just acquiring more hardware and not necessarily to developing the competencies needed to make good use of it (Abbiati et al. 2023, Comi et al. 2017).

The second largest part of the plan concerns the training of existing teachers and the training and selection processes of new teachers particularly in secondary schools where they have traditionally not been systematically trained in teaching methods. This plan has however not been implemented and while in its original spirit required a homogeneous approach nation-wide, the current government favours instead a decentralised one, which again risks widening inequalities further (Gavosto, 2023).

While the plans for the education sector suggest that large amounts of resources will accrue to the system and help compensate for some of the losses incurred, our analysis shows that the largest learning losses imputable to Covid-19 have been experienced especially by upper secondary school pupils. This should cause concern as it suggests that

[7] https://pnrr.istruzione.it/news/pubblicato-il-piano-scuola-4-0/.

these losses will have cumulative effects that in the case of the older cohorts will not be mitigated by the new measures and thus affect future labour market and other outcomes.

The INVALSI report of 2022 (INVALSI 2022), which presents observations based on the latest data collection, indicates that there has not yet been a learning recovery in the third year since the pandemic, suggesting that simply reverting to previous learning modes is not per se sufficient to compensate the losses suffered. This should serve as a reminder to make the best use of resources to bring about a real improvement in the educational provision of schools and their ability to engage pupils of all ages, genders and family backgrounds.

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