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IZA DP No. 15754

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ABSTRACT

The Uneven Effect of COVID School Closures: Parents in Teleworkable vs. Non-teleworkable Occupations*

Teleworking parents can better monitor and help their children with online learning. In this paper, I test whether parents' teleworkability affected children's online learning during Covid school closures. I use panel data from Invalsi, which includes the results of standardized tests given to all Italian students in grades 2 and 5 and parental characteristics. I compare changes in children's performance from grade 2 to grade 5 along two dimensions: whether they experienced Covid school closures between grade 2 and grade 5 and whether their parents work in teleworkable occupations. I also exploit variations in the length of Covid school closures and the use of online learning resources across Italian regions. My results show that one hundred school closure days widens the gap between children of teleworkable and nonteleworkable parents by 0.04 in language tests and 0.01 in maths tests.

JEL Classification: I24, J81
Keywords: teleworkability, online learning, COVID-19, parents

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1 Introduction

The closure of schools during the Covid-19 pandemic, which implied a sudden shift from face-to-face to online learning, damaged student learning according to the economic, psychology, and education literature[1]. Moreover, Covid-driven school closures also increased inequality among students, with the highest losses experienced by low-income students in the US and the UK, those with a disadvantaged background in Germany, low socioeconomic status students in Belgium, students with low educated parents in France and Italy, and low performing students in Italy[2]. I hypothesize that parental occupation may be behind the rise in education inequality during the pandemic. Parents in occupations that allow them to work online from home (teleworkable occupations) may be more able to follow students during online lessons and help with extra homework. In this paper, I study the role of parental occupation's teleworkability as a mediating factor of the damage caused by school closures to Italian students.

I estimate a Difference-in-Difference model comparing students' changes in performance from grade 2 to grade 5 along two dimensions: (i) whether they were affected or unaffected by Covid school closures between grade 2 and grade 5 (the affected cohort is in grade 5 in the academic year 2020-2021), and (ii) whether at least one of their parents is in a teleworkable occupation. In practice, I exploit within student variation by studying the change in performance from second to fifth grade. Regarding dimension (i), I estimate the effect of Covid on school performance by comparing children who finished primary school before Covid with children in fourth grade in 2019-2020, when the Covid pandemic started. To refine this comparison, I also use the number of school closure days during the academic years 2019-2020 and 2020-2021 in each region. Alternatively, I use each region's intensity of online learning resources utilization. As for dimension (ii), I

[1]Examples of the economic, psychology and education literature are Werner and Woessmann [2021], Hammerstein, König, Dreisörner, and Frey [2021], and Zierer [2021], respectively.

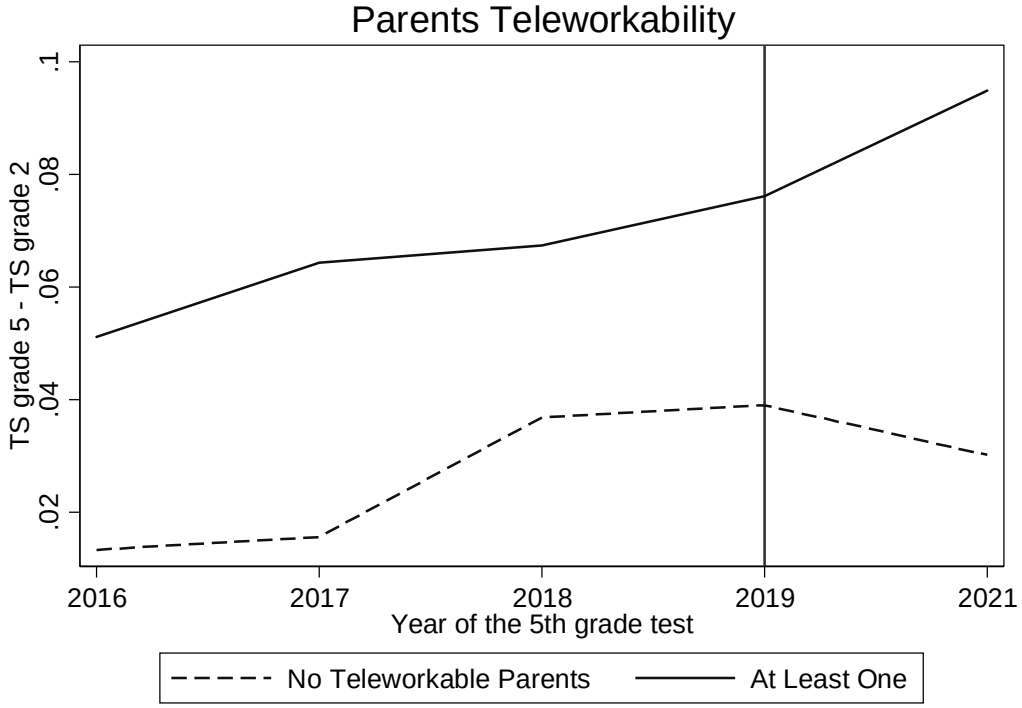
[2]See Chetty, Friedman, Hendren, Stepner, et al. [2020] for the US; Andrew, Cattan, Costa Dias, Farquharson, Kraftman, Krutikova, Phimister, and Sevilla [2020] for the UK; Werner and Woessmann [2021] for Germany; Maldonado and De Witte [2022] for Belgium; Champeaux, Mangiavacchi, Marchetta, and Piccoli [2020] for France and Italy; and Contini, Di Tommaso, Muratori, Piazzalunga, and Schiavon [2021] for Italy.

estimate how the effect of online learning measured in the three modes explained above changes for students with and without parents in teleworkable occupations.

I test my hypothesis that parental teleworkability is behind the increase in learning inequality during school closures using panel data from Invalsi for years 2016-2017, 2017-2018, 2018-2019, and 2020-2021. Invalsi data contains information on standardized test scores and students' characteristics, including parental occupation for the universe of Italian students. I merge this data with information on occupation's teleworkability in Italy from Cetrulo, Guarascio, and Virgillito [2022], which I validate using data on occupation's teleworkability in the US and UK from Adams-Prassl, Boneva, Golin, and Rauh [2022]. I add self-collected data on the number of school closure days in the academic years 2019-2020 and 2020-2021 and validate it using the Save the Children report (2021). Finally, I complete my dataset with data on Google Classroom searches obtained from Google Trends.

I illustrate my results graphically. Graph 1 shows the evolution of the average difference in language test scores between grade 5 and grade 2 over time, separately for children with parents in teleworkable and non-teleworkable occupations. For cohorts unaffected by Covid school closures (before 2020-2021), children with no teleworkable and those with at least one teleworkable parent improved their performance. After the Covid school closures, the performance of children with no teleworkable and at least one teleworkable parent diverges because children with no teleworkable parents worsen their performance in grade 5 relative to grade 2 for the first time.

My work is part of the emerging literature on the consequences of the Covid-19 pandemic for families and children. Related studies include Kuhfeld, Soland, Tarasawa, Johnson, Ruzek, and Liu [2020] who develop projections based on evidence on summer learning loss in the United States and estimate that under a three-month lockdown, learning



gains would be reduced to 37-50 percent of the usual progress for math and 63-68 percent for reading. They find that losing ground during the school closures was not universal, with the top third of students potentially making gains in reading. Kuhfeld, Tarasawa, Johnson, Ruzek, and Lewis [2020] document actual learning loss among US students who took MAP tests in the fall of 2020, and find little learning loss in reading but substantial learning loss in math in line with the projections based on summer learning loss. They consider that the impacts of COVID-19 on achievement for the most vulnerable students may be underestimated. Andrew, Cattan, Costa Dias, Farquharson, Kraftman, Krutikova, Phimister, and Sevilla [2020] find considerable heterogeneity in children's learning experiences - the amount of time spent learning, activities undertaken, and availability of resources to support learning during Covid in the UK. This heterogeneity is strongly associated with family income and, in some instances, more so than before the lockdown. Werner and Woessmann [2021] provide a comprehensive review of the literature on school closures during the pandemic, complemented by an empirical analysis based on a German longitudinal time-use survey. They document learning losses that are par-

ticularly severe for children from disadvantaged backgrounds. Maldonado and De Witte [2022] use test score data from Belgium to estimate the impact of the Covid crisis on learning. According to their analysis, the 2020 cohort of children leaving primary school (6th grade) experienced a learning loss of approximately 0.2 standard deviations compared to the previous cohort. They observe that inequality within and across schools rises by 7% for mathematics and 8% for Dutch. The learning losses are correlated with observed school characteristics, as schools with a more disadvantaged student population experience larger learning losses.

Some papers on the consequences of Covid-related school closures for students' learning focus on the Italian case. Contini, Di Tommaso, Muratori, Piazzalunga, and Schiavon [2021] compare two cohorts of Italian students, one pre-Covid and one post-Covid, and find that the pandemic had an enormous negative impact on the pupils' performance in mathematics (-0.19 standard deviations). Moreover, among children of low-educated parents, the learning loss was more considerable for the best-performing ones (up to -0.51 s.d.) and girls (-0.29 s.d.). Champeaux, Mangiavacchi, Marchetta, and Piccoli [2020] combine Italian and French survey data and find that the lockdown had a more substantial negative effect on boys, on kids attending kindergarten (in Italy) or secondary school (in France), and on children whose parents have a lower education level.

A branch of the literature uses structural models to examine the impact of pandemic-induced school closures on educational inequality. Agostinelli, Doepke, Sorrenti, and Zilibotti [2022] interact the influences of schools, peers, and parents on educational inequality. Using US data, they find that school closures have a large, persistent, and unequal effect on human capital accumulation. According to their estimations, high school students from low-income neighborhoods suffer a learning loss of 0.4 standard deviations after a one-year school closure. In contrast, children from high-income neighborhoods initially remain unaffected. Fuchs-Schündeln, Krueger, Ludwig, and Popova [2020], Fuchs-Schündeln, Krueger, Kurmann, Lalé, Ludwig, and Popova [2021], and Jang and Yum [2020] focus on the long-run repercussions of school closures. Fuchs-Schündeln, Krueger,

Ludwig, and Popova [2020] find that parental reactions reduce the negative impact of school closures but do not fully offset it. The negative impact of the crisis on children's welfare is especially severe for those with parents with low educational attainment and low assets. Fuchs-Schündeln, Krueger, Kurmann, Lalé, Ludwig, and Popova [2021] compare children from the top to children from the bottom quartile of the income distribution and conclude that welfare losses are approximately 0.8 percentage points larger for the poorer children if school closures were unrelated to income. Accounting for the longer school closures in richer counties reduces this gap by about 1/3. Jang and Yum [2020] find that school closures reduce intergenerational mobility. Heterogeneous parental responses to school closures play a key role in explaining the effect of Covid school closures on children's outcomes.

Also related to this paper, Bacher-Hicks, Goodman, and Mulhern [2021] show that early in the pandemic, internet searches for online learning resources rose much more quickly in high-income areas, which suggests that parents in affluent neighborhoods were more engaged with remote learning. Tertilt, Doepke, Alon, and Olmstead-Rumsey [2020] also consider the effects of school closures, but with a focus on implications for parents' labor supply rather than children's education.

The remainder of this paper is organized as follows. I present my methodology in Section 2. In Section 3, I describe the data and institutional background, and in Section 4, I present my results. Section 4.1 presents robustness checks and discusses the heterogeneity of the effects. I conclude in Section 5.

2 Empirical Strategy

I estimate the differential causal effect of the shift from face-to-face to online classes on students' learning by parental teleworkability. To account for children's unobserved characteristics, I estimate regressions where I use the change in children's performance as the dependent variable. This strategy implicitly takes into account students' type by includ-

ing students' performance pre-Covid in the regression. I also account for children's demographic characteristics and class fixed effects. The resulting regression is as follows:

$$TS5_{it} - TS2_{it-3} = \beta_0 + \beta_1 * Closure_{it} * Telework_{it-3} + \beta_2 * D(Year)_{it} + \beta_4 * D(FatherOcc)_{it-3} + \\ + \beta_5 * D(MotherOcc)_{it-3} + \beta_6 * D(FatherEdu)_{it-3} + \beta_7 * D(MotherEdu)_{it-3} + \beta_8 * Male_{it} + \\ + \beta_9 * Immi_{it} + \beta_{10} * ImmiFather_{it} + \beta_{11} * ImmiMother_{it} + \beta_{12} * D(Class)_{it} + \epsilon_{it} \tag{1}$$

where $TS5 - TS2$ is the difference in test scores between grade 5 and grade 2 for student i, and *Closure* is a dummy equal to one if the student experienced Covid-driven school closures between grades 2 and 5. In alternative specifications, *Closure* is the intensity of google searches for the term "Google Classroom" as measured by the Google Trends index or the number of school closure days in the academic years 2019-2020 and 2020-2021 in the region of residence of student i. *Telework* is a dummy equal to one if at least one parent is in a teleworkable occupation. $D(year)$ are year dummies. $D(FatherOcc)$ and $D(MotherOcc)$ are vectors of dummies for the father's and mother's occupations, respectively. Similarly, $D(FatherEdu)$ and $D(MotherEdu)$ are vectors of dummies for the father's and mother's education levels, respectively. The set of controls includes binary indicators for male, immigrant (*Immi*), immigrant father (*ImmiFather*), and immigrant mother (*ImmiMother*). $D(Class)$ are Class fixed effects. Finally, ϵ is the error term.

β_1 is the parameter of interest. I interpret this coefficient as the change in learning inequality between children with and without parents in teleworkable occupations due to school closures (alternatively, higher use of online learning resources or school closure days). A positive coefficient means that school closures have exacerbated differences in learning across children in favor of children whose parents can telework. The coefficients β_1 in the specifications using Google Trends data and Covid school closure days indicate how differences in performance change with an increase in online learning resources as

measured by the Google Trends index, and an additional school closure day, respectively.

3 Data and Descriptive Statistics

Education is compulsory in Italy between ages 6 and 16. The education system is divided into elementary school (five years), middle school (three years), and secondary school (five years). We use standardized test score data from the National Institute for the Evaluation of the School System (INVALSI). Students take standardized tests in the second and fifth year of elementary school, then three years later in the third year of middle school, and finally two years later in the second year of secondary school. INVALSI provides panel data from academic years 2016-17 to 2019-20 and 2021-2022. Data on the academic year 2020-2021 is unavailable as students did not take the test because of the Covid school closures.

We complement Invalsi data with information on occupation's teleworkability in Italy from Cetrulo, Guarascio, and Virgillito [2022] and validate it using the UK and the US data from Adams-Prassl, Boneva, Golin, and Rauh [2022]. Teleworkable occupations according to both datasets are manager, professor, teacher, and low-rank employee. In contrast, employer, high-rank employee, doctor, self-employed, and blue-collar are non-teleworkable occupations. I obtained data on the number of school closure days by region from Italian legislation reports. I validated it using the Save the Children report (2021). Finally, I downloaded data on "Google Classroom" searches by region between March 1, 2020 (the time Covid school closures started) and March 1, 2021 (immediately before Invalsi tests were taken) from Google Trends. I show my data on the number of school closure days, and Google Classroom searches in Table 1. The number of closure days in 2020-2021 presents more variation than in 2019-2020. The number of closure days and Google Classroom Downloads are highly related, which seems reasonable as Google Classroom was a widely used tool for online learning during school closures (correlation equals 0.39).

Table 1: Covid School Closures Data

Region	Closure Days 2019-2020	Closure Days 2020-2021	Google Classroom Downloads
Abruzzo	62	18	57
Basilicata	64	35	41
Bolzano	67		29
Calabria	62	30	60
Campania	65	70	53
Emilia-Romagna	71	13	26
Friuli-Venezia Giulia	74	16	32
Lazio	62	12	43
Liguria	73	10	21
Lombardia	69	19	32
Marche	64	13	43
Molise	61	28	100
Piemonte	71	13	30
Trento	66	11	29
Puglia	63	44	62
Sardegna	60	0	27
Sicilia	61	5	51
Toscana	64	4	43
Umbria	61	15	38
Valle d'Aosta	65	3	15
Veneto	65	13	36

Notes: Data is self-collected from Italian Law Reports and Google Trends.

The INVALSI data contains test scores from two subjects (Italian and mathematics) and indicates the number of correct answers. We standardize scores by subject, academic year, and grade to have zero mean and unit variance (as in Angrist, Battistin, and Vuri [2017]). The data set also includes students' characteristics (among them: gender and whether they are foreign-born) and parental characteristics (among them: whether they are foreign-born, their level of education, their labor market status, and occupation). My sample is composed of children whose parents were employed when children were in second grade and for whom I have data on their performance in second and fifth grade. Table 2 describes the sample included in my main specification:

My most refined specification compares children according to the number of school closure days in their region of residence. I define regions with high closure days as those with a number of closure days higher than the median and regions with low closure days as those that closed schools less than the median. Table 3 shows descriptive statistics for the subsamples of regions with high and low closure days. Tests of equality of means between subsamples show that both sets of regions are reasonably comparable.

Table 2: Descriptive Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Diff. Math Score	0.03	0.851	-4.623	4.524	879780
Diff. Italian Score	0.053	0.89	-5.103	4.748	876450
Teleworkable Parent	0.576	0.494	0	1	876450
Teleworkable Mother	0.494	0.5	0	1	876450
Teleworkable Father	0.309	0.462	0	1	876450
School Closures	0.202	0.401	0	1	876450
Google Trends	38.381	11.483	15	100	874217
Closure Days	85.318	15.658	60	135	876450
Male	0.505	0.5	0	1	876450
Immigrant child	0.013	0.114	0	1	876450
Father from EU	0.022	0.147	0	1	876450
Father from Europe but non-EU	0.018	0.131	0	1	876450
Father from outside Europe	0.026	0.159	0	1	876450
Mother from EU	0.03	0.171	0	1	876450
Mother from Europe but non-EU	0.021	0.143	0	1	876450
Mother from outside Europe	0.029	0.169	0	1	876450
Father elementary school degree	0.008	0.089	0	1	876450
Father secondary school degree	0.246	0.431	0	1	876450
Father 3 years vocational school degree	0.087	0.282	0	1	876450
Father high-school degree	0.417	0.493	0	1	876450
Father musics or arts high-school degree	0.019	0.136	0	1	876450
Father university degree	0.222	0.416	0	1	876450
Father manager / professor	0.042	0.2	0	1	876450
Father employer	0.063	0.243	0	1	876450
Father high-rank employee or doctor	0.179	0.384	0	1	876450
Father self-employed	0.192	0.394	0	1	876450
Father teacher or low-rank employee	0.267	0.443	0	1	876450
Father blue-collar worker	0.257	0.437	0	1	876450
Mother elementary school degree	0.004	0.063	0	1	876450
Mother secondary school degree	0.138	0.344	0	1	876450
Mother 3 years vocational school degree	0.069	0.254	0	1	876450
Mother high-school degree	0.444	0.497	0	1	876450
Mother musics or arts high-school degree	0.029	0.167	0	1	876450
Mother university degree	0.316	0.465	0	1	876450
Mother manager / professor	0.02	0.141	0	1	876450
Mother employer	0.028	0.164	0	1	876450
Mother high-rank employee or doctor	0.163	0.369	0	1	876450
Mother self-employed	0.115	0.319	0	1	876450
Mother teacher or low-rank employee	0.474	0.499	0	1	876450
Mother blue-collar worker	0.2	0.4	0	1	876450

Notes: Data is from Invalsi. This table presents averages, standard deviations, minimum, and maximum values for the sample included in the main estimation.

My objective is to estimate differences in the effect of school closures on student learning between students with at least one parent in a teleworkable occupation and children whose parents worked in no-teleworkable occupations when they were in second grade. Table 4 shows that children with at least one teleworkable parent are less likely to be immigrants or children of immigrants and more likely to have highly educated parents.

4 Results

I show the result of estimating Equation 1 in Table 5. In column one, I define the *Closure* indicator as a variable equal to one if the student was in fourth grade during the first Covid wave, i.e., was in fifth grade in the academic year 2020-2021. In column two, *Closure* refers to Google Trends data on "Google Classroom" searches from March 1, 2020 (first school closures) to March 1, 2021 (Invalsi test). Finally, column three reports the results when the *Closure* measure is the number of closure days in the region of residence.

Reassuringly, results are highly similar for the three measures of *Closure*. The magnitude of the estimated effect indicates that Covid school closures increase differences between children with parents in teleworkable and non-teleworkable occupations by 0.03 standard deviations for language and 0.008 for maths. Likewise, one hundred additional points in the Google Trends index increases language test scores by 0.02 standard deviations. Similarly, one hundred school closure days (with online learning) widens the gap between children of teleworkable and non-teleworkable parents by 0.04 in language tests and 0.01 in maths tests. Hence, teleworkable parents make a difference particularly for Language performance.

My regressor of interest is the interaction of exposure to Covid school closures and a dummy for having at least one parent in a teleworkable occupation. However, there are persistent cultural norms regarding gender roles in childcare, and thus, it may be helpful

Table 3: Descriptive Statistics: High vs. Low Closure Days

	High Closure Days		Low Closure Days	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Diff. Math Score	0.03	0.84	-0.036	0.855
Diff. Italian Score	0.056	0.886	0.049	0.895
Teleworkable Parent	0.576	0.494	0.576	0.494
Teleworkable Mother	0.495	0.5	0.493	0.5
Teleworkable Father	0.308	0.462	0.31	0.463
School Closures	0.196	0.397	0.21	0.408
Google Trends	37.072	13.099	40.246	8.327
Closure Days	93.544	15.398	73.671	5.014
Male	0.506	0.5	0.504	0.5
Immigrant child	0.013	0.114	0.013	0.114
Father from EU	0.02	0.141	0.025	0.155
Father from Europe but non-EU	0.017	0.13	0.018	0.133
Father from outside Europe	0.027	0.162	0.025	0.155
Mother from EU	0.028	0.165	10.033	0.18
Mother from Europe but non-EU	0.021	0.143	0.021	0.142
Mother from outside Europe	0.031	0.172	0.028	0.164
Father elementary school degree	0.009	0.094	0.007	0.083
Father secondary school degree	0.253	0.435	0.237	0.425
Father 3 years vocational school degree	0.089	0.284	0.085	0.279
Father high-school degree	0.409	0.492	0.43	0.495
Father musics or arts high-school degree	0.02	0.139	0.018	0.133
Father university degree	0.221	0.415	0.223	0.417
Father manager / professor	0.043	0.204	0.039	0.194
Father employer	0.064	0.244	0.063	0.242
Father high-rank employee or doctor	0.175	0.38	0.185	0.388
Father self-employed	0.191	0.393	0.193	0.395
Father teacher or low-rank employee	0.264	0.441	10.271	0.445
Father blue-collar worker	0.263	0.44	0.249	0.432
Mother elementary school degree	0.005	0.067	0.003	0.058
Mother secondary school degree	0.144	0.351	0.128	0.335
Mother 3 years vocational school degree	0.074	0.262	0.063	0.243
Mother high-school degree	0.434	0.496	0.457	0.498
Mother musics or arts high-school degree	0.03	0.172	0.027	0.161
Mother university degree	0.313	0.464	0.321	0.467
Mother manager / professor	0.02	0.141	0.02	0.14
Mother employer	0.027	0.162	0.029	0.167
Mother high-rank employee or doctor	0.164	0.37	0.162	0.368
Mother self-employed	0.113	0.317	0.118	0.322
Mother teacher or low-rank employee	0.475	0.499	0.473	0.499
Mother blue-collar worker	0.201	0.401	0.199	0.399

Notes: Data is from Invalsi. This table presents averages, standard deviations, minimum, and maximum values for the subsamples of regions where the number of school closure days are higher and lower than the median, respectively.

Table 4: Descriptive Statistics: Parents in Teleworkable vs. non-Teleworkable Occupations

	Teleworkable		non-Teleworkable	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Diff. Math Score	0.044	0.829	0.017	0.869
Diff. Italian Score	0.072	0.868	0.028	0.918
Teleworkable Parent	1	0	0	0
Teleworkable Mother	0.857	0.35	0	0
Teleworkable Father	0.536	0.499	0	0
School Closures	0.201	0.401	0.202	0.402
Google Trends	38.131	11.208	38.72	11.839
Closure Days	85.057	15.373	85.672	16.031
Male	0.507	0.5	0.504	0.5
Immigrant child	0.01	0.1	0.017	0.131
Father from EU	0.013	0.111	0.035	0.184
Father from Europe but non-EU	0.008	0.09	0.03	0.171
Father from outside Europe	0.012	0.107	0.046	0.208
Mother from EU	0.018	0.132	0.047	0.212
Mother from Europe but non-EU	0.01	0.099	0.035	0.185
Mother from outside Europe	0.013	0.114	0.051	0.221
Father elementary school degree	0.003	0.053	0.015	0.122
Father secondary school degree	0.167	0.373	0.354	0.478
Father 3 years vocational school degree	0.071	0.257	0.109	0.311
Father high-school degree	0.478	0.5	0.335	0.472
Father musics or arts high-school degree	0.019	0.136	0.019	0.137
Father university degree	0.262	0.44	0.168	0.374
Father manager / professor	0.072	0.259	0	0
Father employer	0.048	0.214	0.083	0.276
Father high-rank employee or doctor	0.13	0.337	0.246	0.431
Father self-employed	0.13	0.336	0.275	0.447
Father teacher or low-rank employee	0.464	0.499	0	0
Father blue-collar worker	0.155	0.362	0.395	0.489
Mother elementary school degree	0.001	0.029	0.008	0.091
Mother secondary school degree	0.051	0.219	0.256	0.436
Mother 3 years vocational school degree	0.046	0.21	0.101	0.301
Mother high-school degree	0.505	0.5	0.36	0.48
Mother musics or arts high-school degree	0.028	0.165	0.03	0.171
Mother university degree	0.369	0.482	0.245	0.43
Mother unemployed	0	0	0	0
Mother houseworker	0	0	0	0
Mother manager / professor	0.035	0.184	0	0
Mother employer	0.008	0.087	0.055	0.227
Mother high-rank employee or doctor	0.064	0.245	0.298	0.457
Mother self-employed	0.029	0.168	0.232	0.422
Mother teacher or low-rank employee	0.822	0.382	0	0
Mother blue-collar worker	0.042	0.201	0.415	0.493

Notes: Data is from Invalsi. This table presents averages, standard deviations, minimum, and maximum values for the subsamples of children with at least one parent in teleworkable occupations and the rest of the children, respectively.

Table 5: Parental Teleworkability and Students' Performance after School Closures

	Maths			Language		
	Covid	Google Trends	Closure Days	Covid	Google Trends	Closure Days
	(1)	(2)	(3)	(4)	(5)	(6)
Closure*At Least One Teleworkable Parent	0.008	-.00003	0.00009	0.031	0.0002	0.0004
	(0.004)*	(0.00009)	(0.00005)*	(0.005)***	(0.0001)***	(0.00005)***
Obs.	879780	877554	879780	876450	874217	876450
R^2	0.008	0.008	0.008	0.008	0.008	0.008
F statistic	64.57	65.85	64.568	63.903	64.943	63.896

Notes: Data is from Invalsi for the years 2016-2019 and 2021-2022. The dependent variable is the difference between standardized test scores in grades 5 and 2. The sample is composed of all children whose parents were employed when children were in second grade. *** p<0.01, ** p<0.05, * p<0.1.

to consider mothers and fathers separately. I explore whether having a mother or a father in a teleworkable occupation differently shapes the impact of Covid school closures on children's learning. To this, I run my regression substituting the dummy for at least one parent in a teleworkable occupation by two binary indicators for having a mother and a father in a teleworkable occupation. Results in Table 6 show that, if anything, fathers in teleworkable occupations are more effective in attenuating the adverse effects of Covid on their children than mothers.

Table 6: Father and Mother Teleworkability and Students' Performance after School Closures

	Maths			Italian		
	Covid	Google Trends	Closure Days	Covid	Google Trends	Closure Days
	(1)	(2)	(3)	(4)	(5)	(6)
Closure*Teleworkable Father	0.01	0.0001	0.0001	0.028	0.0003	0.0003
	(0.005)**	(0.0002)	(0.00006)*	(0.005)***	(0.0002)	(0.00006)***
Closure*Teleworkable Mother	0.006	-.00009	0.00008	0.024	0.0002	0.0003
	(0.005)	(0.0002)	(0.00005)	(0.005)***	(0.0002)	(0.00006)***
Obs.	879780	877554	879780	876450	874217	876450
R^2	0.008	0.008	0.008	0.008	0.008	0.008
F statistic	64.039	65.245	64.031	63.596	64.315	63.55

Notes: Data is from Invalsi for the years 2016-2019 and 2021-2022. The dependent variable is the difference between standardized test scores in grades 5 and 2. The sample is composed of all children whose parents were employed when children were in second grade. *** p<0.01, ** p<0.05, * p<0.1.

4.1 Robustness Checks and Heterogeneity Analsysis

In this Section, I explore the robustness of my main results to the exclusion of high-ranked occupations, the use of raw rather than standardized test scores, and including interactions of exposure to school closures with all other students' and parents' observed char-

acteristics. I also explore the heterogeneity of my results by students' characteristics and parental background.

Many teleworkable occupations may coincide with high-ranked occupations, characterized not only by teleworkability but also by high wages and prestige. In order to make sure that it is not high wages that make parents more able to help their children with online schooling, I exclude from my sample all children with at least one parent who is employed in a high-ranked teleworkable occupation (manager, professor, etc.). The exclusion of high-ranked occupations leaves teachers and low-ranked employees as the only teleworkable parents. This exclusion implies a reduction of 6% in the sample. I show the result of this exercise in the table below. The estimated coefficients and significance levels remain highly unaltered with respect to those in Table 5.

Table 7: Excluding High-Ranked Teleworkable Occupations

	Maths			Italian		
	Covid	Google Trends	Closure Days	Covid	Google Trends	Closure Days
	(1)	(2)	(3)	(4)	(5)	(6)
Closure*At Least One Tele Parent	0.01	0.00002	0.0001	0.029	0.0003	0.0003
	(0.004)**	(0.00009)	(0.00005)**	(0.005)***	(0.0001)***	(0.00005)***
Obs.	831916	829814	831916	828572	826468	828572
R^2	0.008	0.008	0.008	0.008	0.008	0.008
F statistic	61.89	63.156	61.887	61.116	62.224	61.114

Notes: Data is from Invalsi for the years 2016-2019 and 2021-2022. The dependent variable is the difference between standardized test scores in grades 5 and 2. The sample comprises all children whose parents were employed in medium-low ranked occupations when children were in second grade. *** p<0.01, ** p<0.05, * p<0.1.

My dependent variables are differences in standardized test scores between the second and fifth grades. I standardized raw scores by subtracting the mean and dividing the result by the standard deviation for each grade and wave. One may be concerned that this standardization induces mechanical differences when one compares the performances of two groups of students (in my setup, students with teleworkable and no teleworkable parents). My setup makes this argument less worrisome as I use differences rather than absolute values of standardized test scores. However, I test the robustness of my results to the use of differences in raw test scores rather than differences in standardized scores as the dependent variable. I present the result of this robustness test in Table 8. The estimates show a differential positive effect of online learning for children with teleworkable

parents only for language tests.

Table 8: Raw Test Scores

	Maths			Language		
	Covid	Google Trends	Closure Days	Covid	Google Trends	Closure Days
	(1)	(2)	(3)	(4)	(5)	(6)
Closure*At Least One Tele Parent	0.017	-.0006	0.0002	0.53	0.001	0.006
	(0.032)	(0.0007)	(0.0004)	(0.032)***	(0.0007)*	(0.0004)***
Obs.	879780	877554	879780	876450	874217	876450
R^2	0.179	0.179	0.179	0.518	0.518	0.518
F statistic	1677.305	1719.53	1677.305	8217.477	8421.426	8217.31

Notes: Data is from Invalsi for the years 2016-2019 and 2021-2022. The dependent variable is the difference between raw test scores in grades 5 and 2. The sample is composed of all children whose parents were employed when children were in second grade. *** p<0.01, ** p<0.05, * p<0.1.

One may be concerned that our measure of parents' teleworkability is proxying other students' or parents' characteristics. To address this, I control for the interactions of *Closure* with all the observed students' and parents' characteristics in Invalsi data. Students' features include male and immigrant indicators. Parents' traits include dummies for father and mother origin (born in the EU, born in Europe but non-EU, born outside Europe), binary variables for father and mother education (elementary school degree, secondary school degree, three years vocational school degree, high-school degree, music or arts high-school degree, university degree). Hence, this regression includes twenty additional interactions. Results presented in Table 9 are totally in line with those in Table 5, indicating that my measure of teleworkability is not reflecting other students' or parents' characteristics.

I now explore the heterogeneity of the results by gender of the child and level of education of the parents. Results in Table 10 show no differences by gender of the student. The estimated positive effect is driven by highly educated mothers and is stronger for low-educated fathers.

5 Conclusion

Covid school closures implied an unprecedented and unexpected shift from face-to-face to online learning. Teleworkable parents may be more able to monitor and help their children with online learning. I explore whether parents' teleworkability is a relevant factor

Table 9: Additional Interactions

	Maths			Language		
	Covid	Google Trends	Closure Days	Covid	Google Trends	Closure Days
	(1)	(2)	(3)	(4)	(5)	(6)
Closure*At Least One Tele Parent	0.0004	-.00004	0.00009	0.023	0.0002	0.0004
	(0.005)	(0.00009)	(0.00005)*	(0.005)***	(0.0001)*	(0.00005)***
Obs.	879780	877554	879780	876450	874217	876450
R^2	0.008	0.008	0.008	0.008	0.008	0.008
F statistic	56.495	57.064	56.024	55.873	56.723	55.746

Notes: Data is from Invalsi for the years 2016-2019 and 2021-2022. The dependent variable is the difference between raw test scores in grades 5 and 2. The sample is composed of all children whose parents were employed when children were in second grade. These regressions include the following interactions as additional regressors: *Closure**male, *Closure**immigrant, *Closure**father born in EU, *Closure**mother born in EU, *Closure**father born in Europe but not in EU, *Closure**mother born in Europe but not in EU, *Closure**father born outside Europe, *Closure**mother born outside Europe, *Closure**father elementary school degree, *Closure**mother elementary school degree, *Closure**father secondary school degree, *Closure**mother secondary school degree, *Closure**father three years vocational school degree, *Closure**mother three years vocational school degree, *Closure**father high school degree, *Closure**mother high school degree, *Closure**father university degree, *Closure**mother university degree. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Heterogeneous Effects

Panel A: Mathematics

	Males	Females	Hi Edu Mother	Lo Edu Mother	Hi Edu Father	Lo Edu Father
	(1)	(2)	(3)	(4)	(5)	(6)
Closure*At Least One T. Parent	0.00002	0.0002	3.95e-06	-.00002	-8.83e-06	0.0002
	(0.00007)	(0.00007)**	(0.00006)	(0.0001)	(0.00006)	(0.00009)*
Obs.	445660	434120	668151	211629	561777	318003
R^2	0.006	0.01	0.01	0.008	0.008	0.008
F statistic	21.014	38.395	13.838	13.838	41.242	20.862

Panel B: Italian

	Males	Females	Hi Edu Mother	Lo Edu Mother	Hi Edu Father	Lo Edu Father
	(1)	(2)	(3)	(4)	(5)	(6)
Closure*At Least One T. Parent	0.0004	0.0004	0.0003	0.0002	0.0003	0.0004
	(0.00008)***	(0.00008)***	(0.00006)***	(0.0001)	(0.00007)***	(0.0001)***
Obs.	442811	433639	666195	210255	560504	315946
R^2	0.005	0.005	0.008	0.008	0.007	0.009
F statistic	17.534	17.892	45.414	14.06	34.535	23.052

Notes: Data is from Invalsi for the years 2016-2019 and 2021-2022. The dependent variable is the difference between test scores in grades 5 and 2. The sample is composed of all children whose parents were employed when children were in second grade. The first column includes only male children, the second column female children, the third column children with highly educated mothers, the fourth column children with low-educated mothers, the fifth column children with highly educated fathers, and the sixth column children with low educated fathers. *** p<0.01, ** p<0.05, * p<0.1.

behind the increase in students' learning inequality during the Covid pandemic. In my analysis, I combine Invalsi panel data with information on the teleworkability of occupations in Italy, the number of school closure days, and the use of online learning resources. I estimate the differential effect of school closures on student learning between children with and without teleworkable parents. My identification strategy is characterized by: (i) I use within student variation in test scores, (ii) I compare students who were in elementary school pre-Covid and during Covid, and (iii) for those who were in school during Covid, I exploit variation in exposure to school closures using number of school closure days and intensity of use of online learning resources.

Differences in parental teleworkability significantly increased children's learning inequality during Covid. For the first time since 2016, the average performances of children with teleworkable and non-teleworkable parents diverge because the performance of children with non-teleworkable parents worsens compared to the average performance. The estimated effect is the same for males and females, is driven by children of highly educated mothers, and is stronger for children of low-educated fathers. My estimates are robust to excluding highly-ranked occupations, using raw rather than standardized test scores as measures of student learning, and including interactions of exposure to school closures with all other students' and parents' observed characteristics.

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