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ORIGINAL ARTICLE

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School closures and educational attainment in Ethiopia: Can extra classes help children to catch up?

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Abstract

School closures impact children's attainment adversely, but understanding the effects of closures on children's attainment in lower-income countries is still limited. Addressing this deficit, this study examines how past school closures have impacted children's educational attainment in Ethiopia. The study uses individual student-level data from the Young Lives School Survey and standardised test scores in mathematics and language recorded at the start and end of the school year to model children's attainment. Multiple regression with propensity score matching is used to analyse how attainment over the school year is impacted by school closures for a matched sub-sample of 4842 students. The effectiveness of additional classes to make up for lost learning is also evaluated. Past school closures have had a detrimental effect on attainment in mathematics, but not literacy. Extra classes, specifically those that families do not pay for, have helped children in the past to recuperate lost learning and could serve this function post-Covid-19. Inequalities in learning outcomes, measured by Gini coefficients in educational

attainment, are widened by school closures. Applying these results to the extensive school closures under Covid-19 furthers our understanding of the likely effects on academic attainment and can inform policy to mitigate the impact.

KEYWORDS
educational attainment, Ethiopia, extra classes, school closures

Key insights

What is the main issue that the paper addresses?

This paper investigates (i) how school closures impact educational attainment in Ethiopia, (ii) the effectiveness of paid and free extra classes as forms of remediation and (iii) the effect of lost instructional time on inequalities in educational attainment.

What are the main insights that the paper provides?

Our results show that school closures do have an impact on attainment, and this is mainly in mathematics. Unpaid extra classes can reduce these negative impacts and also mitigate increases in inequality in educational attainment due to lost instructional time.

INTRODUCTION

School closures that interrupt teaching have set back the education of children across many geographical contexts, occurring for reasons as varied as environmental shocks (De la Fuente, 2007; Nübler et al., 2020; Randell & Gray, 2016) and teacher strikes (Belot & Webbink, 2010). Most recently, the Covid-19 pandemic has disrupted children's education across the world at an unprecedented scale. According to UNESCO (2021), at the global peak of school closures in March 2020, 1.6 billion children were fully out of school while a further 152 million children were affected by partial school closure. In Ethiopia, the country of this study, an estimated 26 million students were out of school as a result of the Covid-19 closures, which occurred between March and October 2020 (World Bank, 2020a). The recent political unrest in Ethiopia's Tigray region has already resulted in the displacement of more than 1 million people, exacerbating the damage caused by the global health pandemic on livelihoods and children's education (UNICEF, 2021a). It is estimated that around a quarter of all schools in the Tigray region have been disrupted by this political unrest, which is at least in part due to the use of schools as military bases (Human Rights Watch, 2021). Understanding how school closures have impacted children's learning in Ethiopia, and across country contexts, is therefore of pressing importance and necessary for developing effective policies to start to address the adverse consequences of closures (Maldonado & De Witte, 2020).

Accordingly, this paper makes three main contributions through its analysis of individual-level data from the Young Lives School Survey for Ethiopia. The first is to estimate the effects of past school closures in Ethiopia on academic attainment in mathematics and language. We use regression analysis with propensity score matching to address individual heterogeneities and employ controls for school-level characteristics. The results indicate that school closures have negative effects on attainment in mathematics but not language. Pupils who lost an hour of instructional time per week in mathematics had an average score in mathematics that was just under 2% of a standard deviation lower than students who did not experience this loss in instruction time. This relatively large effect suggests that the future effects of the current school closures due to Covid-19 are likely to be substantial for the cohort of 2020 students. We cannot directly extrapolate from our results as the scale of the disruption is very different, but as with Kuhfeld et al.'s (2020) study of past school closures in the USA, the results inform us how the more extensive Covid-19 closures are likely to impact. Understanding the extent of lost learning is of high importance in Ethiopia, where 40% of the population are under the age of 14 (World Bank, 2020b) and education spending, at 5% of gross domestic product (GDP), is a government priority.

The second contribution is to evaluate the effectiveness of providing additional classes, as a way of redressing lost learning, that has previously been used in Ethiopia. We evaluate whether the provision of extra classes can make up for the learning lost during school closures, distinguishing classes by whether or not the families of students pay for them. We find that access to extra classes, particularly unpaid classes, helps to reduce the negative impacts on attainment. Thus, our analysis suggests that the provision of classes that students do not have to pay for, and which aim to make up for lost time in school, could effectively contribute to compensating students for their lost learning.

The third contribution is to further our understanding of the distributional effects of school closures and compensatory classes by examining inequality in educational attainment through regression analysis in which the dependent variable is the Gini coefficient of test scores in mathematics. Loss of instructional time in mathematics widens inequality amongst the overall group of students. However, within the group of students who have access to additional unpaid classes, lost mathematics hours are associated with a reduction in inequality. This could be because these classes are provided at times when children who need support are able to attend.

EFFECTS OF SCHOOL CLOSURES

In order to investigate children's learning losses and the effectiveness of additional lessons to make up for this lost learning, we utilise the core theoretical concept of the education production function (Cunha & Heckman, 2007, 2008; Todd & Wolpin, 2003, 2007). The education production function transforms inputs relating to the child, household (family composition), education offer and community into so-called outputs such as children's educational achievement, skills and/or rates of achievement (Cascio & Schanzenbach, 2016; Hanushek, 2020). Previous research has identified as inputs time in schooling, teaching and school quality (e.g. measured by class size), school ownership, teacher experience and training impact attainment (Andrabi et al., 2011; Chin, 2005; Cobb-Clark & Jha, 2016; Lee & Lee, 2020). Expansion of shadow education across many country contexts suggests that the form and extent of provision should be included as inputs in the education production function (Bray & Kobakhidze, 2014). Definitions of shadow education differ but generally include the idea that the provision is private, mimics public provision and involves tutoring, although not necessarily one-to-one tutoring (for a discussion, see Zhang & Bray, 2020).

The quality of schooling needs to be measured more effectively than simply using years of education. In many African countries the quality of education is poor and also variable (Carmichael et al., 2021; Verspoor, 2005), an issue that applies more generally across lower-income countries (Filmer et al., 2020) and is increasingly identified as an issue in higher-income contexts (Hanushek, 2020). Enhancing the measure of education leads to value-added versions of education production functions, an approach we pursue by investigating how instructional time lost to unscheduled school closures impacts measured scores in mathematics and language tests.

There is a wealth of evidence that formal learning by children affects children's human capital and subsequent adult labour market outcomes. It is thus concerning that school closures often result in significantly lowered educational attainment (Di Pietro et al., 2020; Kuhfeld et al., 2020). School closures and interruptions due to teacher strikes, natural disasters, adverse weather events and summer vacations have been studied as sources of children's time out of school and in the main found to lead to a reduction in learning in reading and mathematics, literacy losses and skills gaps. For example, Marcotte and Hemelt (2008) find that school closures caused by snow in the US state of Maryland led to lower performance, particularly in the younger age group (the schools were closed for 5 days on average). Goodman's (2014) study did not find an effect of school closure on individual performance in Massachusetts (schools closed for 2.2 days on average) but did find that individual students missing school accounted for about one-quarter of the overall achievement gap by income (students missed 8.7 days on average). Teacher strikes in the French-speaking part of Belgium during the period between May and November 1990 were associated with a 0.20 standard deviation drop in educational attainment compared to the Flemish-speaking part of the country, which was unaffected by strikes (Belot & Webbink, 2010). In Canada, children from lower-income homes were particularly adversely affected in their mathematics attainment by school strikes that lasted on average 9.7 days, ranging from 3 to 17 days (Baker, 2013). In contrast, Zwerling (2008) finds no effect of teacher strikes on student performance in Pennsylvania (12 days were lost to strikes on average).

Early research on the impact of Covid-19 closures is based mainly on the impact of past closures or extrapolations from past data, predicting detrimental effects of school closures on child attainment (Bao et al., 2020; Frenette et al., 2020; Kuhfeld et al., 2020). Applying previous estimates of the effects on attainment of additional hours of instruction from Lavy (2015) and using recent data on the reduction in time spent in learning, Di Pietro et al. (2020) estimate that the loss of a week of study time in France, Germany and Italy leads to a predicted weekly learning loss of 0.82–2.3% of a standard deviation in test scores.

Maldonado and De Witte (2020) were able to use data from tests administered after the Covid-19 school lockdown in schools in Belgium, finding that the 2020 cohort of primary school children experienced significant learning losses compared to the previous year's cohort. There was a decrease in school averages in mathematics scores of 0.19 of a standard deviation and in language of 0.29 of a standard deviation. These learning losses are predicted to be spread unequally, with more disadvantaged children experiencing larger learning losses (Maldonado & De Witte, 2020).

The effects of school closures are likely to be felt as, if not more, unequally in low- and middle-income countries. Household wealth and parental engagement is a key issue in children's learning (Cooper, 2010; Darko & Vasilakos, 2020; Guryan et al., 2008; Kiernan & Mensah, 2011), however, in the context of Covid-19, concerns for possible future income and job losses may mean that poorer families are no longer able to support and finance their children's education and learning. In rural areas in particular, parents may be forced to keep their children out of school to help with income-generating activities as well as to support with household chores.

EFFECTS OF ADDITIONAL INSTRUCTION TIME

At the start of the pandemic, the Ethiopian government instituted lessons by radio and satellite TV. The effectiveness of these measures was constrained by only 10% of households in Ethiopia having a TV and 28% a radio, well below the African average (Kim & Rose, 2020). Text messaging had positive effects during school closures in Botswana (Angrist et al., 2020), however, mobile phone penetration is lower in Ethiopia than in other parts of Africa and is still highly stratified by income, as is the capability to exchange files and information through Telegram, the messaging platform widely used in Ethiopia (Kim & Rose, 2020).

In sum, unequal access to the existing infrastructure does not facilitate widespread learning based on information communication technologies. While parents in wealthier households may be able to provide computers, alternative learning activities or private tuition, poorer children have access to fewer educational resources at home (Spaull, 2013). In addition, the more limited education of parents in poorer households may mean they are less able to support their children's home-based learning or take time away from income-generating activities to help their children.

In the past, schools in Ethiopia have tried to compensate for time lost from school, for example when children are needed to work on the land during harvest, by providing extra classes (Pankhurst, 2018). Research on shadow education shows that in many parts of the world children access additional teaching time through private classes or individual tutoring to the extent that in, for example, South Korea, payment for private tuition equated to around 2.9% of the nation's GDP (Kim & Lee, 2010). Participation of children in extra classes in low- and middle-income countries is also common (Dang & Rogers, 2008) and viewed as enhancing performance (Glewwe & Kremer, 2006). Evidence from previous research suggests that extra hours of instruction and extensions to the school year can have a positive effect on learning and lead to increased scores in cognitive tests (Aucejo & Romano, 2016; Carlsson et al., 2015; Lavy, 2015). Lavy (2015) finds a lower effect of additional instructional time in 15 developing countries participating in PISA than in 22 OECD countries. This could be explained by lower school quality, which, as mentioned above, is discussed in Verspoor (2005) and Filmer et al. (2020). Lavy (2015) highlights lack of school autonomy and accountability as possible causes.

In Italy, Meroni and Abbiati (2016) find that students who received extra instruction time in mathematics performed better in mathematics (but not language) and developed a more positive attitude towards the subject. Targeted additional instruction time for disadvantaged students can result in an increase in matriculation rates (Lavy & Schlosser, 2005). But there is also variability in findings of the effects of extra classes on pupil performance. For example, in relation to Vietnam, Duc and Baulch (2012), using Young Lives data, find that extra classes do not have a significant effect on pupils' cognitive (mathematics and vocabulary) test scores, but Dang (2007) finds that private tuition that parents paid for has a significant impact on academic performance, particularly for lower secondary school students. Cheo and Quah (2005) even find evidence of a negative effect of private tuition on secondary students' grade in Singapore. In terms of inequality, Rolleston and Krutikova (2014) find that the ‘home advantage’ (captured by hours of instruction received, extra classes and access to computers and the internet) partly explains learning inequalities in Vietnam.

In sum, the range of effects found in relation to additional tuition underlines the importance of country context and whether lessons are paid for, which we address by distinguishing the effects of classes that families pay for from those provided without additional charge. Drawing on research conducted in the field of shadow education on the effects of extra tuition and the finding that a major factor distinguishing between different types of shadow education is whether it is paid for (Bray & Kobakhidze, 2014), we would expect these two types of additional instruction to differ in their effects. Furthermore, country context

differentiates whether such provision is for the enrichment of children, for example in high-stakes education systems or, as Baker et al. (2001) hypothesise, if it is for remediation, which they consider to be more likely in countries where mass education is the norm and there is a policy focus on low achievement. However, Baker et al. (2001) find that shadow education is for remediation in the majority of countries in their sample, including South Africa, the only African country represented. In the context of these different results, consideration of the effects of extra classes in Ethiopia, distinguishing between paid and unpaid extra classes, can potentially add to our understanding of the diversity of shadow education.

COUNTRY CONTEXT

In Ethiopia, as elsewhere, schooling has a wider significance than enhancing literacy and numeracy skills. Sometimes schools deliver food to children under the government's School Meals Programme (Zenebe et al., 2018), which was disrupted during school closures. Thus, the wider societal implications of school closures, including children's health, must be examined (Van Lancker & Parolin, 2020). Indeed, research finds that children in Addis Ababa were experiencing restricted food intake during the period of Covid-19 (Delbiso et al., 2021). Even before Covid-19, undernutrition was widespread in Ethiopia, with childhood height-for-age undernutrition (stunting) of under-fives reported at 38% (Gebru et al., 2019).

Ethiopia's Productive Safety Net Program (PSNP) was introduced in 2005 to enhance household food security in the face of rainfall shocks, which have in the past had severe consequences (Hoddinott & Mekasha, 2020; Hoddinott et al., 2010). Although not directly targeting continuation in schooling, prior participation in the programme has been associated with a significant uplift in mathematics test scores, particularly for boys (Favara et al., 2019).

Previous research on the unequal effects of school closures points to the need to identify the groups requiring particular attention to make up for their lost learning. According to the head teachers in the Young Lives Covid-19 phone survey (Young Lives, 2020), these groups include girls, students who were previously identified as weaker learners, those from poorer households, over-age students and those in rural areas who make up the majority of the younger population (OECD/PSI, 2020). Head teachers further expected that some students, particularly those from the poorest households, would not return after the closures (Young Lives, 2020). Family reliance on children's labour has a significant impact on education participation as over 80% of children in Ethiopia were engaged in some form of work by age eight (Pankhurst et al., 2018).

In Ethiopia, the provision of additional classes to help children catch up following closures is of particular importance as there is restricted potential for online learning. In 2021, only 21 million out of a population of 118 million people are internet users (IWS, 2021), which is low, even in Africa. Early evidence from the Young Lives Covid-19 phone survey (Favara et al., 2020) indicates that only 22% of Ethiopian students in the Young Lives younger cohort switched to online, radio or television-based learning, while 78% reported that their studies were interrupted.[1]

Education system in Ethiopia

Before 1994, when Ethiopia instituted its new Education and Training Policy (Hoot et al., 2004), primary enrolment was very low, ‘abysmal’ according to Mani et al. (2013). Successive governments have prioritised compulsory and free primary education, but education remains of variable and sometimes poor quality, an important factor in the educational production function. Although the primary gross enrolment ratio was 100% in 2015, only 54% of the

relevant age groups had completed primary education[2] (World Bank, 2021). There are also wide socioeconomic gaps in completion rates and attainment (Ilie et al., 2021).

Educational attainment across the population is still low, reflected in the Ethiopian adult literacy rate of just under 52% in 2017. Training of teachers is extensive, but the pupil–teacher ratio remains very high and teachers' salaries, especially at primary level, are very low (World Bank, 2021). The disparities between the rural areas where 80% of the population live and the urban areas remain large, even if Ethiopia is urbanizing and experiencing growth in formal and informal employment outside agriculture (Schewel & Fransen, 2018).

DATA

This study uses the Young Lives School Survey for Ethiopia (University of Oxford, Department of International Development, 2015). Young Lives survey data have previously been used in the context of educational research reported in this journal (Darko & Vasilakos, 2020; Ilie et al., 2021). Young Lives is a longitudinal cohort study (coordinated by the Department of International Development at the University of Oxford) of childhood poverty in Ethiopia, India, Peru and Vietnam. Young Lives has followed a younger cohort (from age one) and an older cohort (from age eight) over five survey rounds spread over 15 years: 2002, 2006, 2009, 2013 and 2016.

The Young Lives School Survey was introduced in 2010 as an extension to the longitudinal study with the aim of capturing detailed information about children's experiences of schooling and was designed to enable analysis of factors that affect children's learning and academic progress over a school year. The school survey data are hierarchically structured at pupil, teacher, class, school-site and head-teacher levels. The school-level indicators on teacher, school and class characteristics are included as controls in the analysis. We use the 2012–13 primary school survey for pupils in Grades 4 and 5 (age 10–11), which included data on both Young Lives children and their peers (University of Oxford, Department of International Development, 2015). The surveys were undertaken within all schools covering these grades located within 30 sites (Rossiter et al., 2018). Two waves of data were collected: the first data collection was at the start of the academic year in October covering 11,982 pupils and the second data collection in the last term of that academic year covering 10,068 pupils, 84% of the initial sample. The sample was distributed across 142 Grade 4 and 134 Grade 5 classes in 94 schools. The schools included government, private, community, faith-based and non-governmental organisation-run schools. Only pupils with data recorded in both waves of the survey were included. Missing observations for gender and excluding pupils recorded as being in Grade 3 reduced the sample size to 9890 pupils across 91 schools.[3] Restricting the sample to cases that recorded information on extra classes further reduced the sample to 8272. Missing observations for test scores and other variables reduced the sample further. The final sample used in the regression analysis is further reduced in the propensity score matching procedures (described below).

The assessment took place in the two core curricular domains of mathematics and reading comprehension/literacy (mother tongue) at the beginning and end of the school year. The tests were adapted from English and Amharic to the languages of instruction and then administered in that language. Detailed description of the test design can be found in James (2014). For analytical purposes, the test scores were standardised to have mean zero and unit standard deviation.

Unscheduled school closure duration caused, for example, by extreme weather events and elections is captured by lost instruction hours in mathematics and language studies. The variables were constructed from questions in the survey that asked: *On how many days was the school closed in the last academic year? How many minutes of instruction does this*

class receive each week in language? and *How many minutes of regular maths instruction does this class receive each week?* The responses to the second and third questions were converted into hours per day and then multiplied by the number of unscheduled closures recorded in the answers to the first question to create the measures *lost mathematics hours* and *lost language hours* per day due to unscheduled closures.

Indicators of whether or not children attended extra classes were constructed from questions that asked pupils whether they attended extra classes or not, and whether these classes were paid for or not. It is likely that there are differences in the reasons for provision and take-up of extra classes. Extra classes may be arranged to address low achievement (remedial) or used by high performers to secure advantage (enriching) (Baker et al., 2001). In the context of Ethiopia, extra classes have also been set up to make up for lost instructional time due, for example, to school closures or to children having to work during harvest. In other contexts, extra classes have aimed to address individual or family-level factors that bear negatively on children's educational attainment. This kind of provision can be categorised as compensatory (which suggests that classes can be either remedial or enriching) and they may be more likely to be fee-free if they are intended to make up for lost instructional time. In Ethiopia, schools sometimes provide extra tutorials for missed classes, for example through flexible arrangements such as half-day shift schooling, evening and weekend classes or extra classes to prevent children dropping out of school altogether, when they have to help with subsistence activities such as harvesting or on market days (Boyden, 2009; Frost & Rolleston, 2013; Morrow & Boyden, 2018; Pankhurst, 2018; Pankhurst et al., 2018). Such measures are particularly effective for poor children (Pankhurst et al., 2018). Teachers will sometimes provide additional classes without payment in such circumstances (Frost & Rolleston, 2013: p. 26).

Table 1 presents summary statistics for the school closure measures and test scores for the full (matched) sample and by sub-sample of individuals who (i) experienced closures

TABLE 1 Summary statistics for closure and test scores by whether or not experienced closures (matched sample)

	Full sample			No closure			Some closure		
	N	Mean	SD	*N*	Mean	SD	*N*	Mean	SD
Number of days closed							838	9.36	6.08
No closure	4842	0.83	0.38						
Some closure	4842	0.17	0.38						
Lost mathematics hours	4790	1.10	2.95				838	6.30	4.14
Lost language hours	4784	0.77	2.07				832	4.43	2.90
Total lost hours	4784	1.87	4.99				832	10.76	6.90
Standardised mathematics score: end of school year	4839	0.09	0.98	4001	0.16	0.96	838	−0.23	1.02
Standardised mathematics score: start of school year	4801	0.06	0.97	3968	0.11	0.96	833	−0.17	1.00
Average mathematics score for the two periods (unstandardised)	4798	14.37	3.74	3965	14.61	3.67	833	13.21	3.84
Language score: end of school year	4840	0.11	0.95	4002	0.17	0.94	838	−0.21	0.96
Language score: start of school year	4816	0.10	0.93	3989	0.17	0.90	827	−0.22	1.02
Average language score for the two periods (unstandardised)	4814	18.00	4.20	3987	18.32	4.10	827	16.47	4.36

Notes: For schools affected by closure, the minimum and maximum number of days lost were 1 and 21.

TABLE 2 Summary statistics for closure variables and test scores by attendance in extra classes (matched sample)

	Paid extra classes			Unpaid extra classes			No extra classes		
	N	Mean	SD	*N*	Mean	SD	*N*	Mean	SD
Number of days closed	1614	0.91	3.49	1614	3.11	5.56	1614	0.84	3.24
No closure	1614	0.88	0.33	1614	0.71	0.45	1614	0.90	0.31
Some closure	1614	0.12	0.33	1614	0.29	0.45	1614	0.10	0.31
Lost mathematics hours	1596	0.61	2.36	1592	2.12	3.75	1602	0.58	2.26
Lost language hours	1595	0.45	1.61	1587	1.38	2.49	1602	0.49	1.89
Total lost hours	1595	1.06	3.94	1587	3.49	6.20	1602	1.07	4.11
Standardised mathematics score: end of school year	1614	0.11	0.96	1613	−0.01	0.94	1612	0.17	1.03
Standardised mathematics score: start of school year	1601	0.12	0.94	1600	−0.03	0.94	1600	0.10	1.03
Average mathematics score for two periods (unstandardised)	1601	14.52	3.69	1599	13.95	3.57	1598	14.64	3.91
Language score: end of school year	1613	0.10	0.95	1614	0.11	0.92	1613	0.12	0.98
Language score: start of school year	1609	0.08	0.90	1598	0.10	0.93	1609	0.13	0.97
Average language score for the two periods (unstandardised)	1608	17.92	4.14	1598	17.99	4.07	1608	18.08	4.39

and (ii) did not experience closures. For those schools that experienced some closure, the mean number of days closed was 9.36 and the mean number of hours of instruction lost due to closures was 6.30 in mathematics and 4.43 in language. The days of school closure ranged from 1 to 21 days. The data show that those who did not experience any closures performed better in both mathematics and language, both at the start and end of the school year, than the smaller sub-sample (17.3%) of students who experienced closures. Not only did students who were to experience closures start off with mathematics scores below the overall mean, they fell relatively further behind during the year, potentially explained by the closures. With regard to language, students who were to experience closures during the year started below the average but the difference in the scores between those who did and those who did not experience closures hardly changed during the year. Table A1 in the online Supplementary Material provides definitions of variables used in the analysis. Table A2 shows summary statistics for all other variables used in the analysis for the full sample and separately by whether or not the students experienced closures.[4] Table A3 further shows summary statistics of all variables for the full unmatched and matched samples.

Table 2 shows summary statistics for the main variables separately by attendance in unpaid classes, paid classes or no attendance. Those who attended unpaid extra classes experienced more than three times as many days of school closures and lost more hours of instruction overall and in mathematics than those who did not have extra classes or who accessed paid classes. It therefore seems likely that extra classes were intended to make up for lost teaching time. The figures also show that students who attended extra unpaid classes scored lowest of the three groups in mathematics tests, even at the outset, especially in comparison to those in the group of attending no classes who achieved the highest scores. Differences in the language scores are smaller.

Figure 1 shows the lower frequencies of higher scores in mathematics among those who attended extra classes, showing that these differences widen over the school year. Taken together, the data suggest that variation in attainment, particularly in mathematics, the exposure to school closures and attending extra classes are interrelated.

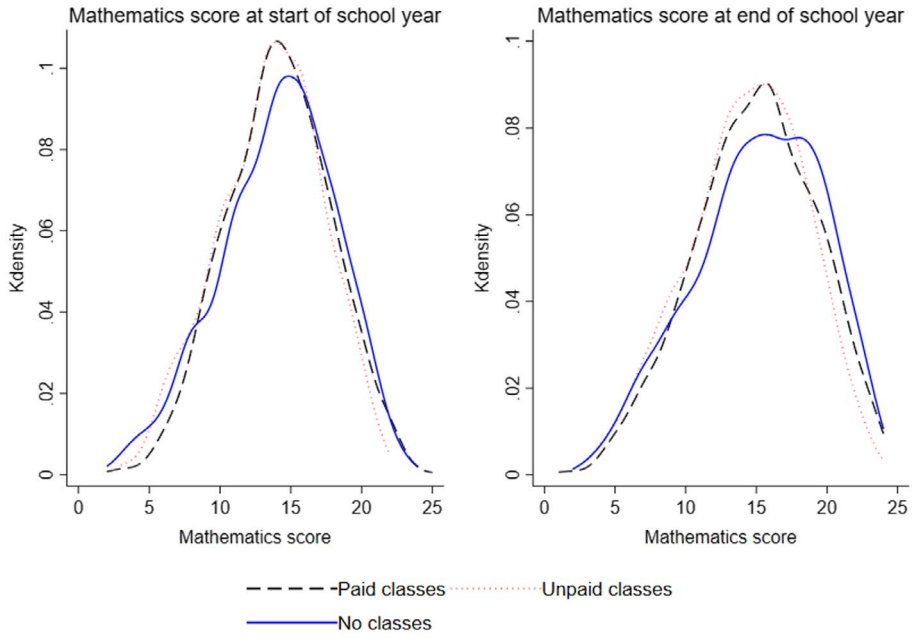

FIGURE 1 Distribution of academic performance of pupils at start and end of academic year

EMPIRICAL STRATEGY

The theoretical framework of our analysis of the impact of school closure on educational attainment draws on the production function for cognitive achievement (Cunha & Heckman, 2007, 2008; Todd & Wolpin, 2003, 2007). The generalised education production function (Todd & Wolpin, 2007) in which attainment is a function of individual-level inputs, including time in education as well as household and school-level inputs, can be written as

$$A_{it} = A_t(Z_i(t), \mu_{i0}) \tag{1}$$

where A_{it} is the measure of the educational attainment of child i at time t (or equivalently at age a in Todd and Wolpin's, 2007 specification) and is a function of all inputs, past and current up to time t, $Z_i(t)$. In addition, attainment depends on individual child endowments linked to mental capacity and intellectual potential, μ_{i0}. However, data on child endowments and inputs are rarely complete. In addressing this deficit, Todd and Wolpin (2003, 2007) argue that as the effect of earlier inputs, including endowments, declines over time, with the age of the child, the production function in Equation (1) can be estimated using a value-added specification. This includes a lagged measure of achievement acting as a proxy for such inputs, including ability, and leads to the following estimable model:

$$A_{it} = \beta X_{it} + \gamma A_{it-1} + e_{it} \tag{2}$$

A_{it} is the measure of achievement as before, which in our analysis is the score from tests conducted at the end of the school year (time t). The vector X contains observed inputs assumed to have deterministic influences on child skills. In our analysis these include time out of schooling during the past academic year due to closures, participation in extra classes and an interaction term. The vector also includes school-level inputs and

measures reflecting individual, household and regional/location characteristics. A_{iht-1} is the lagged measure of attainment, the result of tests administered at the start of the school year (time $t - 1$). e_{iht} is the residual term. This lagged model has less restrictive assumptions than a first-difference model and addresses issues due to incomplete data for lagged inputs.

Applying this model leads to the following specifications, which include a lagged measure of attainment, the child's baseline scores in tests in mathematics M_{it-1} and literacy L_{it-1}, administered at the start of the school year, $t - 1$:

$$\begin{aligned} M_{it} &= \beta_0 + \beta_1 M_{it-1} + \beta_2 Closure_{it-1} + \beta_3 Closure_{it-1} \times Extraclasses_{it-1} \\ &\quad + \beta_4 Extraclasses_{it-1} + \beta_5 H_{it} + \beta_6 S_{pt} + \beta_7 S_{ct} + \beta_8 S_{ot} + \beta_9 R_{It} + e_{it} \end{aligned} \tag{3i}$$

$$\begin{aligned} L_{it} &= \beta_0 + \beta_1 L_{it-1} + \beta_2 Closure_{it-1} + \beta_3 Closure_{it-1} \times Extraclasses_{it-1} + \beta_4 Extraclasses_{it-1} \\ &\quad + \beta_5 H_{it} + \beta_6 S_{pt} + \beta_7 S_{ct} + \beta_8 S_{ot} + \beta_9 R_{It} + e_{it} \end{aligned} \tag{3ii}$$

where M_{it} is the standardised test score in mathematics and L_{it} in literacy; L_{it-1} in literacy for individual i at the end of the school year t and M_{it-1} for mathematics at the end of the school year. *Closure* is lost hours due to unscheduled closures and *Closure* × *Extraclasses* are interactions between lost hours and attendance in extra classes, *Extraclasses* (either paid classes, unpaid classes or no classes). H_i is a vector of child and household characteristics including gender, health, grade, whether they have repeated the grade and parental literacy. We also include a measure of household wealth, which as a measure of living standards over the long term is arguably a better measure than income, as yearly incomes fluctuate considerably in Ethiopia (Mani et al., 2013). S_p controls for characteristics of the class teacher and principal including gender, experience and number of years that the teacher has taught the current grade. S_c controls for class size and the number of class hours per day. S_o is a vector of school-level organisational characteristics including the age of the school, school ownership (government or other), whether or not the school operates a system of automatic progression and whether the school operates a full day or a shift system. R_I includes regional dummies (Addis Ababa, Amhara, Oromiya, SNNP, Tigray, Somali and Afar) and a dummy recording whether the individual resides in an urban area or a rural area. e_{it} is, as before, the residual term. Table A1 provides variable definitions. Equations (3i) and (3ii) are estimated using ordinary least squares (OLS). Results are recorded as statistically significant if $p \leq 0.05$ (Vitello & Crawford, 2018).

MATCHED SAMPLE

Divergences in attainment between those attending paid and unpaid classes or not attending any classes might partially be explained by other observable characteristics. To address these potential individual-level heterogeneities which could bias the results, we used propensity score matching. The propensity score matching (PSM) technique (see Deheija & Wahba, 2002) involves matching individuals in the three groups (attended extra paid classes, attended unpaid classes, attended no extra classes) on their propensity scores constructed from characteristics determined prior to the end-of-year attainment test. The choice of characteristics for use in the matching was determined by variables that are likely to affect attainment but also likely to be determined before the end-of-year attainment test, so that any subsequent divergence in attainment associated with attendance at extra classes is more reliably attributable to such attendance and the associated school closures. The variables used for the matching process were: gender, grade and whether the child had repeated a grade; whether living in an urban or rural location; hours spent by the child in paid work; and

whether the mother and father are literate. The PSM procedure employs nearest-neighbour matching and one-to-one matching with no replacement.[5] The propensity scores were obtained by estimating two logit regressions with restricted samples; first, those who had attended either paid classes or unpaid classes and second, those who had attended paid classes or not attended any classes. In each case, the binary dependent variable equalled one if a given pupil attended paid classes. An outcome of this process is that some individuals were removed from the sample because they were not close enough matches to individuals in the paid classes group (the smallest group).

The remaining sample includes only those children who were close enough matches to those in the paid classes group. The matching exercise resulted in a total of 4842 matched individuals. Figure 2 illustrates results from the matching process and shows the kernel distributions of propensity scores before and after the matching procedure. The graphs provide sufficient support for good matching and the regression analysis was conducted with the matched samples.

RESULTS

Regression analysis

Table 3 shows the results of the OLS regression estimations for the matched samples in which the dependent variables are the standardised mathematics and language scores. As we would expect, the results show the predicted positive significance of the lagged test scores for mathematics and language which capture endowment effects up to the start of the school year, child ability and other unobserved child and household effects.

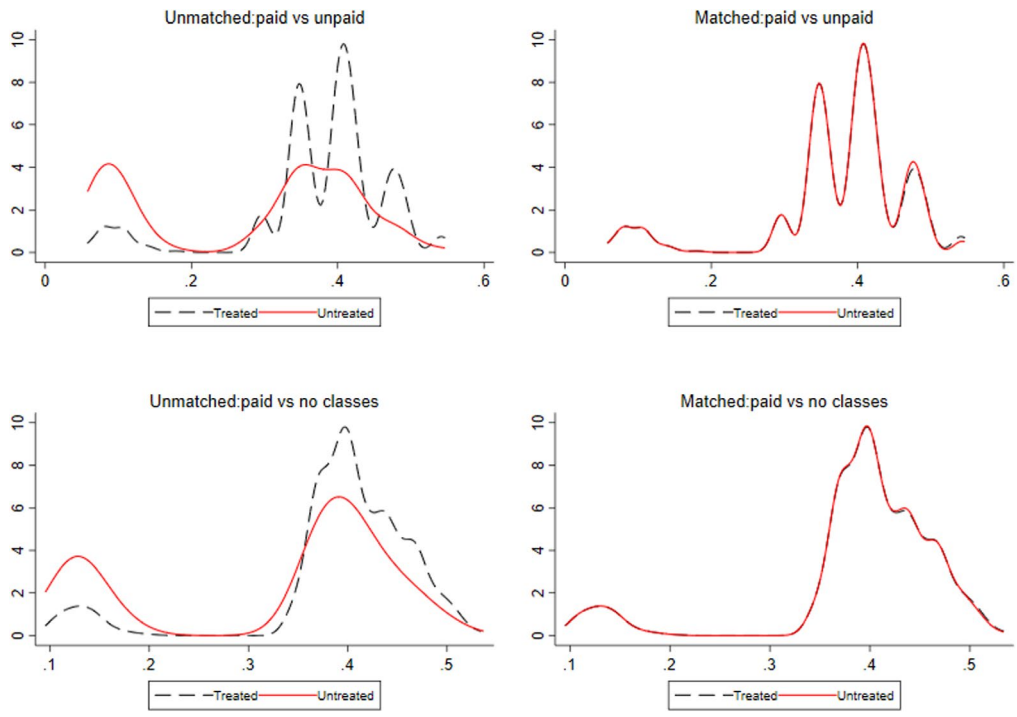

FIGURE 2 Matching process

TABLE 3 The effect of closure on attainment in mathematics and language

	(1) OLS mathematics	(2) OLS language
Standardised mathematics score: baseline	**0.5847**	
	(0.0156)	
Closure: Lost mathematics hours	**−0.0189**	
	(0.0087)	
Unpaid extra mathematics classes*Lost maths hours	**0.0354**	
	(0.0091)	
No extra mathematics classes*Lost maths hours	0.0052	
	(0.0099)	
Unpaid extra mathematics classes	0.0649	
	(0.0359)	
No extra mathematics classes	**0.0775**	
	(0.0349)	
Standardised language score: baseline		**0.6664**
		(0.0230)
Lost language hours		0.0118
		(0.0216)
Unpaid extra language classes*Lost language hours		−0.0000
		(0.0194)
No extra language classes*Lost language hours		−0.0030
		(0.0148)
Unpaid extra language classes		0.0625
		(0.0448)
No extra language classes		0.0195
		(0.0459)
Girl	−0.0299	**0.0376**
	(0.0275)	(0.0181)
Grade 5	0.0490	0.0572
	(0.0333)	(0.0341)
Repeated grade: Yes	**−0.1766**	**−0.0846**
	(0.0294)	(0.0233)
Health problems	−0.0471	**−0.0524**
	(0.0257)	(0.0219)
Wealth index	**0.0393**	**0.0209**
	(0.0092)	(0.0077)
Mother can read	0.0040	0.0014
	(0.0260)	(0.0301)
Father can read	−0.0432	−0.0217
	(0.0284)	(0.0286)

(Continues)

TABLE 3 (Continued)

	(1) OLS mathematics	(2) OLS language
Lives with mother	0.0160	0.0066
	(0.0310)	(0.0303)
Lives with father	0.0433	**0.0560**
	(0.0232)	(0.0277)
Female teacher	−0.0334	0.0373
	(0.0335)	(0.0309)
Teacher: Experience (in years)	0.0001	0.0019
	(0.0018)	(0.0013)
Teacher: Year taught current grade (in years)	0.0006	0.0007
	(0.0026)	(0.0031)
Principal: Female	0.0205	0.1302
	(0.0478)	(0.0747)
Principal: Years as principal	0.0046	−0.0046
	(0.0059)	(0.0075)
Class: Size	−0.0002	−0.0003
	(0.0017)	(0.0024)
Class: Hours of class time a day	0.0664	−0.0264
	(0.0344)	(0.0372)
School ownership: Other	0.0059	−0.1511
	(0.1009)	(0.1031)
School age (in years)	−0.0012	−0.0035
	(0.0016)	(0.0021)
School: Automatic progression, yes	−0.0933	−0.0982
	(0.0642)	(0.0861)
School: Full day school	0.0945	**0.2655**
	(0.0922)	(0.0777)
Constant	−2.7794	−7.6357
	(3.2534)	(4.2162)
Observations	3743	3154
R^2	0.468	0.561

Notes: Standard errors clustered at school level in parentheses.
Bold, underlined values are significant at $p < 0.05$.
All regressions include region dummies and an urban–rural dummy.

Turning first to the results for the test scores in mathematics (column 1), instructional time lost to closures has a significant negative effect on attainment in mathematics. The marginal effect on mathematics attainment is −0.019 standardised standard deviations. This means that pupils who lost an hour of instructional time had an average score in mathematics that was just under 2% of a standard deviation lower.[6] Table 2 shows that the impact of closures was distributed unequally. Those who accessed unpaid extra classes lost more time than others, suggesting that some classes were arranged to compensate for closure. The positive and significant interaction between closure and attendance in unpaid extra mathematics

classes points to the effectiveness of the extra classes in helping children to catch up on what would have otherwise been lost instructional time (relative to the reference category of paid extra classes). This conclusion is supported by the lack of a significant effect for the interaction of closure with no extra classes.

The dummy variable for unpaid extra classes is positive and weakly significant, and the dummy variable for the child not attending any extra classes is also significant, in both cases relative to the reference category of paying for extra classes. The interpretation is that paying for extra classes is not associated with any improvement in attainment relative to unpaid classes or no extra classes, in fact the opposite appears to be true. Possibly, families only pay for extra classes if they identify that the child needs remedial instruction and parents cannot provide the necessary educational support.

Interestingly there are no comparable effects of closure or extra classes on attainment in literacy. This is consistent with some previous research suggesting that children's learning in mathematics is less resilient to lost instructional time or absences (e.g. in the USA: Goodman, 2014; Kuhfeld et al., 2020). However, as noted above, Maldonado and de Witte (2020) find a stronger effect of closure on language (Dutch) scores than mathematics scores in Belgium. They attribute this to the teaching methods implemented during the Covid-19 closures and to the affected students speaking French rather than Dutch at home.

Being female is positively significant in relation to literacy scores but not mathematics.[7] The other variables included in the model have the effects we might expect. Ill-health has a predictable negative effect as does grade repetition, which is a frequent occurrence in Ethiopia. Household wealth has a strong positive association with attainment in mathematics and language, even after controlling for endowment effects through the inclusion of the lagged test score. In relation to the other family and household characteristics, living with the child's father has a significant, positive association with test scores, implying a link between the presence of the father in the household and children's educational attainment. This relationship may be explained by evidence linking male-headed households to lower risk of poverty in Ethiopia (Bigsten & Shimeles, 2008). Direct involvement by fathers in young children's education has also been shown to be important in the UK (Flouri & Buchanan, 2004). The results on the relationship between school quality characteristics and educational attainment are rather mixed. More specifically, a female principal appears to be linked to higher attainment in language. Class size has no effect, but daily hours of class time are associated positively with mathematics but not language attainment. The implication is that instructional time is critical for learning in mathematics and therefore even in the context of relatively modest school closures, lost instructional time results in lower attainment in mathematics. School ownership, the structure of the school day and whether or not the school operates automatic progression have no significant effect on either mathematics or language scores, perhaps because of the low levels of attainment overall (Rossiter et al., 2018).

Inequality assessment

School closures are likely to fall unevenly and to exacerbate the existing inequality in attainment, while extra classes have the potential to allay such effects. To examine this possibility, Gini coefficients for end-of-year test scores in mathematics were calculated at the school level to measure inequality in attainment within schools (Maldonado & De Witte, 2020). The Gini coefficient takes the value of 0 for perfect equality and 1 for perfect inequality. The Gini coefficients were calculated for the full sample, and separately for the sub-samples of those accessing extra classes (paid or unpaid) or no extra classes.

TABLE 4 The effect of closure on inequality in mathematics attainment within schools

Dependent variable:	**(1)**	**(2)**	**(3)**	**(4)**
Mathematics Gini coefficient	Full sample	Paid classes	Unpaid classes	No classes
Lost mathematics hours	**0.0019**	**0.0054**	**−0.0018**	**0.0052**
	(0.0002)	(0.0006)	(0.0006)	(0.0004)
Observations	3745	1016	1227	1502
R^2	0.490	0.464	0.418	0.658
Mean Gini coefficient	0.16729	0.16045	0.16592	0.17068
P90/910	2.222	2.222	2.222	2.333
Entropy index	0.04341	0.04018	0.04281	0.04512

Notes: Standard errors in parentheses.

Bold, underlined values are significant at $p < 0.05$.

All regressions include the regressors used in Table 3 (other than the extra class indicators and interactions).

To examine how lost hours of instruction in mathematics are associated with inequality in attainment in mathematics, OLS regressions were estimated in which the dependent variable is the Gini coefficient. The regressions were estimated for the full sample and for students with and without access to different kinds of extra classes. Table 4 reports the results and also shows mean Gini coefficients, P90/P10 percentile ratios and entropy indices for the full sample and the three sub-samples.

The regression results for the full sample show that the Gini coefficient in attainment for mathematics increases with lost instructional time: lost mathematics hours increase the Gini coefficient by 0.0019 overall. With a mean Gini coefficient of 0.167, this corresponds to an increase in inequality of 1.1%. The increase in the Gini coefficient is larger for those who attended paid classes or did not attend any extra classes while among those attending unpaid extra classes, lost mathematics hours is associated with a reduction in inequality of 0.0018, suggesting that within this group the unpaid classes are effective in reducing inequality in attainment within the group. Inequality in attainment is highest within the sub-sample who did not access extra classes and lowest among those who accessed extra paid classes.

The results show that lost hours of instructional time increase inequality in mathematics attainment for the group of all students. More tentatively, increased inequality can be counteracted by access to extra classes at no extra cost to parents. Presumably this is because free instruction is more widely accessible and not restricted to children from families who can afford to pay.

Distributional analysis

This part of the analysis extends the regression analysis to explore further how access to extra classes at different quintiles of the distribution of mathematics scores might compensate for the potential loss of learning from reduced hours of schooling, following Maldonado and De Witte (2020). The combined effects of unscheduled closures and access to extra classes might affect children differently along the attainment distribution. While it is expected that lost instructional time would have more of a negative impact on vulnerable learners at the lower end of the attainment distribution, leading to greater inequality, the effect of extra classes could also be weaker for this group because of their already lower attainment. This group could also have less access to extra classes if poverty is behind their lower attainment.

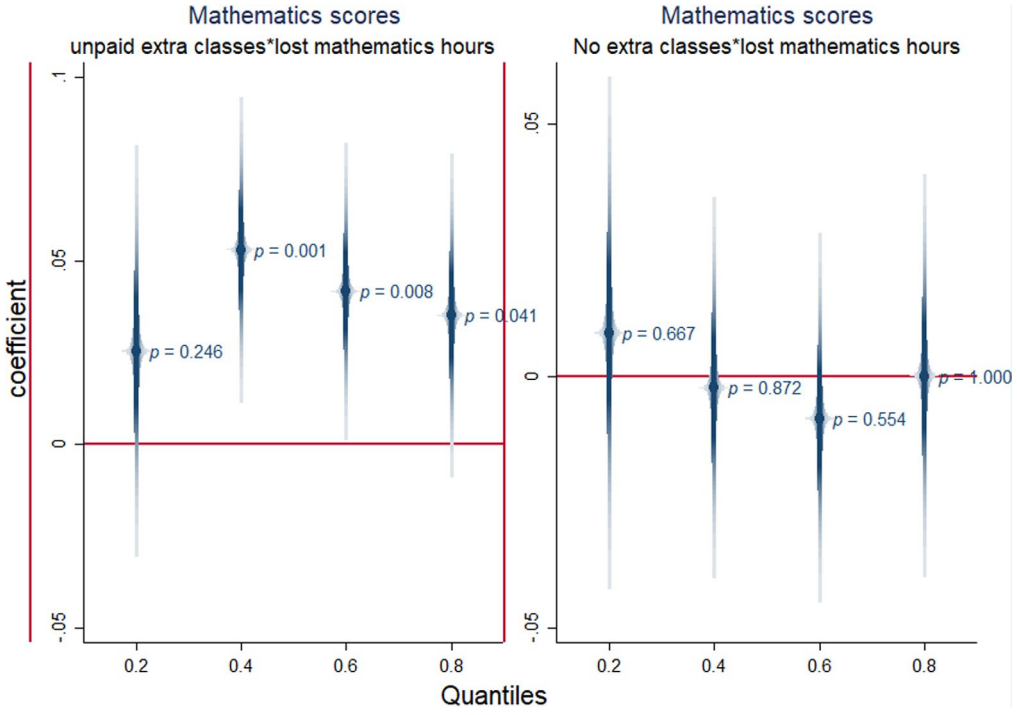

FIGURE 3 Distribution of mathematics test scores

We examine this possibility using quantile regression to estimate Equation (3i), which allows the effects of the independent variables to be estimated at different quantiles. We estimate the effects at the 0.20, 0.40, 0.60 and 0.80 quantiles. Figure 3 graphs the estimated interaction effects (between lost instructional time and access to classes) at these different points in the distribution of attainment. The lack of significance of the interaction between lost hours of instruction and extra unpaid classes at the 0.20 quantile suggests that the weakest learners in terms of their prior attainment are the least helped by extra classes. The positive interaction effect is larger and more significant for those at the 0.40 quantile of the attainment distribution than at the higher quantiles. Provision of extra unpaid classes for children in the 0.40 quantile of the attainment distribution could help to counteract some of the expected effects of lost instructional time on inequality of attainment due to school closures. The interaction effects of unpaid extra classes are also significant at the 0.60 and 0.80 quantiles. Although these results are not conclusive, the contrasting lack of significance at the higher quantiles of the interaction between lost instructional time and no extra classes provides support for the effectiveness of unpaid classes in compensating for lost instructional time.

DISCUSSION

This paper contributes to our understanding of how school closures have impacted academic attainment in Ethiopia. Lost learning due to school closures negatively impacts students' attainment in mathematics. Previous research on the wage returns to education suggests this loss in attainment could affect the future employment opportunities of these children. Rossiter et al. (2018) present qualitative findings of how children's hopes have been dashed in Ethiopia. Learning losses have multifaceted impacts on society, which is all the more

concerning in Ethiopia with its young population. There are pronounced economic effects, since educational attainment and cognitive skill levels at a population level are important for economic growth and future well-being (Cobb-Clark & Jha, 2016; Hanushek & Woessmann, 2012; OECD, 2010). Wider social benefits come from improvements in maternal health and lower fertility (Strauss & Thomas, 1995), reductions in infant mortality, lower crime rates and even enhanced political stability (Appiah & McMahon, 2002). The social and health crisis of Covid-19 can only have exacerbated the individual and wider socioeconomic effects of learning losses, as all schools were closed for such a long period of time. For example, Takaka and Yokoyama (2021) found that the effects of school closures in Japan extended to non-academic outcomes, specifically large increases in children's weight and heightened maternal anxiety.

Focusing on academic attainment, the analysis used individual test scores to measure how school closures which occurred during the school year 2012–13 impacted attainment in mathematics and language for children in Grades 4 and 5. We were able to use data on the same pupils at the start and end of the school year. The results show that school closures impacted attainment in mathematics but not literacy. These effects were produced when the average extent of school closures was very limited but nevertheless even a relatively short loss of instructional time in mathematics had a notable effect. The average effect of a lost hour of mathematics instruction for the full sample was in the order of a reduction of 2% of a standard deviation. Applying this finding to the context of Covid-19 and ongoing school closures in Ethiopia indicates that because of the long period of time students have been out of school, the extent of learning losses will be substantial. The learning losses we have quantified probably mark a lower bound on the extent of such losses in the current situation. Moreover, the likelihood is that many children will not return to school during or even after the Covid-19 pandemic, a situation which is now exacerbated by conflict. Shocks to livelihoods through Covid-19 and conflict heavily impact parents' abilities to send their children to school or to support educational activities. Thus, the time out of school during the Covid-19 crisis is likely to have a substantial impact on the educational ecosystem and learning environment, with such widespread school closures. Further studies are clearly needed to identify additional ways of enabling children to learn and catch up.

At the beginning of the Covid-19 crisis, 56% of school head teachers surveyed in the Young Lives Head Teachers Survey were particularly concerned that learning in mathematics would be affected (Young Lives, 2020). This is consistent with previous research which has similarly reported greater learning losses in mathematics. For example, Baker's (2013) study of the effects of teacher strikes in Canada found that longer periods of school closure, 120 days or more, had a worse effect on mathematics than language test scores. In the USA, Kuhfeld et al. (2020) were estimating that in the first part of the pandemic, students would have lost more ground in mathematics than language, with students making only 37–50% of the gains in mathematics in 2020 that they would have made in a normal school year. However, Maldonado and De Witte's (2020) recent study found that test score reductions due to lost instructional time in the Flemish region of Belgium were greater for language scores than mathematics. The language of instruction was Dutch but 19% of the students did not speak Dutch at home (Maldonado & De Witte, 2020) and the loss of instructional time is likely to have had a greater impact on those students. In addition, Maldonado and De Witte (2020) suggest that mathematics may have been easier to teach by the distance learning methods implemented during the pandemic. In the context of low-income countries such as Ethiopia, where access to the internet is limited, this is less likely to be relevant.

During the Covid-19 pandemic, factors other than lost teaching time have impeded children's learning. Food insecurity is an overriding concern. Ethiopian children are also likely to experience heightened stress about their future prospects—for example, girls may be at higher risk of earlier marriage when they are not in school (McDougal et al., 2018). For many

children in Ethiopia, time out of school means working in agriculture and in household work, lowering the chance of returning to education in the future.

Previous research has consistently found that school closures have been experienced unequally, a situation which is likely to persist but perhaps in a different way in the context of Covid-19 (Kufeld et al., 2020). In Ethiopia, the potential school learning losses from the Covid-19 crisis have to be examined further in the context of food security, which is linked to work opportunities, rainfall and regional location. Against these sources of insecurity, household assets have always been a critical issue in protecting against vulnerability. In our estimations we see that household wealth is linked to children's gains from education in both mathematics and language, showing its potential protective effects during Covid-19. Children whose father is in the household also experienced a greater uplift in test scores in mathematics and language, which points to the enhanced vulnerability of children whose father is not in the household. In relation to inequalities in educational outcomes, the results show that lost hours of tuition in mathematics increase the Gini coefficient of mathematics scores, so it is not only that there is an aggregate loss in scores but also that school closures widen the inequality of children's outcomes.

It is perhaps reassuring in relation to the quality of education that the hours-of-class-time-a-day variable is related to higher scores in mathematics and full school day is related to higher scores in language. Furthermore, the results show that extra classes that families have not paid extra for have helped children to recuperate lost learning. In sum, these results seem to point to some effectiveness of educational provision, which has been a matter of great concern in Ethiopia. However, the results also highlight how interventions will need to be modified for learners who have different starting points in relation to learning attainment and ability. The results on the positive effects of providing extra unpaid classes that children can access and fit around other household obligations is likely to be an important part of making learning accessible after a period in which children have spent their time in household production. This result adds to our understanding of shadow education, by showing that extra classes to catch up for lost time do contribute to children's learning, while the evidence is that paid-for classes, potentially as a remediation intervention, do not seem to be as effective in Ethiopia.

CONCLUSION

This paper examined the impact that school closures have had on the educational attainment of children in Ethiopia. The effectiveness of one type of compensation for lost learning, namely the provision of additional classes, was considered. The results indicate that extra classes, specifically unpaid classes, can reduce the negative impacts of school closures on attainment, mainly in mathematics, and may also mitigate increases in inequality in educational attainment due to lost instructional time.

In a country with both absolute low learning levels and large gaps in achievement between advantaged and disadvantaged groups (Pankhurst et al., 2018), our results highlight the importance of additional learning support in narrowing the attainment gap. Previous studies have highlighted the importance of additional and alternative learning to children's attainment (Angrist et al., 2020; Aucejo & Romano, 2016; Carlsson et al., 2015; Dang & Rogers, 2008; Glewwe & Kremer, 2006; Lavy, 2015). Additional and alternative learning initiatives, such as the Ethiopian Distance Learning Plan (Belay, 2020), are unlikely to eliminate existing educational inequality (Tiruneh, 2020) but could help to mitigate education deficits resulting from closures. Similar distance-based learning programmes have been developed in other African countries (Adarkwah, 2021). A downside is that there are strong regional as well as socioeconomic inequalities in access (Tiruneh, 2020). The lack of educational

resources available to poorer children during the current health pandemic is therefore likely to have a large impact on their learning and academic progression.

The analysis in this paper examined the effects of school closures when the instructional time lost was on average relatively low. The reported effects inform our understanding of the likely effects of the much more extensive school closures that took place as a result of Covid-19. However, we need to keep in mind that under Covid-19, most schools were completely closed and for much longer periods of time than those analysed in this paper. Between 11 March 2020 and 2 February 2021, Ethiopia reported a total of 151 days of school closure due to Covid-19 (UNICEF, 2021b). It is therefore difficult to be confident about extrapolating from these results, particularly in relation to time lost in language instruction. It seems likely that the negative effects of Covid-19 on livelihoods for most of the population will have worsened the impact on education. Further research is needed to identify whether the marginal effects of closure on attainment remain constant when the number of days lost to closure increases dramatically as they have done in the pandemic. Nevertheless, our analysis, using high-quality data, contributes to evaluating the direct impact on education of recent closures and to policy discussions over potential remediation post-Covid-19.

Avoiding unscheduled school closures altogether is unrealistic at the current time in Ethiopia. Our results show that additional extra classes with a timetable that responds to the exigencies of some children's lives can help narrow the educational inequalities among children. In the context of the UK, Campbell et al. (2018) found that more flexibility in early years provision enabled poorer families to access the service. The lesson is that education provision should be more responsive in fitting around children's lives, which in Ethiopia would mean a policy of providing additional instruction that fits around children's ability to attend. This is particularly important in deprived areas where due to, for instance, food insecurity and weather shocks, it is impossible for schools to open throughout the academic year. It is also important to continue to address the lack of food security in young people's lives, particularly in the rural areas, as Ethiopia's productive safety net programme has done. Favara et al. (2019) found that students whose families were on the scheme attained an uplift in both numeracy and vocabulary skill. However, Favara et al. (2019) also found that the uplift in numeracy was greater for boys, indicating that support needs to be better targeted to girls and other vulnerable students. There is likely to be an increasing imperative for targeted interventions in the wake of Covid-19 since, as Tiruneh (2020) argues, school closures are expected to increase inequality between advantaged and disadvantaged children in Ethiopia.

CONFLICT OF INTEREST

No conflict of interest is declared.

ETHICS APPROVAL

No ethics approval was required.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available in Young Lives at https://beta.ukdataservice.ac.uk/datacatalogue/studies/study?id=7823&type=Data%20catalogue

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ENDNOTES

[1] Several commentators note the need for evidence to evaluate whether online or alternative forms of intervention are more effective, which would inform the design of policies to address the learning deficits created by Covid-19 (Dube, 2020; Mhlanga & Moloi, 2020; Mulenga & Marbán, 2020).

[2] The primary completion rate is the number of new entrants, not including repeaters, in the last grade of primary education regardless of age, divided by the population at the entrance age for the last grade of primary education.

[3] The sample that we use in our analysis is restricted to children in schools that took the tests, and therefore the results are more relevant for this group; in 2015 the net enrolment rate for 6–11 year-olds was 85% (World Bank, 2021). In terms of representativeness, the sample is drawn from four regional states [Amhara, Oromia, Southern Nations, Nationalities and Peoples (SNNP), Tigray] and Addis Ababa. These five regions (four regional states and Addis Ababa) alone account for 96% of the national population. These regions were further extended to Somali and Afar for the school survey. We thank an anonymous referee for their comment on this point.

[4] The figures show some difference between those that did and did not experience closures (e.g. those living in rural areas are disproportionately more likely to experience closure as are those in Tigray, the third most rural region, after Amhara and Oromiya). These sample differences are controlled for in the propensity score matching and regressions.

[5] As there are three groups, the procedure necessitates two steps. First, a ratio of one paid classes group case to one unpaid classes group case and second, a ratio of one paid classes group case to one no classes case.

[6] With the standard deviation in average mathematics scores of 3.74, this can be interpreted to imply that test scores are just under 0.5% lower for every extra hour of instructional time lost due to closure.

[7] The finding in relation to literacy is in line with a body of literature that highlights links between pupil gender and educational outcomes, often seen in developing and lower-middle-income countries that are characterised by strong patriarchal societies. For instance, Darko and Vasilakos (2020) show that there are significant gender differences in the way that household wealth affects educational performance of children in India.

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