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DATA MUST SPEAK

Unpacking Factors Influencing Primary and Middle School Performance in Ethiopia

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DATA MUST SPEAK

Unpacking Factors Influencing Primary and Middle School Performance in Ethiopia

Ministry of Education Ethiopia
UNICEF Ethiopia
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This is a working paper that has been prepared to stimulate policy dialogue. However, the analysis presented in this publication does not necessarily reflect the policies or the views of UNICEF.

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Executive summary

Executive summary

In 2022, the Ministry of Education (MoE) in Ethiopia published its sixth Education Sector Development Programme (ESDP VI) to guide implementation of its education policies between 2020/21 and 2024/25. The ESDP VI prioritizes improving the quality and equity of education, including by enhancing the Education Management Information System (EMIS) to enable stakeholders' access to and use of detailed data. Strengthening EMIS can help facilitate data and evidence-based improvements to policies and programmes (Ethiopia, MoE, 2021a).

The Data Must Speak (DMS) Positive Deviance research is a collaboration between the MoE, UNICEF Innocenti – Global Office of Research and Foresight, and UNICEF Ethiopia. In this report, the DMS research analyses existing national education data to understand the factors associated with school performance in Ethiopia. This analysis is a critical step in supporting the MoE's objective of using data and evidence to strengthen existing policies and develop innovative solutions to improve education.

This report summarizes the results of this analysis, which leveraged four years of EMIS data from 2019 to 2022.

Key findings

Boys are more likely than girls to enrol in primary and middle school. However, when enrolled, girls are more likely to be promoted to the next grade.

As of 2024, 26 per cent of primary school-aged girls are out of school in Ethiopia (Malala Fund, 2024). Girls that enter the education system are 1 percentage point more likely than boys to survive to higher grades. Boys are more likely to enrol in school but drop out earlier. While all students in Ethiopia need support to complete their primary education, targeted supports are needed for boys and girls based on their specific needs.

Higher proportions of overaged students in a grade are associated with lower promotion rates. Students being overaged could in part be linked to high repetition rates in the country. In 2021, average repetition rates between grades 1 and 8 were 7.8 per cent. National dialogue on student repetition policies, especially those that have already repeated or are overaged, could be considered.

Increasing the proportion of teachers with the correct qualification for the level they teach is positively associated with promotion rates. While 94 per cent of teachers are qualified to teach in primary school, only 37 per cent of teachers have the correct qualification to teach in middle school This highlights the importance of increasing teachers' knowledge and skills through Colleges of Teacher Education, which could improve students' progression through primary and middle school.

Reducing pupil-teacher ratios and class sizes is positively associated with higher promotion rates. Pupil-teacher ratios (PTRs) were higher in schools located in rural areas (50:1) compared to urban areas (42:1). However, average class sizes were larger in urban areas than in rural areas, suggesting that urban areas could improve infrastructure bottlenecks, like physical classroom availability, while rural areas may need to prioritize hiring more teachers.

The presence of a toilet in the school was positively associated with promotion rates. Toilet availability has increased in Ethiopia from 85 per cent of schools having a toilet in 2019 to 97 per cent in 2021, highlighting the importance of improving sanitary conditions in schools. Other school characteristics such as school grants, strategic planning, or the presence of a library or a pedagogical centre, did not have a clear association with promotion rates.

Political violence and conflict in the school's *woreda*, or local administration level, and in neighbouring *woredas* is negatively associated with promotion rates. Even if there are no fatalities, the number of political violence events has negative implications for children's education.


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1. Introduction

Introduction

The Ministry of Education (MoE) of Ethiopia is committed to improving quality and equity of education through system strengthening and governance. This includes allowing stakeholders to access more detailed data on the quality and efficiency of the education system, understanding how resources are allocated, and where improvements can be made (Ethiopia, MoE, 2021a).

The Data Must Speak (DMS) positive deviance research is an innovative collaboration between the MoE and UNICEF that aims to identify and scale local solutions already working in Ethiopia's primary and middle schools. The positive deviance methodology is rooted in the premise that there are individuals in every community whose behaviours and practices help them find better solutions to the same problems their peers face, despite operating in similar circumstances (Herington and Van De Fliert, 2018, as cited in Lévano et al., 2022). This research extends the positive deviance methodology to the education sector in Ethiopia, and aims to understand why some schools are performing better than their peers, even when operating in similar conditions and with similar resources.

The DMS research includes four country-level stages and leverages various methodologies. In **Stage 1**, secondary data is analysed using quantitative methods to understand factors that correlate with school performance. **Stage 2** then identifies positive deviant schools, while in **Stage 3**, primary data is collected from positive deviant schools and comparison schools to understand how positive deviant schools differ from their peers, and what practices and behaviours contribute to their higher performance. Finally, **Stage 4** identifies opportunities at the system, policy, school and community levels to scale the identified positive deviant practices and behaviours in other schools to improve education outcomes.

Figure 1: Stages of the DMS positive deviance research

Stage 1

Analysis of resources and context associated with school performance
(Quantitative research)

Stage 2

Identification of positive deviant schools and school typology
(Positive deviance)

Stage 3

Understanding school-level positive deviant behaviours/practices
(Behavioural sciences)

Stage 4

Investigating levers for optimum scale
(Participatory implementation research and scaling science)

2. Education context

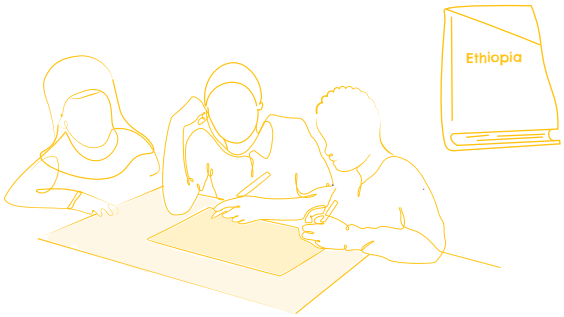
Education context

Ethiopia is a federal republic, currently divided into 12 regions and two city administrative units. The country is diverse in ethnicities, with over 90 different ethnic groups and 80 distinct spoken languages (Ethiopian Statistical Service, 2007). While Ethiopia has a federal system of governance, regions have significant autonomy. Regional Education Bureaus (REBs) and, within regions, Woreda Education Offices (WEOs), are responsible for the delivery of primary education by hiring and deploying teachers, building and maintaining schools, and ensuring enrolment and monitoring performance (World Bank, 2022a). Since publishing the Ethiopian Roadmap for Education and Training in 2020, the country has focused on building national unity through diversity measures in its education policies and planning (Teferra et al., 2018).

Over the last two and a half decades, Ethiopia's education system has made important advances. Enrolment has more than tripled between 2000 and 2017, and youth literacy rates improved from 49.9 per cent to 69.5 per cent between 2004 and 2015 (UNICEF Ethiopia, 2018). Some improvements have partially been associated with the implementation of local languages in the curriculum and the abolition of school fees in 2002 (Oumer, 2009; Seid, 2016; Chicoine, 2019).

Despite this progress, stark inequalities in access to education remain. While attending public school is free, uniforms and learning materials are still paid for by families, and long distances between home and schools may require additional time or funds, which can exclude low-income households from education. It is estimated that almost a third of school-aged children are out of school in Ethiopia, and that one in five have never attended school (World Bank, 2022a).

Gender norms in the country also influence children's enrolment, with Ethiopian families often sending boys to school instead of girls (UNESCO, 2015). In 2022, the net enrolment rate for boys in primary school was 98 per cent, while for girls it was 90 per cent, and in middle school it was 47 per cent for boys and girls (Ethiopia, MoE, 2023). It is estimated that male students from advantaged backgrounds are two times more likely to start their primary education than female students from disadvantaged backgrounds (Ethiopia, MoE, 2021b; World Bank, 2022a).



Access to education has also not guaranteed learning for children. The 2019 National Learning Assessment (NLA)1 results showed grade 4 students in Ethiopia were only able to answer 30 per cent of the questions in English correctly, and 40 per cent of math questions correctly. Boys slightly outperformed girls, especially in mathematics (World Bank, 2022a).

Progress with education outcomes was also hindered by the COVID-19 pandemic, conflicts and natural disasters in the country. Enrolment has declined in conflict areas in Tigray, Afar and Amhara, and school infrastructure has been damaged amid wars and droughts (UNICEF, 2021; World Bank, 2022b). The combined impact of the COVID-19 pandemic and ongoing conflict in the country has further exacerbated the learning crisis.

It is estimated that over 3.5 million students in conflict-affected areas who had already experienced significant learning losses due to COVID-19 school closures remained out of the classroom for significant periods (Bedasso, 2021).

Amid these challenges, the MoE introduced structural reforms to the education system in 2020, restructuring the 12 years of basic education into six years of primary education (grades 1–6), two years of middle school (grades 7–8) and four years of high school (grades 9–12). Some regions administer an examination at the end of grade 6, although this is not harmonized across regions, and all regions administer grade 8 exams. However, the grade 8 exam no longer determines if students can progress from primary to secondary school, removing a hurdle for students to progress in their studies.

Table 1: Changes to Ethiopia's education system introduced in 2020

Grade	Education level before 2020	Examinations before 2020	Education level after 2020	Examinations after 2020
Kindergarten 1	Pre-primary		Pre-primary	
Kindergarten 2				
Kindergarten 3/C-to-C/O-Class/ASR			N/A	
Grade 1	Lower primary		Primary school	
Grade 2				
Grade 3				
Grade 4				
Grade 5	Upper primary			
Grade 6				Grade 6 Regional Assessment (low stakes)
Grade 7			Middle school/ junior school	
Grade 8		Grade 8 National Examination (high stakes)		Grade 8 Regional Assessment (low stakes)
Grade 9	Secondary school		High school	
Grade 10				
Grade 11	Upper secondary school/ preparatory school	Grade 12 National Examination (high stakes)		Grade 12 National Examination (high stakes)
Grade 12				

Sources: Ethiopia, MoE (2021a), UNICEF Ethiopia (2021).

The sixth Education Sector Development Programme (ESDP VI) 2020/21–2024/25 guides the MoE's development and implementation of education policies. The ESDP VI and Ethiopian Roadmap for Education and Training focus on improving the quality and equity of education through many measures, including:

Changing the education structure and adjusting the administration of regional and national assessments and examinations (see **Table 1**).

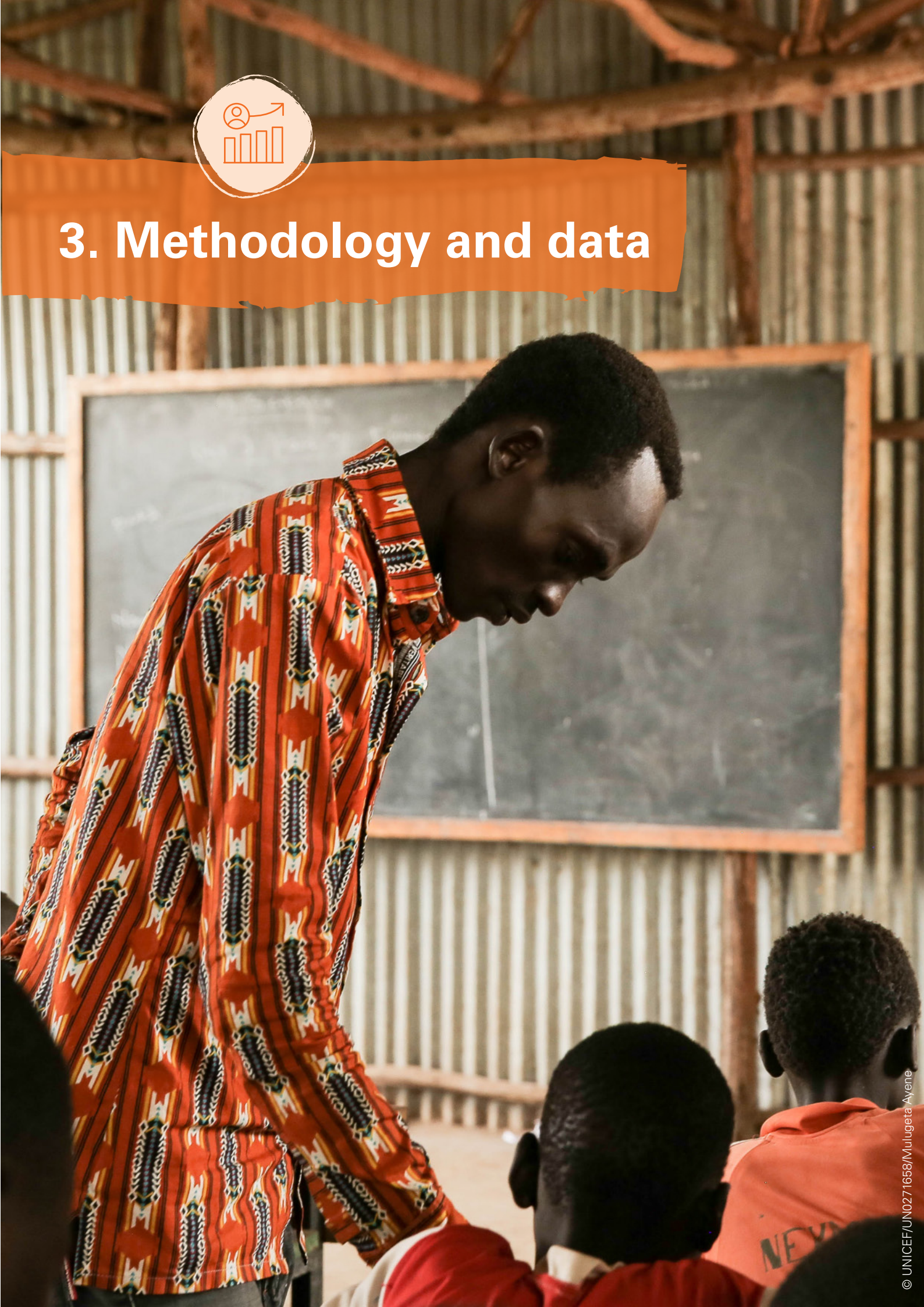
Revising the existing national curriculum to integrate national unity, moral education and civics education and focus on extracurricular activities that contribute to these areas.

Increasing the minimum requirements for teacher qualifications at each level of schooling.

Supporting out-of-school children and students who have dropped out of school through Alternative Basic Education (ABE) programmes and offering incentives, including school feeding programmes, scholarships and financial support for education materials, to support student completion.

Moving from a data-rich to a data-driven education system by improving the quality, reliability, availability and use of Education Management Information System (EMIS) data at all levels of the education system (Ethiopia, MoE, 2021a).

3. Methodology and data



Methodology and data

Stage 1 of the DMS research leverages quantitative data analysis to answer the following research questions, which were developed in collaboration with MoEVT and various education stakeholders in Ethiopia:

1. What resources and contextual factors are associated with primary and middle school children advancing from one grade level to the next in Ethiopia?

2. Are there specific resources associated with girls advancing from one grade level to the next?

3. How do education outcomes and resource constraints vary by region?

4. How do various forms of political violence affect education outcomes?

The education outcome indicator used in this analysis to measure school performance was promotion rates (cohort-based), representing the ability of schools to keep children enrolled and progressing through their education. Learning outcomes could not be used as a measure of school performance, as learning assessment data were not available from all regions for either grades 6, where assessments are not harmonized, or grade 8, at the time of writing this report.

3.1 Data and sample

This analysis was based on Ethiopia's four most recent years of EMIS data available at the time of writing this report for primary and middle school grades (2012–2015 in the Ethiopian calendar, equivalent to 2019–2022 in the Gregorian calendar).[1] Ethiopia's EMIS contains a comprehensive list of information for almost every school in the country, except for the Tigray region.[2] EMIS data includes information by grade and gender of the number of students enrolled, the number of repeaters, and the number of readmitted students,[3] as well as teacher characteristics and school infrastructure.

This analysis focuses only on government schools, which in 2022 accounted for almost 95 per cent of primary and middle school students who were enrolled in over 33,000 schools in Ethiopia. Of these schools, 68 per cent are in rural areas. Schools that did not offer all primary and middle school grades are also included in this analysis.

EMIS data was merged across the four years. However, 7 per cent of schools did not have a stable unique identifier between 2019 and 2020, 13 per cent between 2020 and 2021, and 15 per cent between 2021 to 2022. To overcome this challenge, a technique called 'fuzzy merging'[4] was used to identify schools throughout time and between different sections of data (student, teacher and school characteristics).

[1] This report will present analysis using the Gregorian calendar years.

[2] The Tigray region has not collected EMIS data since 2020, and is therefore excluded from the analysis.

[3] Readmitted students are those that have been out of school for one or more years and have reenrolled.

[4] Fuzzy merging is a technique for joining data sets based on approximate rather than exact matches between text fields. In Ethiopia's case, the variables used to identify schools across time included their names, regions, zones, *woreda*, school locality and ownership. These were used as they are mostly stable, and it is unlikely that schools would switch all of these identifiers from one year to the next. A total of 70 per cent of schools where unique identifiers were not stable were government schools, and 60 per cent were in rural areas.

After the fuzzy merging, 97.2 per cent of schools in 2019 were identified in the 2020 database; 92.7 per cent of schools existing in 2020 were identified in the 2021 database; and 93.5 per cent of schools existing in 2021 were identified in the 2022 database. After the fuzzy merging, over 83 per cent of schools existing in Ethiopia between 2019 and 2022 were successfully and uniquely identified in all four years of data (almost 33,000 schools), 5 per cent were identified in three years of data (2,000 schools) and 7 per cent identified in two years of data (2,500 schools). Despite this large identification of schools throughout time, schools are sometimes not included in the sample because of missing information. Calculating promotion rates was only possible because schools were uniquely identified across time.

In some cases, school or teacher characteristics information was missing or likely incorrect for an entire region in a specific year. For example, the education level teachers taught in was missing for the Somali region in 2019; in 2021, almost all teachers in Addis Ababa had less than a diploma as a qualification, even though this data did not match that of the year before and after; in 2021, data on school libraries, number of pits and pedagogical centre availability were missing for the Afar region, and data on library and pedagogical centre availability were missing for the Somali region. To avoid excluding entire regions from the main regression analysis, three methods were used. First, when two kinds of information on the same variable were available, but either one was incomplete for a school, both were used to create a third variable. For example, data on toilets included information on the type of toilet available at the schools, as well as whether toilets were separate for boys and girls. From these variables, it could be deduced whether a school had at least one toilet. Second, when the first method could not be implemented, and when two years of information on a specific variable was available, missing values were replaced by calculating an average of the values of the two years of information. Third, when neither the first nor the second methods could be used, values were replaced with the most recent data. **Tables 10, 11** and **12** in **Appendix C** show how each variable was treated for this report.

Finally, in addition to EMIS data, this analysis leveraged data from the Armed Conflict and Location Event Data (ACLED) database to explore the impacts of political violence on student promotion rates. ACLED collects information on the dates, actors, locations, fatalities and types of all reported political violence (including battles, protests, riots, remote violence or explosions,[5] strategic development[6] and violence against civilians) around the world, including in Ethiopia.

This analysis used political violence at the *woreda* level on a yearly basis, and analyses its effects on education within a *woreda* and on surrounding *woredas*. ACLED data was summarized at the *woreda* level and into yearly statistics – number of events in a *woreda*, number of fatalities due to political events – so that it could be matched with EMIS data on schools. Although Tigray is a region with one of the highest escalations due to the ongoing conflict, as previously discussed, EMIS data has not been collected in the region since 2020, so the effects within *woredas* in this region could not be included. However, analysis on surrounding *woredas* was included to capture some insights on implications for regions neighbouring Tigray where EMIS data is still collected and available.

[5] According to ACLED definitions, "explosions" or "remote violence" refer to events where an explosion, bomb or other explosive device was used to engage in conflict. They include one-sided violent events in which the tool for engaging in conflict creates asymmetry by taking away the ability of the target to engage or defend themselves and their location.
[6] According to ACLED definitions, "strategic developments" are contextually significant, non-violent events by conflict actors that signal shifts in conflict dynamics, potential future violence or political strategy, like peace talks, significant recruitment, base establishment or non-violent territory transfers.

3.2 Models for analysis

A univariate regression model with multiple covariates and fixed effects (FE) analysis was used as the main model to estimate the factors associated with school performance, measured by grade 1–7 promotion rates, presented in section 5. The model (Equation 1) estimated the relationship between dependent variables (promotion rates at the school-grade-gender level) and various independent variables (school characteristics represented as precisely as possible). This model analysed the relationship of many independent variables with the dependent variables at the same time:

$$(1)\ Promotion_{ijkl} = \beta_0 + \beta_s Student_{ijkl} + \beta_q Teacher_{ijk} + \beta_r Infrastructure_{ijk} + School_i + Year_k + \varepsilon_{ijkl}$$

Where

$Student_{ijkl}$ represents student characteristics and includes a student gender dummy, where 1 represents female students and 0 represents male students in school i, for grade j in year k, as well as proportion of overaged students for their grade[7] in school i, for grade j in year k for students of gender l.

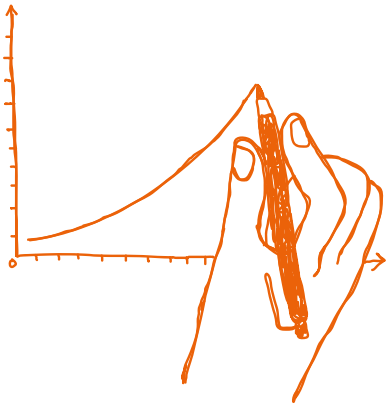
$Teacher_{ijk}$ represents teacher characteristics and includes proportion of teachers that are qualified for the level taught, as well as proportion of teachers in a school that are female, in school i, for grade j in year k.

$Infrastructure_{ijk}$ represents basic school characteristics in school i in year k, and includes a dummy variable that identifies if schools offer all grades from primary and middle school, average pupil-teacher ratio (PTR), average grade class size, and dummies identifying if the school receives a grant, offers feeding to students, develops strategic planning, has at least one toilet, and has a library or a pedagogical centre.

Variables included in the regression model were chosen based on data availability, variance and relevance to the performance indicator and broader education context in Ethiopia, based on discussions with the Ministry of Education during co-creation sessions.

Since there could be unobserved factors in the database that are associated with performance (such as socioeconomic factors) and do not vary or vary only slightly over time, school FE are included in the models to take these into account. Year FE were also included to control for trends in school performance which are uniquely associated with time; when appropriate, grade FE were included to take into consideration the cycle of dropout/repetitions in the education system.

$School_i$ are unobserved time-invariant heterogeneities across each school i (school FE). $Grade_j$ are unobserved time-invariant heterogeneities across grades when using promotion rates as the school performance indicator (grade FE). Finally, $Year_k$ are unobserved time-invariant heterogeneities across each year k, three years ranging from 2019 to 2021 (year FE).



[7] Overaged students are defined as two years older than the correct age for their grade.

In addition to the main model, two other models were run with interactive variables, which are detailed in **Appendix A**, along with the presentation of the regression analysis tables. An additional pooled ordinary least squares (POLS) model was run as a robustness check for variables that do not vary throughout time, and is further described in section 5.3.4.

Promotion rates were estimated by tracking cohorts of students as they moved through grades over time using enrolment data (**Equation 2**). The method accounts for students who repeat a grade or have been readmitted, meaning they have returned to school after leaving for any period of time. While it is not possible to follow individual students, the changes in enrolment represent overall student progression. The data was also disaggregated by gender to explore differences in boys' and girls' promotion rate patterns. Promotion rates were calculated as:

$$(2)\ Promotion_{kiji} = (Enrolment_{(k+1)(j+1)li} - Repeaters_{(k+1)(j+1)li} - Readmitted_{(k+1)(j+1)li)}) / Enrolment_{kjli}$$

where k is the year of the data analysed, j is the grade, l is the gender of students, and i is the school. Observations where promotion rates were higher than 120 per cent or lower than 20 per cent were not included in the analysis as they were outliers (totalling 6 per cent of observations).

Repetition rates are also presented in the descriptive analysis, but not as an outcome variable, as they could partly explain what is happening to children that are not being promoted. Repetition rates were calculated as follows:

$$(3)\ Repetition_{kijl} = Repeaters_{(k+1)ijl} / Enrolment_{kijl}$$

This measure reflects the proportion of students enrolled in a given grade, school and gender group in year k who are still enrolled in the same grade in year k+1. As such, it does not capture the proportion of repeaters within a classroom at a specific point in time, but rather the share of a cohort that did not progress to the next grade level in the following year. Section 3.2. provides further details on promotion rates.

Raw data used for the DMS research analysis differ from those used for Ethiopia's Statistical Annual Abstract (ESAA). This could be because of differences in data manipulation for analysis and reporting. For example, the DMS research does not remove high repeater and enrolment data points from the analysis, only outlier promotion and repetition rates, after calculations. Due to the differences in the raw enrolment and repeater numbers, the final calculation of promotion and repetition rates in DMS and ESAA reports differ (see Table 2), which may also mean differences in interpretation of results. However, some patterns converge. For example, grade 1 has lower promotion rates compared to other grades, average promotion rates have declined between 2019 and 2021, and the number of repeated and readmitted students has been increasing in Ethiopia over the last three years.

Table 2: Differences in raw data and calculation of promotion and repetition rates between ESAA and the DMS analysis

Year of data	ESAA/ DMS	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
Enrolled students									
2019	ESAA	3,814,417	2,899,767	2,608,416	2,409,150	2,171,115	1,813,642	1,632,480	1,480,253
	DMS	3,807,146	2,897,064	2,625,543	2,443,210	2,226,038	1,867,044	1,685,467	1,540,128
2020	ESAA	3,037,455	2,944,615	2,544,909	2,340,398	2,059,584	1,907,480	1,620,461	1,499,669
	DMS	2,914,792	2,836,129	2,449,223	2,259,064	1,992,007	1,849,451	1,569,983	1,451,183
2021	ESAA	3,850,669	2,689,731	2,589,139	2,384,884	2,137,976	1,860,933	1,699,446	1,470,858
	DMS	3,609,418	2,495,663	2,416,435	2,231,056	2,010,550	1,750,515	1,600,259	1,371,250
2022	ESAA	3,865,191	3,057,325	2,403,061	2,309,060	2,087,659	1,823,508	1,614,790	1,485,431
	DMS	3,674,132	2,891,570	2,264,383	2,187,311	1,984,465	1,733,742	1,536,057	1,414,215
Repeated students									
2020	ESAA	14,036	11,113	20,502	17,187	14,932	12,005	9,205	11,592
	DMS	29,890	23,154	18,468	16,834	13,962	10,197	8,112	14,937
2021	ESAA	69,264	64,622	54,221	53,667	51,120	39,722	36,171	20,256
	DMS	327,694	286,096	232,816	237,781	254,412	191,682	174,062	131,024
2022	ESAA	111,216	78,996	65,000	63,639	64,832	47,524	46,822	47,015
	DMS	367,972	266,883	220,965	219,650	233,570	161,658	155,703	154,670
Readmitted students									
2020	ESAA	266	2,435	15,855	14,648	13,992	12,331	10,493	9,469
	DMS	16,988	16,660	15,418	14,895	12,576	10,686	9,619	9,347
2021	ESAA	89,390	83,330	72,674	71,923	67,189	55,341	47,935	31,595
	DMS	112,380	93,363	86,650	86,631	75,755	61,661	53,849	49,674
2022	ESAA	97,121	63,458	53,051	47,952	42,619	34,158	29,545	21,750
	DMS	351,586	221,739	184,783	169,630	150,401	116,381	99,556	71,979
Promotion rates									
2019	ESAA	77%	87%	89%	84%	87%	88%	91%	72%
	DMS	73%	83%	85%	80%	82%	83%	85%	-
2020	ESAA	83%	83%	88%	85%	85%	84%	87%	85%
	DMS	73%	74%	78%	74%	75%	74%	76%	-
2021	ESAA	76%	85%	85%	83%	81%	83%	83%	77%
	DMS	67%	74%	74%	72%	72%	73%	74%	-
Repetition rates									
2019	ESAA	0%	0%	1%	1%	1%	1%	1%	1%
	DMS	1%	1%	1%	1%	1%	1%	1%	1%
2020	ESAA	2%	2%	2%	2%	2%	2%	2%	1%
	DMS	9%	11%	10%	11%	13%	11%	11%	10%
2021	ESAA	3%	3%	3%	3%	3%	3%	3%	3%
	DMS	10%	9%	10%	10%	12%	9%	10%	11%

Source: Ethiopia, MoE (2020), Ethiopia, MoE (2021), Ethiopia, MoE (2022), Ethiopia, MoE (2023).

Although over 1,000,000 grade and gender promotion rates were calculated across the three years, due to outliers and missing school information, the final regression sample had 762,229 observations, representing data on 30,704 unique schools. This allows a univariate model using fixed effect regression analysis on the correlations between teacher, student and school characteristics, and promotion rates, as well as an exploration of how conflict events are associated with promotion rates, controlling for all other school resource and characteristics.[8]

3.3 Reliability of promotion rates indicator

Promotion rates were selected as the indicator of performance as they indicate schools' potential to advance children through the education cycle. Promotion rates remain an important measure of school performance, as repetition rates in Ethiopia have been on the rise since 2020.

While in 2020, 18 per cent of government schools reported repeating at least one student, in 2022, this figure increased to 48 per cent (see **Table 3**).

Enrolment and repeater data follow a consistent pattern of increasing, rather than changing abruptly from year to year, aligned with population growth in Ethiopia and events in the country, like COVID-19 and reported cases of violence, suggesting promotion rates are a reliable measure. This is supported by analysis examining how total school enrolment varied from one year to the next between 2019 and 2022 (**Figure 2**), and a subsequent analysis on the distribution of all promotion rate observations included this analysis in the same period (**Figure 3**).

School-level total enrolment experienced the most disruption in 2020 (**Figure 2**), with a notable leftward shift (towards negative change and decrease in enrolment), while enrolment changes became progressively more stable and centred around 0 in 2021 and 2022, indicating a partial recovery or stabilization. Urban schools also show a larger growth in enrolment sizes and rural schools a smaller growth.

Table 3: Repetition trends in Ethiopia from 2020 to 2022

Year	Per cent of schools repeating 0 students	Average number of repeaters by school	Total number of schools analysed
2020	82.8%	4	32,703
2021	52.8%	52	33,674
2022	51.7%	53	33,972

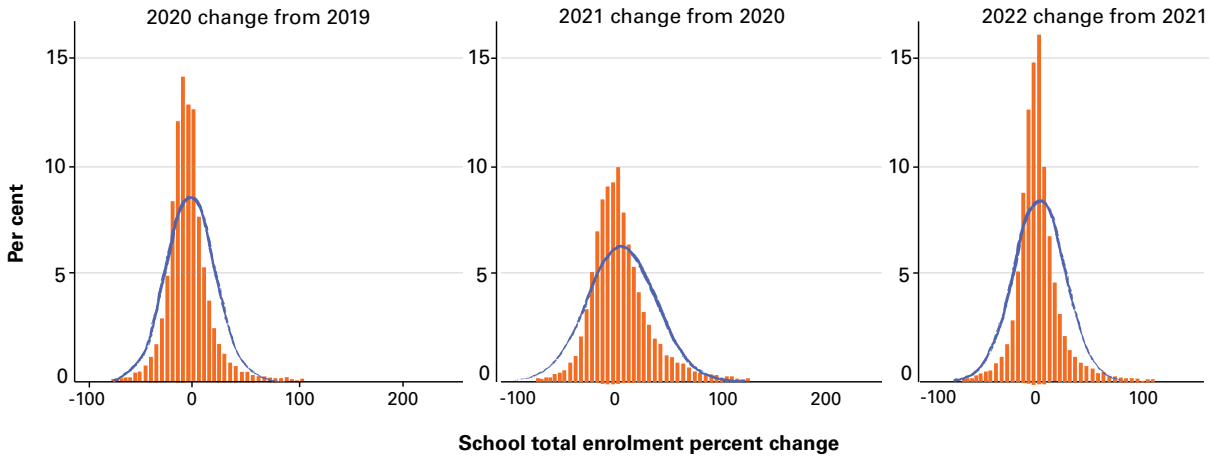
Source: Authors' analysis of EMIS data.

[8] Political violence characteristics were first broken down into the general number of cases and fatalities at the *woreda* level. Table 8 in Appendix A presents the different models used for analysis.

Enrolment and repeater data follow a consistent pattern of increasing, rather than changing abruptly from year to year, aligned with population growth in Ethiopia and events in the country, like COVID-19 and reported cases of violence, suggesting promotion rates are a reliable measure. This is supported by analysis examining how total school enrolment varied from one year to the next between 2019 and 2022 (**Figure 2**), and a subsequent analysis on the distribution of all promotion rate observations included this analysis in the same period (**Figure 3**).

School-level total enrolment experienced the most disruption in 2020 (**Figure 2**), with a notable leftward shift (towards negative change and decrease in enrolment), while enrolment changes became progressively more stable and centred around 0 in 2021 and 2022, indicating a partial recovery or stabilization. Urban schools also show a larger growth in enrolment sizes and rural schools a smaller growth.

Figure 2: Histogram of the change in total enrolment in schools in Ethiopia (percentage change)



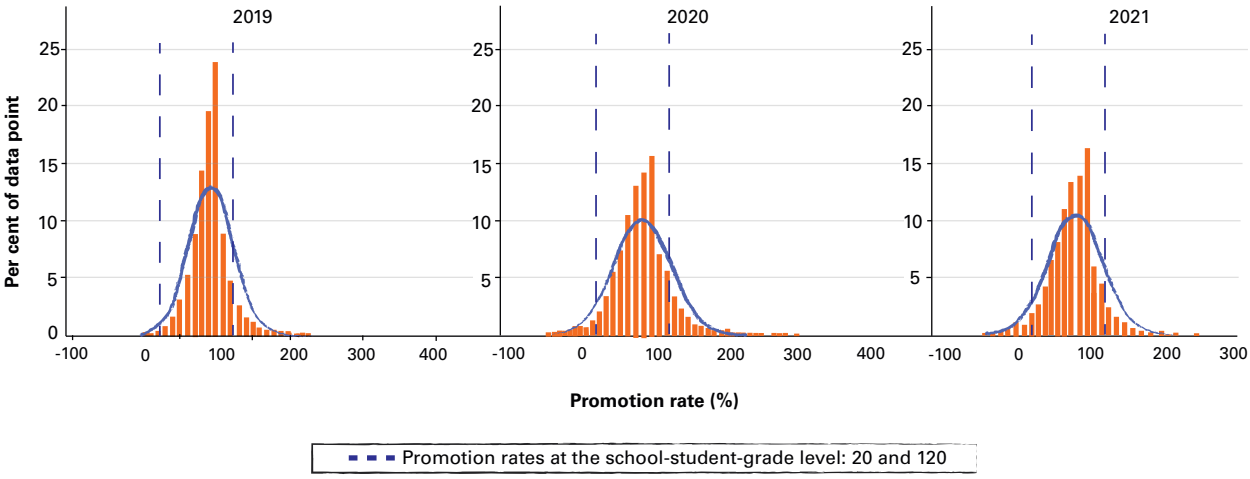
Source: Authors' analysis of EMIS data.
Note: start=50; width=5; bin=62. Percentage of schools refers to percentage of schools falling within each bin (a range of values used to group data points in a histogram). X-axis is year over year percentage change in total school enrolment.

Promotion rate distribution at the school-grade-gender level between 2019 and 2022 (**Figure 3**), which considers these changes in enrolment and repetition at the same time, also suggest it is a reliable measure. For example, most promotion rates are concentrated between 60 and 100 per cent. In addition, looking at the outlier threshold defined by this report, 90 per cent of data points in 2019, 83.3 per cent of data points in 2020 and 86 per cent of data points in 2021 are promotion rates between 20 and 120 per cent (**Figure 3**).[9]

While some promotion rates are above 100 per cent, these can occur naturally in the system. At the school level, promotion rates higher than 100 per cent can occur when students transfer between schools or when readmitted students are counted as a new enrolment. For this reason, this research uses 120 per cent promotion rate as a threshold for outliers.

[9] At the regional level, only five regions had an increase in promotion rates lower than 20 per cent. The research also analysed promotion rate stability at the regional level. The increase in the variance of promotion rates was widespread across all regions. Benishangul-Gumuz, Dire Dawa, Gambella, Harari and SWEPR saw an increase in grade and gender promotion rates below 20 per cent. Compared to 2019, Benishangul-Gumuz saw declines in promotion rates in 2020 and 2021.

Figure 3: Histogram of all promotion rate observations included in the analysis (government schools)



Source: Authors' analysis of EMIS data.
Note: start=49.6; width=10; bin=45. Percentage of observations falling within each bin. Dashed lines indicate promotion rates at 20 and 120. Promotion rates at the school-student-grade level.

3.4 Limitations

This analysis has limitations that are important to consider while interpreting the results.

First, the associations between school, teacher and student characteristics with promotion rates represent correlations and not causal relationships. For example, the regression analysis shows that larger class sizes are negatively associated with promotion rates. However, this does not mean that only reducing class sizes on its own will improve promotion rates. Instead, it could be that overcrowded classrooms mean there are not enough places for children to sit in the classroom, or that there are not enough classrooms available for the schools' size to be reduced. Hence, the presented results are not necessarily causal, and must be considered in tandem with other similar research and available analyses.

Second, the available data capture information on some, but not all, factors that are associated with school performance. Other observed or unobserved factors, such as conditions surrounding the school, family and socioeconomic characteristics of students, student well-being, and the different practices and behaviours of school stakeholders, may also influence promotion rates, but are not represented in the data. Inclusion of school FE in the model accounts for some of these unobservable factors, but is unlikely to capture all potentially relevant factors. While the data models used provide valuable insights, they do not fully explain the determinants of school performance and student outcomes. In Stage 3 of this research, additional primary qualitative data will be collected to complement this analysis and obtain deeper insights into other contributors to school performance.

While the methods used to replace missing variables enabled more regions to be included in this analysis, they may cause biases in the regression results. Coefficients may be over- or under-estimated depending on how well the replaced missing value reflects the realities on the ground. Robustness checks were run and are included in Appendix C, along with details of missing variables and value replacement methods.

In some cases, raw data and totals differ from the ESAA (see **Table 2**). Differences in this raw data significantly impact calculations of promotion, repetition and dropout rates, and explain why statistics presented in this report sometimes differ to the statistical abstracts produced by the MoE.

Finally, despite significant improvements in EMIS, implementation challenges may still contribute to data quality issues. For example, the EMIS questionnaire is paper-based, lengthy and sometimes not understood by respondents, usually the school principal, despite yearly orientation provided by the REBs (Szucs, 2021).[10] This could cause data-filling errors or missing information. In line with the description of EMIS data in yearly ESAAs, the DMS research observed regional disparities in missing data or puzzling variations of an indicator from one year to the next (which were addressed as specified **section 3.1** and **Appendix C**). Missing information reduces the number of variables included in the model, and the resulting data quality could cause some coefficients to be over- or under-estimated. Nevertheless, the statistics still represent a pathway for policy discussion and prioritization of resources.

Despite these limitations, this analysis offers a unique opportunity to use existing data sets to understand the current state of the education system and to make meaningful and contextualized recommendations for education policy in the country.

[10] During a workshop in Addis Ababa in February 2024, some EMIS colleagues expressed their belief that challenges with questionnaire completion may also be due to language barriers.

4. Descriptive statistics

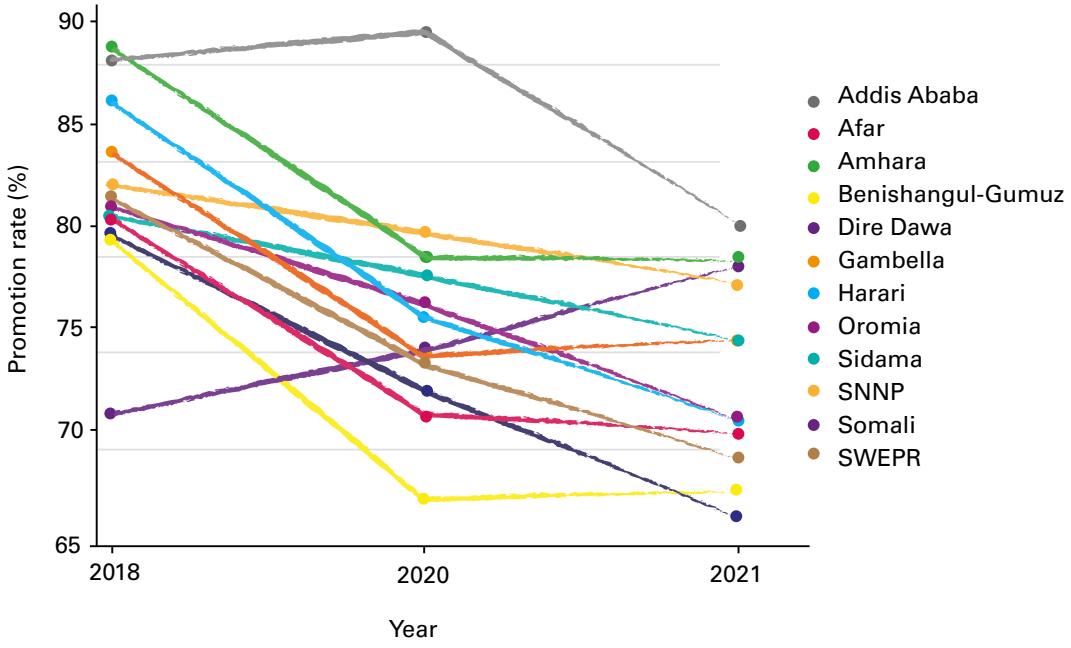
Descriptive statistics

4.1 Promotion rates

Between 2019 and 2021, average promotion rates in government schools fell by nearly 10 percentage points, from 82.6 to 73.8 per cent. The COVID-19 pandemic, which kept an estimated 26 million Ethiopian students out of school for at least seven months (World Bank, 2022b), may have influenced children's learning continuity and, consequentially, their progression in school.

The Somali region was the only region where average promotion rates increased (**Figure 4**). While promotion rates decreased in all other regions between 2019 and 2021, the Somali region's average promotion rates increased from 70.7 to 77.9 per cent, making it the region with the third highest promotion rate after Amhara and Addis Ababa. In contrast, Dire Dawa recorded the lowest promotion rates in 2021, about 15 percentage points lower than Addis Ababa. Conflict in the country between 2020 and 2022 is likely to have resulted in internal displacement and migration of students (see **section 5.5**), which would affect regional performance. However, student-level data to track student transfer were not available for this analysis.

Figure 4: Average promotion rates from grades 1 to 7 in government schools, by region and year (%)



Source: Calculations made by authors using EMIS data.
Note: Promotion rates adjusted by cohort. Excludes values below 20 per cent and above 120 per cent.

[10] During a workshop in Addis Ababa in February 2024, some EMIS colleagues expressed their belief that challenges with questionnaire completion may also be due to language barriers.

Promotion rates were lowest for grade 1 students and have been declining since 2019 (**Figure 5**). Only 68 per cent of grade 1 students were promoted in 2021, compared to 74 per cent of students in 2019 and 2020, meaning nearly one in three children did not progress to grade 2. Rising repetition, dropout and readmittance rates in grade 1 may contribute to these trends. Repetition rates for grade 1 students increased from 1 per cent in 2019 to 8 per cent in 2020 and 2021, and in 2021 at least 18 per cent of grade 1 students in government schools dropped out or interrupted their studies (**Table 4**). While readmittance rates rose from 1 per cent in 2020 to 3 per cent in 2021, these patterns suggest that many students experience delays in their education, either because of repeating grades or by dropping out and re-enrolling later, causing them to become overaged for their grade (Pankhurst et al., 2018).

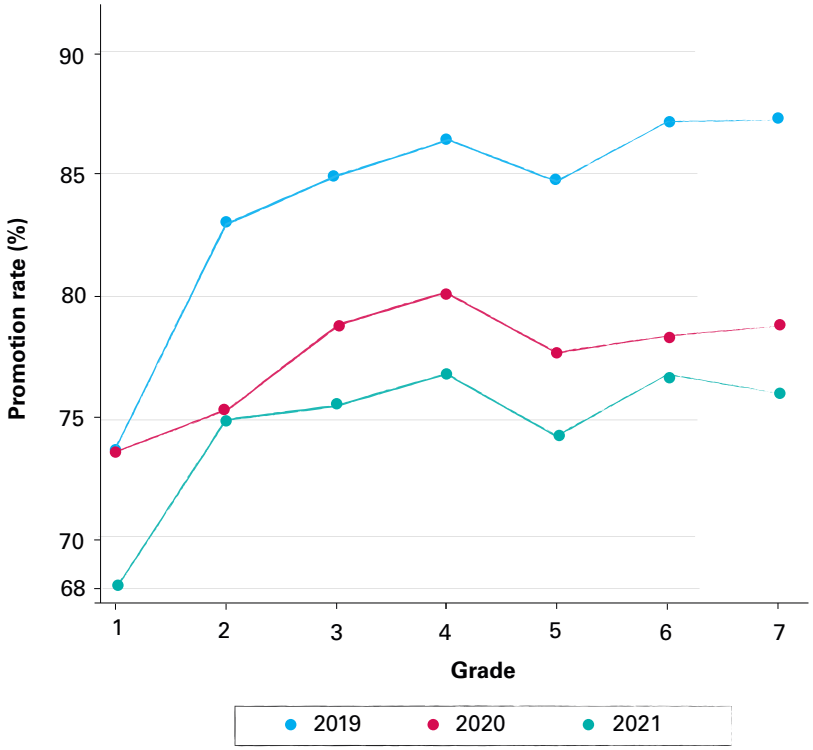
Table 4: Average promotion, repetition and readmittance rates, by grade and year (%)

		Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
2019	**Promotion rate (%)**	73.57	82.99	84.94	86.45	84.74	87.15	87.28	-
	Repetition rate (%)	0.81	0.81	0.72	0.71	0.65	0.56	0.51	1.01
	Readmittance rate (%)	-	-	-	-	-	-	-	-
2020	**Promotion rate (%)**	73.54	75.27	78.73	80.13	77.62	78.34	78.81	-
	Repetition rate (%)	7.99	7.63	7.39	7.97	9.04	7.84	8.36	4.90
	Readmittance rate (%)	0.58	0.59	0.62	0.66	0.63	0.57	0.61	0.64
2021	**Promotion rate (%)**	67.99	74.82	75.48	76.72	74.28	76.65	75.94	-
	Repetition rate (%)	8.06	8.25	7.46	7.93	8.58	7.18	7.99	6.02
	Readmittance rate (%)	2.56	2.75	2.87	3.05	3.08	2.96	2.81	2.96

Source: Calculations made by authors using EMIS data.
Note: Readmittance rate represents proportion of students that had interrupted their studies previously and now have re-enrolled in school. The table represents weighted average at the grade and gender level. Promotion rates are not calculated for grade 8 as it would represent transition rates to high school, which extends beyond this analysis. Grade 1 promotion rates from 2019 indicate the proportion of students enrolled in grade 1 in 2019 that the following year were in grade 2.

Grade 5 also emerged as bottleneck, with average promotion rates lower for this grade than for grades 4 and 6 (**Figure 5**). Whereas in 2019 grade 5 was considered the first year of upper primary, the structural changes to the education system introduced in 2020 meant grade 5 came before the final grade of primary school and the low-stakes regional assessment administered in grade 6. Repetition for grade 5 reached 9 per cent in both 2020 and 2021, the highest across primary and middle school grades. These outcomes may reflect academic barriers, such as students being retained to better prepare for the grade 6 assessment, or institutional factors, including limited availability of schools offering grade 6 or middle school levels.

Figure 5: Promotion rates between 2019 to 2021, by grade and by year (%)



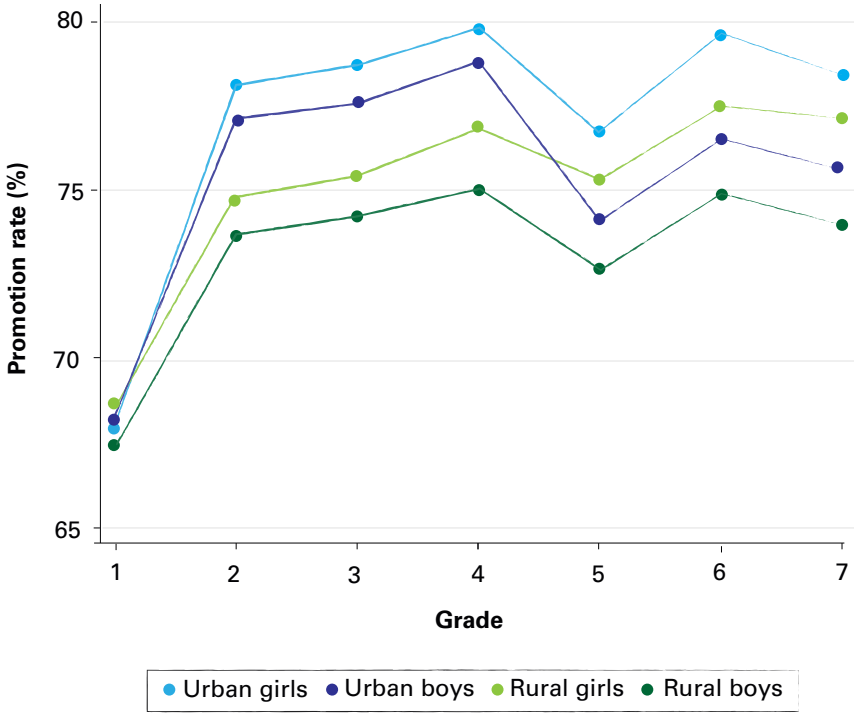
Promotion and repetition rates also vary by student gender and school location. In 2021, urban schools had slightly higher promotion rates (76 per cent) than rural schools (74 per cent), yet repetition was also higher for urban schools than rural schools (10 per cent versus 7 per cent, respectively). On average, girls were at least 1 percentage point more likely than boys to be promoted in all seven grades,[11] and boys were only slightly more likely to repeat a grade compared to girls (7.6 per cent versus 7.9 per cent, respectively).[12] When analysing school location and student gender at the same time, promotion rates were lowest among boys in rural schools, while boys in urban schools were particularly susceptible to being held back in grade 5 (see **Figure 6**).

The Government aims to eliminate primary school repetition and dropout by 2030. The ESDP VI targets reducing repetition from 4 per cent in 2021 to 1 per cent by 2026, alongside quality improvements and better learning environments. Federal promotion guidelines introduced in 2022 now require a minimum 50 per cent average score for grade progression. Together, reducing repetition and dropout while supporting timely promotion are central to ensuring that more Ethiopian children complete primary and middle school without disruption.

The Government of Ethiopia is seeking to eliminate primary school repetition and dropout by 2030. The ESDP VI targets reducing primary school repetition rates from 4 per cent in 2021 to 1 per cent by 2026 by improving quality of education and the school environment. The Education and Training Policy signed in 2022 also introduced federal guidance on promotion policies, specifying that students need to acquire a minimum average score of 50 per cent in the grade level to be promoted to the next grade. Lowering repetition rates, combined with increasing students' promotion rates, could help keep children progressing through their primary and middle school education.

[11] T-tests indicate that the difference between average promotion rates for girls and for boys is statistically significant at the 90 per cent confidence level.
[12] T-tests indicate that this difference is statistically significant at the 90 per cent confidence interval.

Figure 6: Promotion rates for different grade levels in 2021, by school location and student gender (%)



Source: Calculations made by authors using EMIS data, representing a weighted average of schools' promotion rates at the grade and gender level.
Note: Grade 1 promotion rates from 2019 indicate the proportion of students enrolled in grade 1 in 2019 that the following year were in grade 2.

5. Factors associated with school performance

Factors associated with school performance

The following section presents results from the school FE regression analysis on various factors correlated with promotion rates, including student characteristics, teacher characteristics, school characteristics and reported instances of violence. Analysis presented is based on available variables in EMIS and from the ACLED database described in Section 3.

5.1 Student characteristics

5.1.1 Student gender

When enrolled, girls were one percentage point more likely than boys to be promoted to the next grade, even when taking other student and school characteristics into consideration (**Appendix A: Table 7**). In 2021, there were only 88 girls enrolled for every 100 boys between grades 1 and 6, even though official population estimates indicate there are 96 girls for every 100 boys (Ethiopian Statistical Service, 2007), suggesting that girls still face barriers to accessing education. Families in Ethiopia, especially low-income households, often must choose which child(ren) will go to school and which will not. The choice can vary on birth order or sex depending on household needs, such as domestic and agricultural work. Families often favour boys over girls in education, and sometimes have higher aspirations for boys than they do for girls (Jones et al., 2019).

Girls were also more likely than boys to remain enrolled until higher grades, even though boys are more likely to be enrolled in grade 1 (**Figure 7**). This could partly be because families that are able to enrol girls in school may be more actively invested in their education, which could support their survival to higher grades. Another possibility relates to gender dynamics for boys and girls as they grow older: boys are more affected by trends in paid labour, including temporary work requiring migration in rural areas and driving seasonal non-attendance, contributing to early dropout. Girls, on the other hand, are more often burdened with helping with household chores, which could allow for greater flexibility to combine with schooling more years – often at the cost of their learning progression, due to long working hours affecting time for homework and sleep (Jones et al., 2019).

These dynamics of enrolment and survival to higher grades mean gender barriers vary for girls and for boys at different levels of their primary and middle school education. Targeted interventions are needed to support girls' access, and to remove specific gender barriers that prevent girls and boys from completing their primary and middle school education.

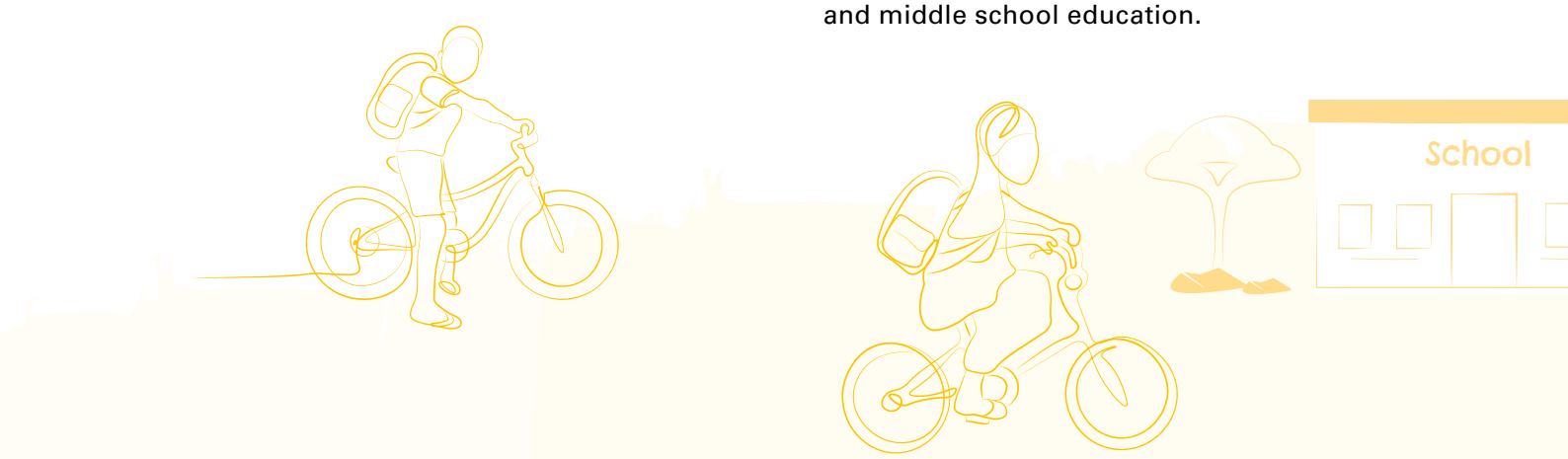
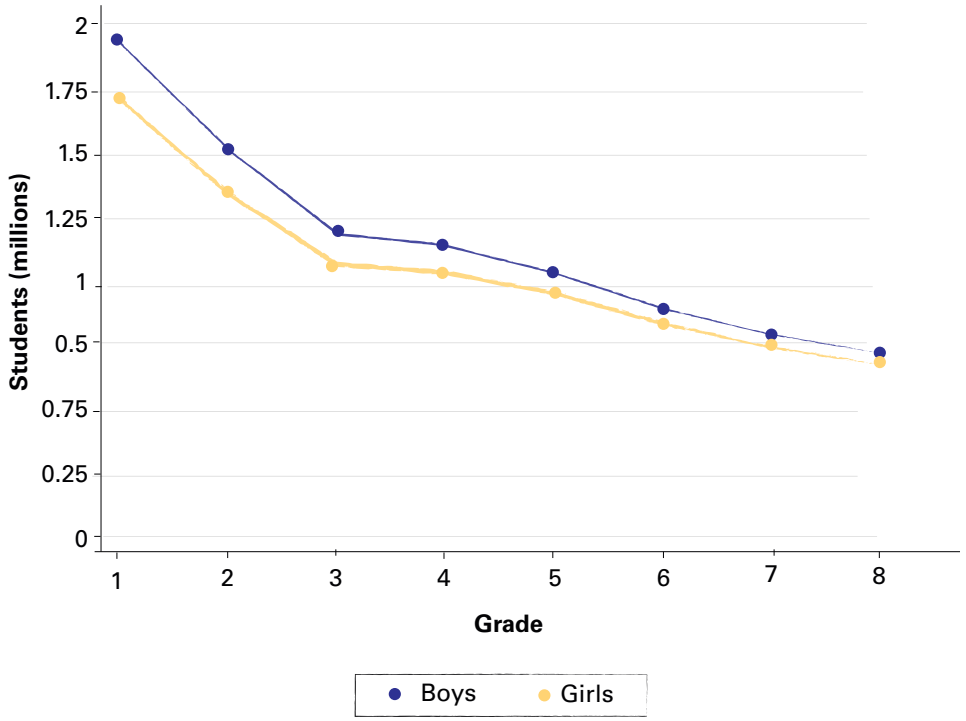


Figure 7: Enrolled students by gender and grade (2022)



Source: Calculations made by authors using EMIS data.

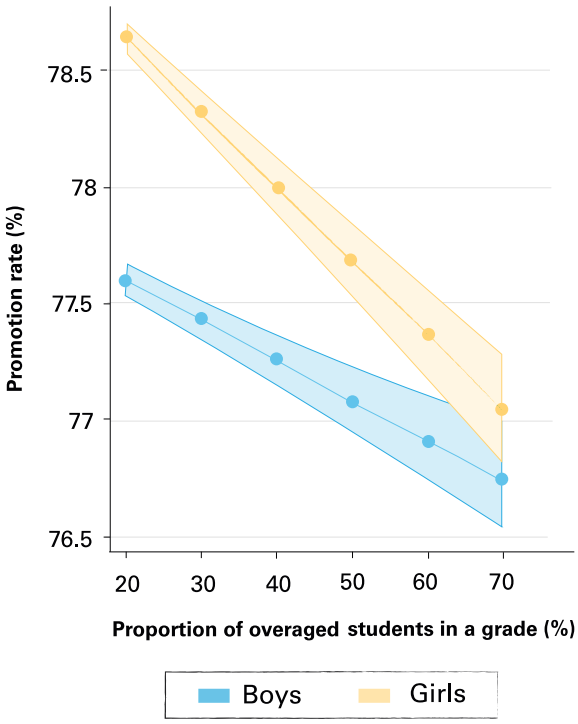
5.1.2 Student age

Higher proportions of overaged students in a grade are associated with a lower proportion of students promoted to the next grade, even when controlling for student gender. Overage students were less likely to move on to the next grade than students of the correct age. Overaged girls are even less likely to be promoted than overaged boys, even though in all years, all grades had a higher proportion of boys who were overaged compared to girls (**Figure 8**).

In 2021, almost 13 per cent of enrolled grade 1 students were already overaged. By grade 5, almost one in every five students were two years older than the correct age for the grade. High overaged figures may be because children enrol late in education, interrupt their studies or are repeated in a grade. Lack of accurate birth registration systems could also mean families register children late to school (UNICEF Ethiopia, 2019). Ethiopia has made progress in the last four years with lowering the proportion of grade 1 students who were overage, from 15 per cent in 2019 to 12 per cent in 2021.

Schools in urban areas had a higher proportion of overaged students than rural schools in all years and in all grades. In 2021, 22 per cent of urban school students were overaged for their grade compared to 17 per cent of rural school students. Since students being overaged is negatively associated with promotion rates, urban government schools need more tailored support to address overage students.

Figure 8: Marginal effects of proportion of overaged girls and boys on promotion rates



Source: Calculations made by authors using EMIS data.
Note: Marginal effects of the interaction between student gender term and proportion of overaged students in a grade from regression analysis in Appendix A, Table 7, column 3. Marginal effects in this regression context represent how much promotion rates change when the proportion of overaged girls or boys changes by a small amount, holding other variables constant.

5.2 Teacher characteristics

5.2.1 Teacher qualifications

Ethiopia has made a considerable effort to improve teacher training and qualifications. In 2022, almost 95 per cent of primary and middle school teachers had at least a diploma compared to 91 per cent in 2019, and the proportion of teachers with less than a diploma fell from 6.6 per cent to 5 per cent between 2019 and 2022. This reflects the system's absorption of more qualified teachers and training of unqualified teachers. The Government of Ethiopia has also made significant efforts to expand Colleges of Teacher Education (CTEs) and supply teachers with appropriate training (Barnes et al., 2017).

Increasing the proportion of teachers with the correct qualification for the level they teach has a strong positive association with promotion rates. The current minimum qualification to teach primary school is a diploma earned through a three-year teacher training programme at a CTE. To teach middle school grades, the minimum requirement is a bachelor's degree which can be acquired by joining a higher education institution where candidates take professional and pedagogical courses for a year (Barnes et al., 2017; Young Lives, 2017; Yimam, 2019; Ethiopia, MoE, 2022; Kebede, 2022).[13]

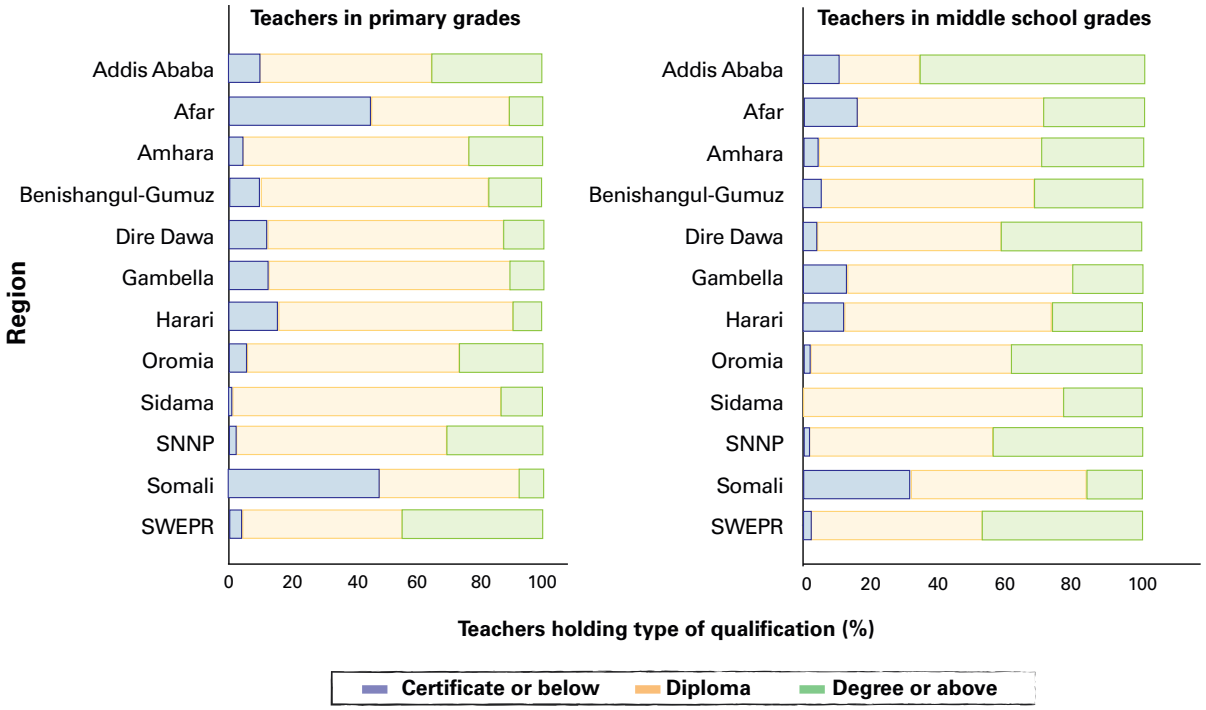
[13] The ESDP III changed the minimum qualifications to a '10 + 3' diploma programme (grade 10 plus a three-year diploma). Previously, teachers only had to train for one year to receive a TTI certificate. However, the TTI was no longer recognized, which required teachers to upgrade their qualifications through summer and distance-learning programmes. They were still permitted to teach in primary schools while doing this (Young Lives, 2017).

These results suggest that the degree training in university better prepares teachers to work with higher grades compared to holding a CTE diploma.

However, there is still a significant proportion of teachers that do not have the correct qualification for the level they teach, especially in middle school grades (**Figure 9**). As of 2022, only 37 per cent of teachers in middle school grades had the appropriate qualification, compared to 94 per cent of teachers in primary school grades. This suggests there is need to further strengthen teacher qualifications and training in both middle and primary school grades.

Improving teacher qualifications in regions with higher needs could support student promotion rates. For example, in the Somali region, over 45 per cent of primary and middle school teachers did not have the minimum qualifications to teach for their level. More than 9 per cent of teachers had less than a Teacher Training Institute (TTI) certificate, indicating they might only hold a grade 10 diploma and may have been hired to address teacher shortages or attrition. The Somali region had one of the youngest teacher labour forces in the country, with teachers on average being younger than 31 years old, and with almost 10 per cent of teachers younger than 21 years old.[14] By comparison, in Addis Ababa, over 44 per cent of teachers in primary and middle school hold a degree or higher – almost five times higher than in the Somali region, where only 9.3 per cent of teachers had a degree or higher. Addis Ababa also had one of the oldest teaching cohorts in Ethiopia, with the average age being 34 years old.

Figure 9: Proportion of primary and middle school teachers (%), by type of qualification and region



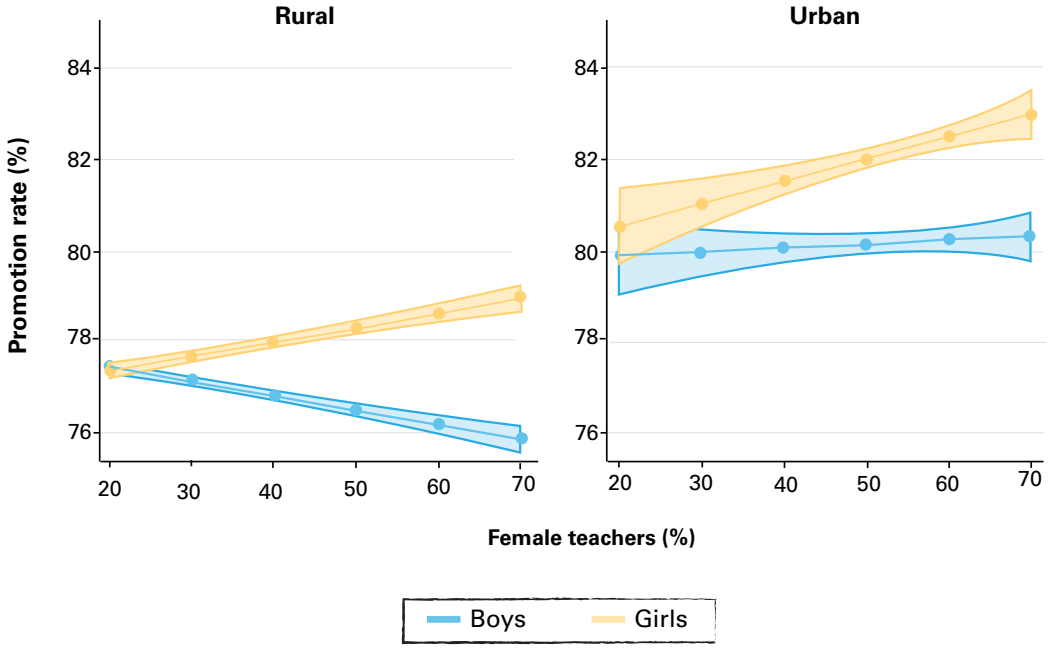
Source: Calculations made by authors using EMIS data.
Note: Certificate or below indicates teachers do not meet the minimum requirement to teach in primary school. At least a diploma indicates they can teach in primary school and degree or above indicates they can teach in primary or middle school.

[14] Teacher age is highly correlated with years of experience in the job.

5.2.2 Teacher gender

Higher proportions of female teachers working at a school has a positive association with girls' promotion rates. However, in rural schools, this pattern is negatively associated with boys' promotion rates (**Figure 10**). These results suggest that there are same student-teacher gender effects, and that role models or gender norms could influence children's learning in the country, especially in rural areas where there are fewer female teachers. Further investigations on classroom gender attitudes could shed light on these dynamics and how they shape students learning trajectories.

Figure 10: Marginal effects of proportion of female teachers on girls' and boys' promotion rates in urban and rural government schools

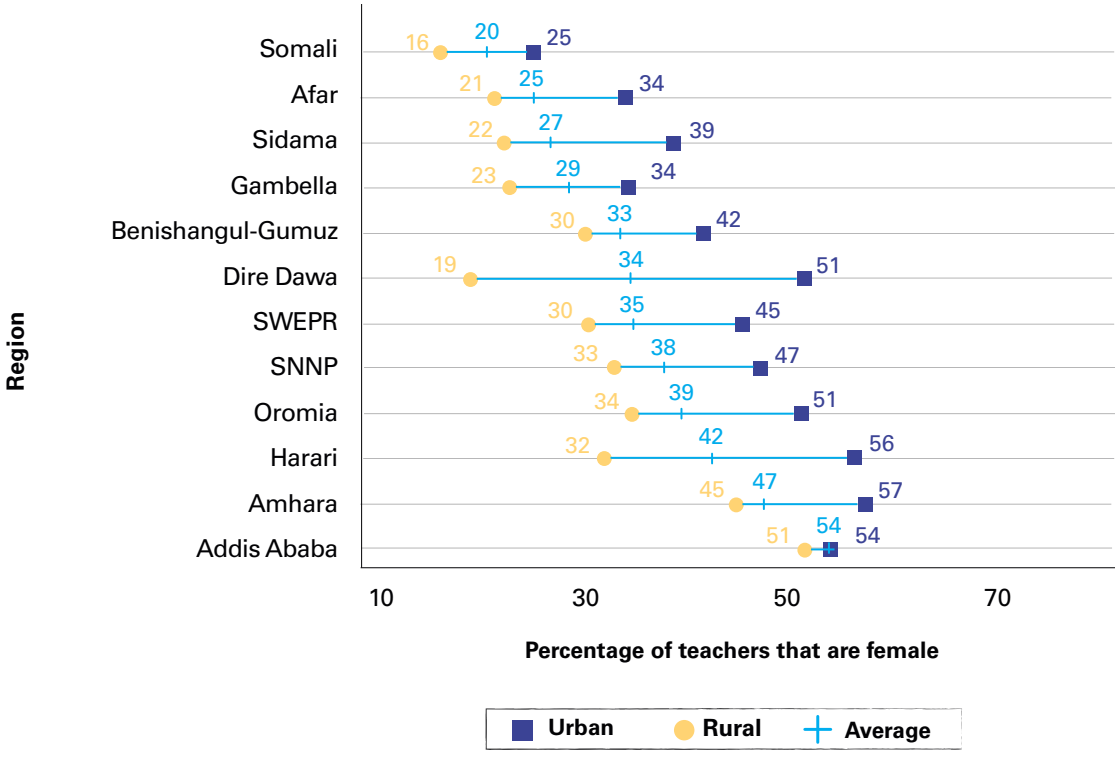


Source: Calculations made by authors using EMIS data.
Note: Marginal effects of the interaction between student gender term and proportion of female teachers in a school from regression analysis in **Appendix A**, **Table 7**, **column 4**. Marginal effects in this regression context represent how much promotion rates change when the proportion of female teachers in a school changes by a small amount, holding other variables constant.

Less than half of the teachers in primary and middle schools in Ethiopia are women, and most were concentrated in urban schools and specific regions (**Figure 11**). In 2022, just 40 per cent of all primary and middle school teachers in Ethiopia were women. Gender composition varies by school location, region and the grade level taught. On average, urban schools had a higher proportion of female teachers than rural schools. In rural schools, just over one third of all teachers were female, compared to almost half of the staff in urban schools. When it comes to regions, variation is higher. For example, in the Somali region, only 1 in 5 teachers were women, compared to Addis Ababa where almost half of all teachers were women.

Female teachers were more likely to work in primary school grades than middle school grades, even though they have similar qualification to their male counterparts. Female teachers were more likely than male teachers to hold a diploma (67 per cent versus 64 per cent respectively) and only 1 percentage point more likely to hold a degree.[15] Despite these small differences in qualifications, women were more likely to work in primary school grades than middle school grades. In primary grades, 47 per cent of all teachers were female compared to 29 per cent of middle school teachers.

Figure 11: Percentage of female teachers by region and location (2022)



Source: Calculations made by authors using EMIS data.

[15] T-tests confirm these differences are statistically significant at the 90 per cent confidence interval.

Box 1

Women in school leadership in Ethiopia

In addition to lower representation of women in the teaching workforce, few women are in school principal positions in Ethiopia. In 2022, only 7 per cent of government primary and middle schools had principals who were women, even though 40 per cent of the labour force was female, suggesting women face barriers in advancing to leadership roles. Urban government schools were more likely than rural schools to be led by women (8.5 per cent versus 6.2 per cent respectively). Addis Ababa had the highest proportion of schools with female principals, with 21 per cent of schools led by women. Women's representation in leadership was lowest in the Somali region, with less than 2 per cent of schools led by women.

Women were more likely to be vice principals than principals, with 25 per cent of vice principals being female. Almost one third of government schools had a vice principal. Addis Ababa had the highest proportion of schools with a vice principal (95 per cent), with over a quarter of vice principals being female. In Afar, less than 8 per cent of schools had a vice principal, of which 25 per cent were female. In the Somali region, 21 per cent of schools had a vice principal, but less than 5 per cent of vice principals were female. This is an additional indication of a glass ceiling in women's careers to leadership roles, and secondary evidence that women ascend to these roles more often in specific regions of Ethiopia.

While it was not possible to explore as part of this analysis associations between the school principal's gender and promotion rates,[16] the Women in Learning Leadership research, a joint initiative between UNICEF Innocenti, IIEP-UNESCO Dakar and the Gender at the Center Initiative, will explore this further.

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[15] Data on the gender of school leaders was only provided for 2022, but data needed to calculate promotion rates for this year was not available.

5.3 School characteristics

5.3.1 Grades offered

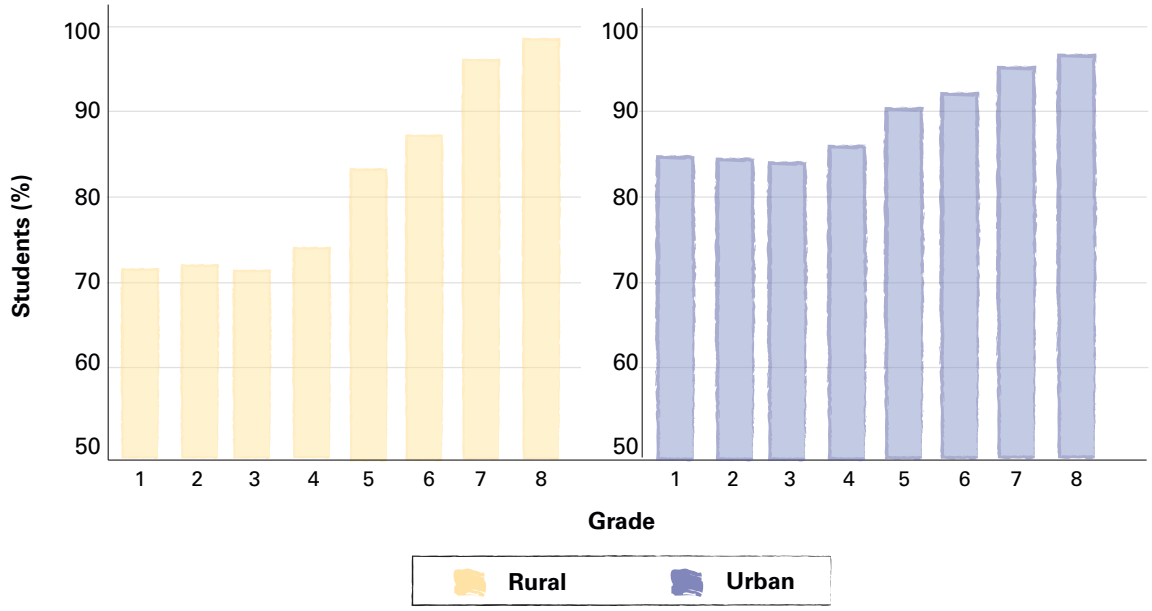
Not all schools in Ethiopia offer the full primary and middle school cycle from grades 1 to 8 and as children progress in their education, the number of schools offering the next grade decreases (**Figure 12**). Since 2019, the proportion of students enrolled in schools that offer all grades has increased from 80 to 82 per cent. This could partly be due to schools adapting to the changes in the education system in Ethiopia – previously primary education was split into two cycles of four years (lower and upper primary), while currently primary education is composed of six years, and schools offer two years of middle school. Nevertheless, in 2022, 33,000 schools in Ethiopia offered grade 1, while less than 22,000 schools offered grade 8.

Schools that offer all grade levels for primary and middle school on average had higher promotion rates than schools that offered only part of the education cycle, even when controlling other school characteristics.

Schools that do not offer the full primary and middle school cycle may contribute to student dropout or repetition, particularly in transition grades.

Students enrolled in schools that do not offer the full cycle are more often located in rural regions and in the Somali region, and are more likely to be boys, posing challenges for equity in education delivery. In 2022, students in rural schools are 10 per cent more likely to be enrolled in schools that do not offer all primary and middle school grades (20 per cent compared to 10 per cent in urban schools). This suggests that just under 30 per cent of students in grade 1 attending rural government schools will need to move to another school to continue their primary and middle school cycle, compared to 15 per cent of students attending urban government schools (**Figure 12**). Just over half of the students in the Somali region and Afar are enrolled in schools that offer the full cycle. Boys are 1 percentage point less likely to be in these schools than girls (81 per cent versus 82 per cent, respectively).

Figure 12: Proportion of students enrolled in schools offering the full primary and middle school cycle, by grade and school location (2022)



Source: Calculations made by authors using EMIS data.

[16] Data on the gender of school leaders was only provided for 2022, but data needed to calculate promotion rates for this year was not available.

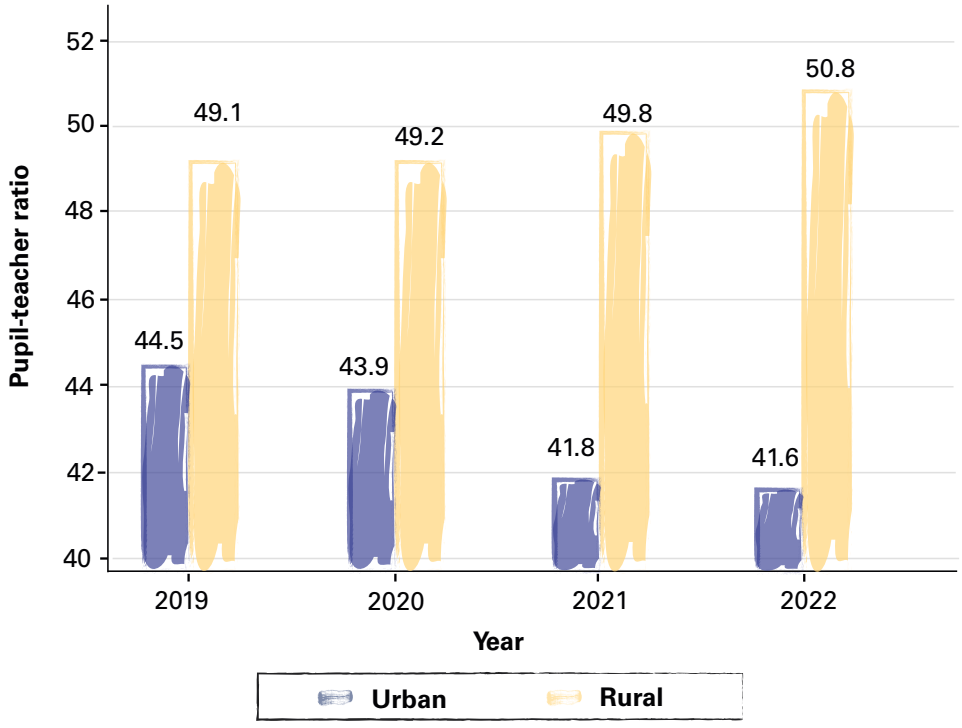
5.3.2 Pupil-teacher ratio

Higher pupil-teacher ratios (PTRs) are negatively associated with promotion rates. In 2021, government schools had an average PTR of 48:1, and in 2022, almost 10 per cent of government schools had a PTR higher than 85:1. The Government has a target of reaching a PTR of 40:1 by 2025 in its latest ESDP VI. Increasing the total number of teachers will be critical to achieving this goal and can contribute towards improving promotion rates. For example, decreasing PTRs from 48 to 45 at a national average could increase promotion rates by 0.5 percentage points, which could keep up to 92,000 students in school longer. Decreasing PTR from 48 to 40 could increase promotion rates by 1.4 percentage points, keeping up to 257,000 students in school an additional year.[17]

Despite larger enrolment numbers in urban government schools, PTRs are much higher for rural schools. The average PTR for rural schools was 50:1 while in urban schools it was 42:1. The difference in PTR between rural and urban schools has been widening in the last three years (**Figure 13**), suggesting that rural schools may face larger challenges in hiring or retaining teachers than urban schools.

The distribution of government teachers between regions is unequal, creating vast disparities in PTRs. For example, Addis Ababa had 10 times more teachers per school than Afar and the Somali region, even though these regions' school sizes are on average only 6.2 or 3.3 times smaller respectively (see **Table 5**). In 2021, government schools in Addis Ababa had a low PTR of 24:1, but in the Somali region the PTR was three times higher, with 76 students to every teacher. Some of the variation between regions can occur because teacher hiring is decentralized, meaning that regions oversee the process and may have specific challenges in recruiting, distributing and/or retaining teachers.

Figure 13: PTRs in government schools, by school location and year



Source: Calculations made by authors using EMIS data.
Note: PTR excludes outliers (PTRs above 157 and below 13). Average is weighted by school enrolment size.

[17] Calculations made using PTR coefficients presented in **Table 7**, **column 4**. The coefficient was multiplied by the decrease in PTR (3 or 8), resulting in the promotion rate change.

Disparities in PTRs are also present even within regions. Within the Somali region, for instance, 20 per cent of schools had an average PTR lower than 43:1, while another 20 per cent had an average PTR higher than 109:1. Such variations within regions suggests that some schools have a higher number of teachers than others for their relative size. Prioritizing allocation of teachers to schools with teacher gaps, or higher PTRs, could help improve internal regional efficiencies and ensure more equitable progress towards the Government's goals.

Table 5: Total number of teachers in government schools, number of schools and average number of teachers per school (by region, 2021)

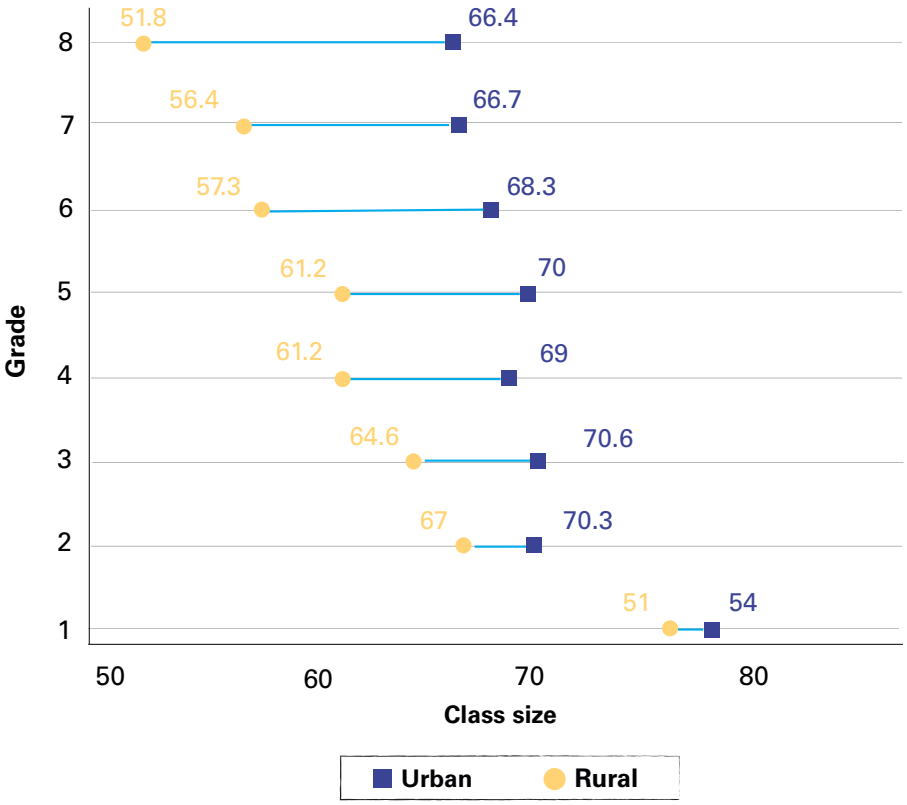
REGION	Total number of teachers in government schools	Average government school enrolment	Teachers per school (raw average)	PTR (weighted average)
Addis Ababa	18,178	1,472.6	73.3	23.9
Afar	4,148	237.7	6.8	44.6
Amhara	135,571	435.6	14.9	29.4
Benishangul-Gumuz	6,731	412.9	11.7	41.7
Dire Dawa	2,132	727.4	22.7	34.5
Gambella	3,704	466.9	13.5	51.2
Harari	1,641	753.2	23.4	31.1
Oromia	163,223	612.4	11.7	60.3
Sidama	30,448	1,066.6	28.9	41.1
SNNP	71,791	658	17.6	41.7
Somali	10,864	449.6	7.3	75.9
SWEPR	23,798	445.4	16.0	30.9

5.3.4 Class size

Reducing class size was consistently associated with higher promotion rates. In 2021, the average class size for Ethiopian students attending government schools was 66 students. Reducing class sizes from 66 to 63 students is associated with 0.5 percentage point higher promotion rates.[18] Larger class sizes may suggest the need to improve infrastructure such as physical classroom availability, hiring more teachers, or allocating more teachers to overcrowded classrooms.[19] This is especially true for urban schools, where the average class size was 71 students, compared to 64 students in rural schools (see **Figure 14**).

Lower primary grades had larger class sizes than middle school grades, which may have implications for early learning. On average, grade 1 class sizes were 77 students while grade 8 class sizes were 55 students. Larger class sizes are associated with lower learning (McEwan, 2015), suggesting that students in lower primary grades may fall behind in acquiring foundational learning skills, which is more difficult to address once students advance in their education.

Figure 14: Class size by location in 2021



Source: Calculations made by authors using EMIS data.
Note: Class size is calculated by dividing the total number of students enrolled in a given grade by the number of sections in that grade. Class size excludes outliers (above 172 and below 12). Class size is weighted by grade enrolment size at the school level.

[18] Calculations made using class size coefficients presented in column 4 in Table 7. The coefficient was multiplied by the decrease in class size (3), resulting in the promotion rate change.

[19] The Teachers for All research led by UNICEF Innocenti is currently active in 14 countries across sub-Saharan Africa, and aims to explore teacher allocation and effective strategies for improving equitable allocation both across and within schools.

Even though Addis Ababa had a PTR three times lower than the Somali region, class sizes in Addis Ababa remain higher. This means there are more teachers in schools in Addis Ababa than sections in a grade. Analysis suggests an average of nine teachers for one section in Addis Ababa, at least three times higher than any other region in the country. This could be because teachers sometimes hold administrative responsibilities and do not engage in instructional activities. Having more precise information about the type of activities teachers spend their time on at school is crucial to better understanding these dynamics and provide reflections on how to improve efficiencies in teacher distribution, as PTRs may mask actual experiences of children in classrooms.

Table 6: Average government school size, PTR, class size and average number of teachers per pedagogical group

REGION	Total number of teachers in government schools	Average government school enrolment
Addis Ababa	87.4	8.7
Afar	56.5	1.5
Amhara	48.2	1.8
Benishangul-Gumuz	63.0	1.9
Dire Dawa	61.8	2.0
Gambella	81.3	2.4
Harari	64.1	2.7
Oromia	73.0	1.4
Sidama	69.7	1.9
SNNP	63.4	1.8
Somali	84.5	1.4
SWEPR	53.1	1.8

Source: Calculations made by authors using EMIS data.
Note: Class size excludes outliers (above 172 and below 12) and PTR excludes outliers. Class size, PTR and average number of teachers per pedagogical group are weighted by the grade and school enrolment number.

5.3.5 Infrastructure and resources

The presence of a toilet in the school is positively associated with promotion rates, demonstrating the importance of the efforts of improving sanitary conditions in schools. Schools having at least one toilet is positively associated with a 1.37 percentage point increase in promotion rates.[20] Toilet availability has increased in government schools, rising from 85 per cent of schools with a toilet in 2019 to 96 per cent of schools with a toilet in 2021. However, regional differences in sanitation facilities remain. In the Somali region, only 10 per cent of students attended schools that have a toilet, while in Addis Ababa all government schools had at least one toilet.

Having a school feeding programme was negatively associated with promotion rates. This result may reflect the fact that students who benefit from school meals are perhaps the most vulnerable and therefore those who have the greatest difficulties with academic progress. In 2021, only 10 per cent of students in Ethiopia were enrolled in schools with a feeding programme in place. Addis Ababa students had by far the highest access to school feeding in the country, with 94 per cent of students enrolled in schools where a programme was in place, compared to just 7 per cent of students in Oromia attending schools with school feeding programmes. These results are consistent with other studies, including DMS research in Cote d'Ivoire and the mainland of the United Republic of Tanzania (UNICEF Innocenti, Côte d'Ivoire, Ministry of Education and UNICEF Côte d'Ivoire, 2023; UNICEF Innocenti et al., 2024). It should be noted that important information on school meals, including quality of meals, quantity and frequency of meal distribution, and the students targeted, was not incorporated in the model, as data were not available.

Whether a school received a grant was not associated with promotion rates, suggesting the need for further research into challenges with accessing and using this resource. Between 2019 and 2021, the proportion of government schools that received school grants jumped from 67 to 90 per cent. Increases were slightly more evident in rural locations, where there was a 26 percentage-point increase in schools receiving a grant, compared to a 20 percentage-point increase for urban schools. As of 2021, 88 per cent of urban government schools received a grant compared to 93 per cent of rural government schools. Other studies have described that in some *woredas*, grants were well-targeted and effectively utilized, while in others, challenges such as delays in funds disbursement and lack of capacity hindered their impact. Similarly, challenges for schools to open bank accounts to receive grants was a major challenge in the Somali region (Kelil et al., 2014), where this analysis showed there was the lowest proportion of schools receiving a grant. These challenges may explain why the association between school grants and promotion rates was not statistically significant.

Schools having a pedagogical centre was also not associated with promotion rates. Pedagogical centres are spaces where teachers gather to develop teaching aids and learning materials and discuss pedagogical strategies. Between 2019 and 2021, the proportion of students in schools with pedagogical centres decreased from 73 to 70 per cent. Further research is needed on how these resources are used.

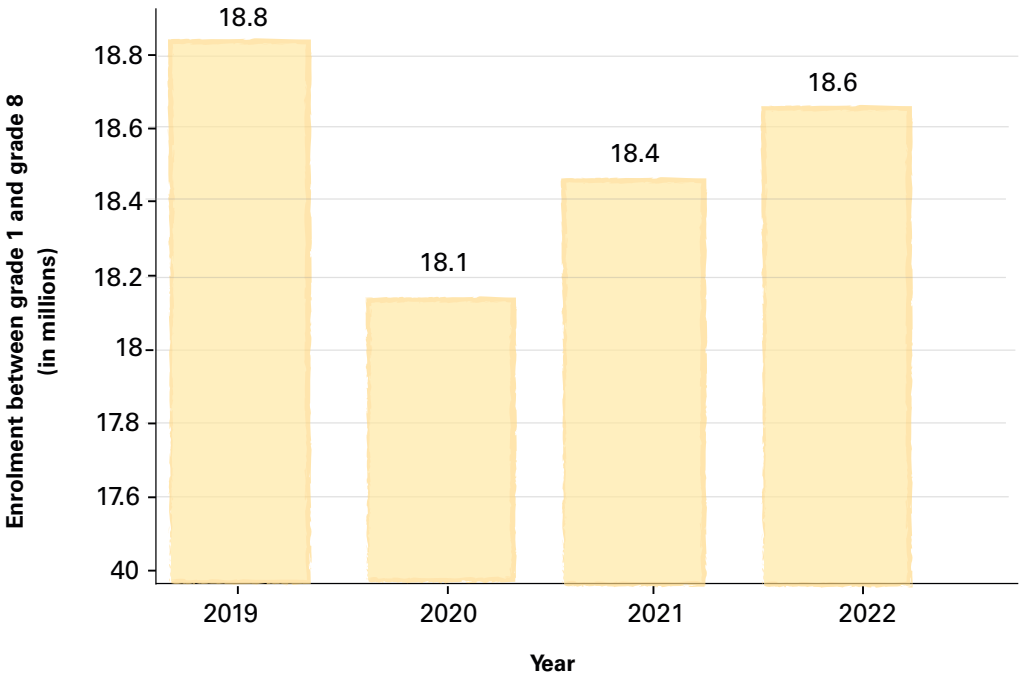
[20] The POLS specification (**Appendix A**, **Table 7**, **column 1**) suggests a similar positive association, but with a different coefficient, with schools having at least one toilet being positively associated with a 0.42 percentage point increase in promotion rates, holding other included variables constant.

The presence of a library or strategic planning did not have a clear association with promotion rates, as this result varies between models. Between 2019 and 2021, the proportion of students that had access to a library at their school remained the same (67 per cent) and the proportion of students enrolled in schools where there was strategic planning also remained stable (93 per cent). Main results indicate that strategic planning is negatively associated with promotion rates and that libraries are not associated with promotion rates. Nevertheless, the lack of variation of these variables throughout time within schools present challenges to interpreting results, and could partly explain why results differ between a POLS and the school FE model.[21]

5.4 Violent events

Political violence has been on the rise in Ethiopia, with number of reported cases increasing especially in Tigray, Afar and Amhara (**Appendix B: Figure 17**). Reported cases of political violence[22] increased overall in Ethiopia by almost 11 times between 2019 and 2021. Political violence rose most sharply in Tigray and Afar, where the number of events was 509 and 29 times higher in 2021 than in 2019. In Amhara, reported cases increased by 15 times during the same period. As of 2023, these regions are estimated to be home to over 14 million school-aged children (between the ages of 5 and 20), suggesting impacts on children's education, learning and well-being.

Figure 15: Student enrolment between grades 1 and 8 in Ethiopia between 2019 and 2022



Source: Calculations made by authors using EMIS data.

[21] When comparing the school with itself throughout time (school FE model, **column 4**, **Table 7**, **Appendix A**), libraries are not associated with promotion rates and strategic planning is negatively associated with promotion rates. However, when comparing schools on average (POLS model, **column 1**, **table 7**, **Appendix A**), libraries are positively associated and strategic planning is not associated with promotion rates.
[22] Excludes events classified by ACLED as demonstrations.
[23] The decrease in enrolment numbers can associated to the events of 2020, because population estimates point towards an increase in school age population (Ethiopia, Central Statistical Agency, 2013), and Ethiopia has been increasing the gross enrolment rate (GER) since the abolition of school fees. The events of 2020 include the political unrest described in this section but also droughts, school closures during the COVID-19 pandemic, and any subsequent displacement.

Tigray, Afar and Benishangul-Gumuz had the highest increases in fatalities per million inhabitants. In Afar and Tigray, fatalities surpassed 400 per million inhabitants in both 2021 and 2020. Fatalities in Benishangul-Gumuz surpassed 600 per million inhabitants in 2021, but the region had a lower number of reported events than Afar and Tigray, suggesting its events could be more violent (**Appendix B: Figure 18**). These regions experienced a rise in battles and violence against civilians, most of which peaked in 2021.

Between 2019 and 2022, student enrolment in Ethiopia's education system declined, coinciding with increases in reported cases of violence and the onset of the COVID-19 pandemic (**Figure 15**). Excluding Tigray, in 2022 there were 200,000 fewer students enrolled than in 2019 (**Figure 15**).[23] At the interregional level, enrolment trends suggest a displacement of students out of Amhara (300,000 students), Sidama (39,000), South West Ethiopia Peoples' Region (SWEPR) (25,000) and Benishangul-Gumuz (12,000). Regions with the highest increases in enrolment are the Somali region (170,000 students) and Oromia (76,000), suggesting these regions are possibly absorbing some displaced students.

The number of reported cases of political violence in a school's *woreda* is negatively associated with promotion rates, even after controlling for the number of fatalities. This suggests that even when there are no fatalities, the occurrence of political violence has negative impacts on students' promotion rates and can impact their schooling. One reported event without any fatalities is associated with a 0.1 percentage decrease in promotion rates; however, when a fatality occurs, promotion rates decrease an additional 0.026 percentage points.

Political violence affects schools in the surrounding *woredas* as well, even when there are no fatalities. According to estimates of this regression analysis, distance to a reported case of political violence is associated with promotion rates. When there is a fatality in an event in a neighbouring *woreda*, promotion rates decrease 0.01 percentage points.

6. Policy implications and areas for further research

Policy implications and areas for further research

The analysis from Stage 1 of the DMS research presented in this report can serve as valuable evidence for policymakers, practitioners and researchers, especially amid Ethiopia's ongoing education policy implementation and upcoming education sector planning. The following policy implications and areas for further exploration have emerged from the results of this analysis:

Supporting girls' and boys' education requires targeted approaches that respond to differing needs.

While boys are more likely to start primary school, once in school, girls are more likely to progress through the system. All students need support to complete primary and middle school in Ethiopia, but targeted approaches should ensure girls' enrolment in primary school and boys' survival to the end of primary and middle school. Further exploration could examine the gender norms and barriers surrounding girls' enrolment rates in lower grades as well as boys' interruption to their studies, including time use, labour-market dynamics, and engagement in household and caregiving activities. Such studies should consider regional differences due to the wide variance of promotion rates in the country.

National dialogue on repetition policies and on-time enrolment is needed to support students to progress in their education

At the time of this analysis, repetition rates in the country remained high and varied greatly between regions. There were also a large proportion of students who are overaged for their grade, with overaged students less likely to progress through primary and middle school. This suggests a need to harmonize repetition policies across regions and create robust guidelines around which students should repeat a grade. Furthermore, a large proportion of students in grade 1 were already overaged, suggesting that they start their education at a more vulnerable position. Further explorations could shed light on why students start their education overaged, supporting future policies and advocacy strategies.

Exploring regional challenges is essential to improving the equitable allocation of teachers and reducing disparities in PTRs.

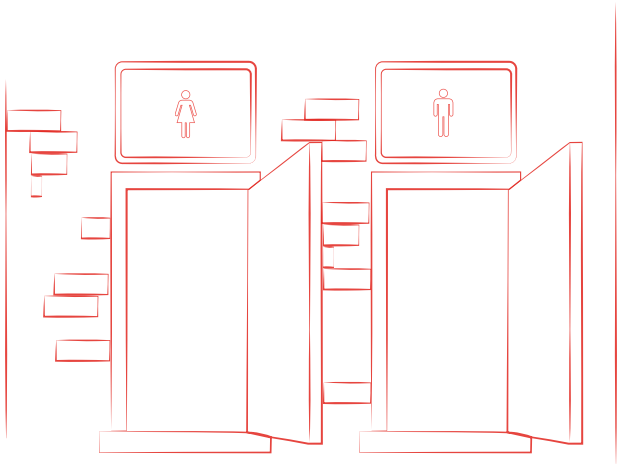
Reducing PTRs and class sizes is positively associated with improving promotion rates. The former suggests the need to hire more teachers while the latter suggests increasing the number of physical classrooms so there can be more pedagogical groups. Further research could explore specific hiring bottlenecks in regions with the highest PTRs and class sizes, such as the Somali region, for further support from the federal Government.

The presence of sanitation facilities, such as toilets, is important to keep students in school.

Further data analysis could support understanding how sanitary conditions could support students, especially girls, as they get older. The conditions of toilets, the number of toilets available per student, if toilets are separated for boys and for girls, and the availability of sanitary items, especially for older girls, are other factors that could be integrated in future analysis if EMIS data is improved.

Political violence is disrupting children's education, and more data on displaced students is needed.

The association between political violence, the number of fatalities and promotion rates highlights the need to further monitor the impacts of conflict and migration on the education system. This is also important in the context of climate change in Ethiopia, where frequent droughts and other disasters have contributed to displacement (UNICEF Ethiopia, 2024). For example, including in the EMIS questionnaire how many students in a school are internally displaced could help understand changes in class sizes when political violence or other disruptions have occurred; how many students have dropped out and not returned to school in areas where disruptions has occurred; where affected populations have moved; and whether girls or boys more likely to return to school once a disruption occurs. Answering these questions could help target education in emergency measures, and support affected populations.



7. Appendices

Appendix A: Models used for analysis

The main univariate regression model used for this analysis is presented in **Section 3.1**. In addition to this model, two additional school FE models were run with interactive variables to test differences in promotion rates between overaged boys and girls (**Equation 4**), as well as same student and teacher gender effects (**Equation 5**).

$$(4)\ Promotion_{ijkl} = \beta_0 + \beta_s Student_{ijkl} + \beta_q Teacher_{ijk} + \beta_r Infrastructure_{ijk} + School_i + Grade_j + Year_k + \varepsilon_{ijkl} + \beta_{15} Proportion\ of\ overaged\ students_{ijkl}\ X\ Girls = 1_{ijk}$$

$$(5)\ Promotion_{ijkl} = \beta_0 + \beta_s Student_{ijkl} + \beta_q Teacher_{ijk} + \beta_r Infrastructure_{ijk} + School_i + Grade_j + Year_k + \varepsilon_{ijkl} + \beta_{15} Proportion\ of\ female\ teachers_{ijk}\ X\ Girls = 1_{ijk}$$

Results from this regression analysis using the models are presented in **Table 7.** Results from the analysis that also include the ACLED data are presented in **Table 8**.

Table 7: Promotion rates regression outputs

	With school FE	POLS	FE + overage gender interaction	FE + same teacher and student gender interaction
Student characteristics				
Student gender (girls =1; boys = 0)	1.068***	1.164***	1.326***	-1.251***
% students overage	-2.382***	-7.968***	-1.716***	-2.349***
Girls X % students overage	-	-	-1.461***	-
Teacher characteristics				
% female teachers	0.002	0.032***	0.002	-0.027***
% female teachers X girls = 1	-	-	-	0.061***
% of teachers qualified for level taught	4.340***	-1.390***	4.341***	4.337***
School characteristics				
School offers full cycle	0.851**	0.808***	0.851**	0.857**
PTR	-0.177***	-0.006***	-0.177***	-0.177***
Class size	-0.148***	-0.099***	-0.148***	-0.148***
School received a grant	0.185	0.111	0.186	0.189
School offers feeding	-0.898***	-0.459***	-0.895***	-0.900***
School develops strategic planning	-0.715**	-0.152	-0.717**	-0.713**
School has at least one toilet	1.366***	0.419**	1.367***	1.365***
School has a library	-0.012	0.337***	-0.013	-0.014
School has a pedagogical centre	-0.022	0.346***	-0.022	-0.022
School has electricity	-	1.529***	-	-
Region FE	No	Yes	No	No
Grade FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes
R-squared	0.304	0.105	0.304	0.305
Observation	765117	758415	765117	765117
Schools	30,048	-	30,048	30,048

*** p<0.01, ** p<0.05, * p<0.1
Source: EMIS data in 2019, 2020 and 2021. Calculations made by authors.

Table 8: Promotion rates regression analysis outputs with ACLED data using school FE and same teacher and student gender interaction

Woreda violent events	*Woreda*-level analysis (school FE)	Nearest event analysis with same teacher and student gender interaction
Number of events	-0.095**	
Fatalities per million population	-0.026***	
Nearest event characteristics		
Distance to an event (km)	-	0.007*
Distance to an event (km) X distance to an event	-	-0.000***
Total fatalities in the event	-	-0.009***
Student characteristics		
Student gender (girls = 1; boys = 0)	-1.250***	-1.196***
% students overage	-2.330***	-2.089***
Teacher characteristics		
% female teachers	-0.027***	-0.030***
% female teachers X girls = 1	0.061***	0.062***
% of teachers qualified for level taught	4.200***	4.120***
School characteristics		
School offers full cycle	0.855**	0.549
PTR	-0.179***	-0.173***
Class size	-0.148***	-0.153***
School received a grant	0.182	0.386***
School offers feeding	-0.890***	-1.387***
School develops strategic planning	-0.753***	-0.337
School has at least one toilet	1.328***	1.306***
School has a library	-0.033	0.120
School has a pedagogical centre	-0.022	-0.031
School FE	Yes	Yes
Grade FE	Yes	Yes
Year FE	Yes	Yes
Constant	Yes	Yes
R-squared	0.305	0.304
Observation	765117.000	707146.000
Schools	30,048	27,484

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

Source: EMIS and ACLED data from 2019, 2020 and 2021. Calculations made by authors.

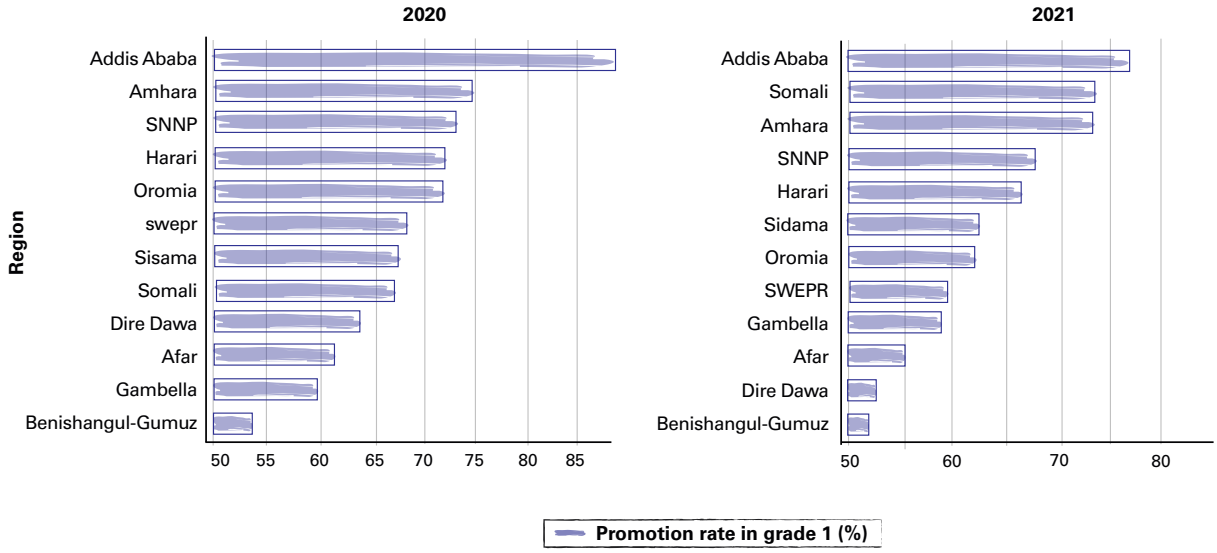
Appendix B: Descriptive statistics on key variables

Table 9: Descriptive statistics on key variables (2021)

Variables	National	Government schools			
		Rural	Urban	Girls	Boys
School characteristics					
Promotion rate (%)	73.8	73.3	75.6	74.8	73.0
Repetition rate (%)	7.8	7.1	9.9	7.7	7.9
Readmitted students (%)	2.8	2.7	3.2	2.6	3.0
Overaged students (%)	18.4	17.4	21.7	17.8	18.9
Proportion of girls (%)	47.3	46.5	50.0	-	-
Electricity available (%)	40.6	28.4	79.4	-	-
Water available (%)	46.4	36.9	76.8	-	-
Toilet available (%)	97.7	97.5	98.3	-	-
PTR	47.9	49.8	41.8	-	-
Class size	65.6	64.3	70.7	-	-
School grant available (%)	90.6	90.9	89.9	-	-
School feeding available (%)	10.4	8.6	16.4	-	-
Strategic planning available (%)	94.7	94.7	94.6	-	-
Library available (%)	65.7	60.9	81.2	-	-
Pedagogical centre available (%)	70.4	67.3	80.7	-	-
Teacher characteristics					
Female teachers (%)	35.5	34.1	45.0	-	-
Teachers with a diploma or more (%)	90.9	91.4	87.0	-	-
Teachers with a certificate or less (%)	9.1	8.6	12.9	-	-
Qualified teachers for level taught (%)	90.8	91.4	86.6	-	-
School leader characteristics (2022)					
Female school leaders (%)	7.1	6.2	8.5	-	-
Schools with a vice principal (%)	29.2	22.6	55.3	-	-
Vice principals that are female (%)	23.2	22.2	26.3	-	-

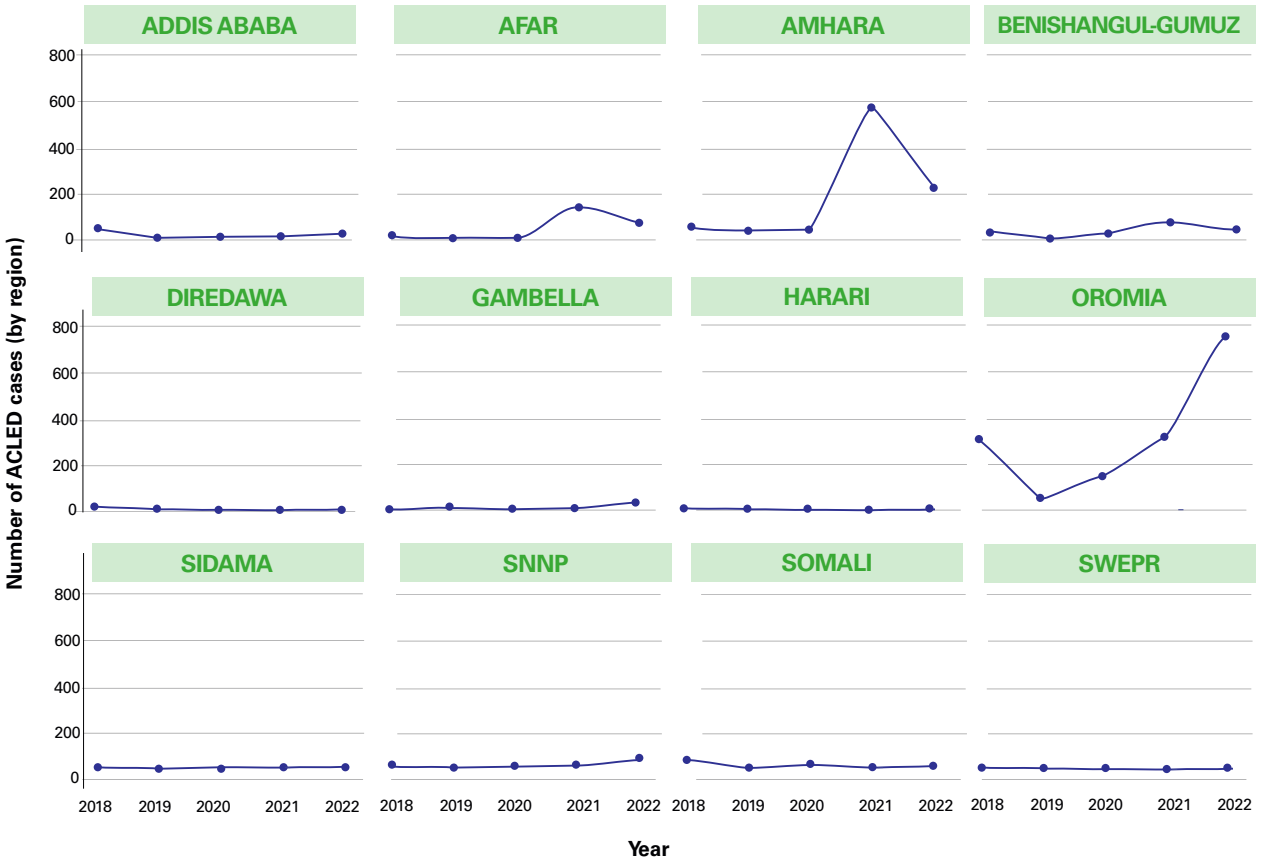
** Weighted averages by grade and school enrolment.*

Figure 16: Government school grade 1 promotion rates in 2020 and 2021, by region



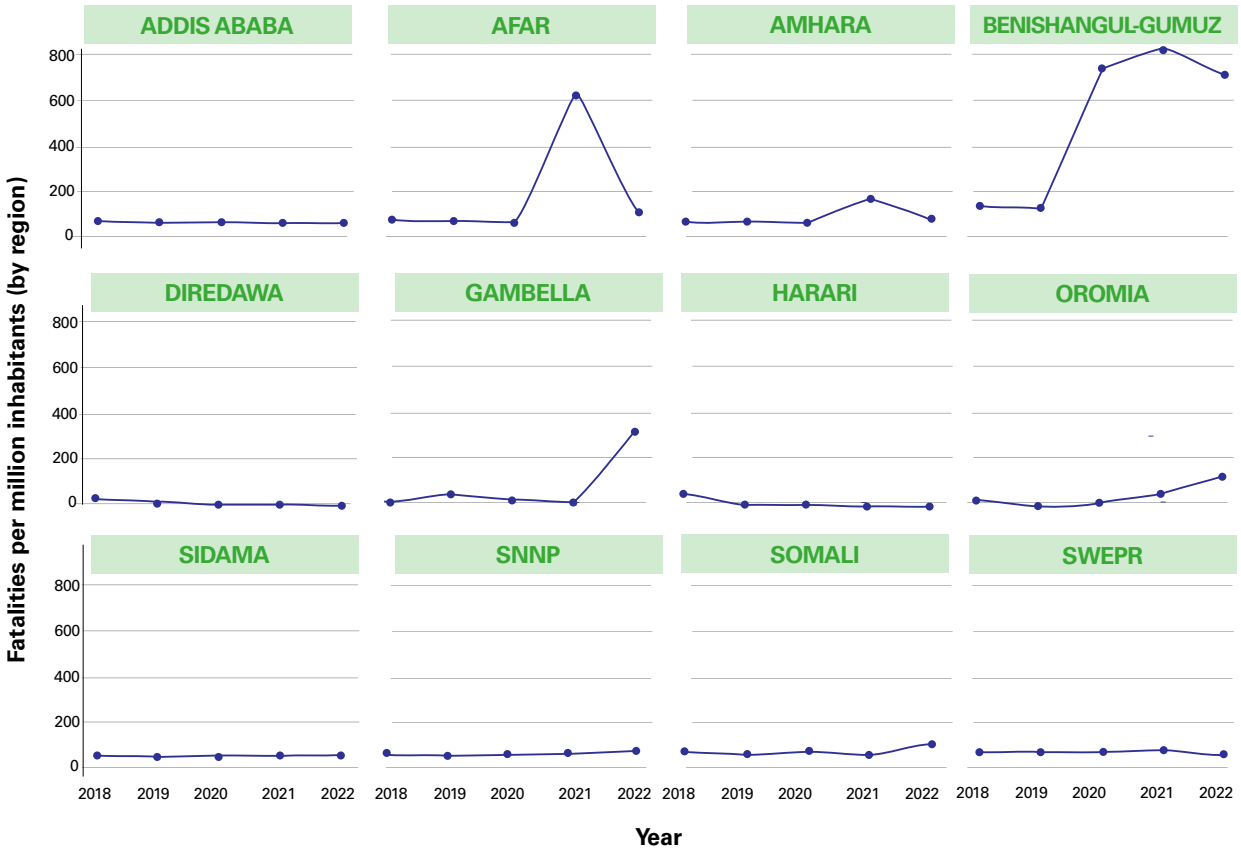
Source: Author's analysis of EMIS data.
Note: Weighted by schools' enrolment in grade 1.

Figure 17: Number of political violence events registered by ACLED between 2018 and 2022, by region



Source: Author's analysis of ACLED data set.

Figure 18: Number of fatalities per million inhabitants registered by ACLED due to political violence events between 2018 and 2022, by region



Source: Author's analysis of ACLED data set.

Appendix C: Missing data and related robustness checks

To avoid dropping entire regions from the regression analysis, the DMS research prioritized variables with the least amount of missing data, or generated new variables based on available data. Tables 10 to 12 show the proportion of schools with missing data by region and in the years analysed.

To include some measurement of water, sanitation or hygiene infrastructure in the regression, several variables included in EMIS were explored. While the absence of many variables indicated couldn't be included in the regression (such as menstrual sanitation items), toilets had many different variables (such as the type of toilet, single-sex toilet, accessible toilet) that could therefore be used to create a new variable that captured whether schools had at least one toilet. For example, if a school answered that they have separate toilets, or that male and female toilets are separated, or the type of toilet available, this indicates that the school had at least one toilet available. In Addis Ababa in 2021, there was no information on the distance to male and female toilets or whether there were accessible toilets, but there was information on whether separate toilets were available and the type of toilet available. Therefore, for 2021 it could be deduced whether at least one toilet was available in a school. This approach has its limitations, but it does illustrate some minimum sanitary conditions at the school.

Table 10: Percentage of schools with missing data related to water, sanitation and hygiene

REGION	year	Availability of girls toilet	Availability of handwashing	Fuctionation handwashing available	Availability of menstual waste disposal	Availability of menstrual education	Availability of menstrual sanitation	Type of menstrual sanitation	Other toilet supply available	Male and female toilet is far	Accesible toilet availble	Number of pits	Seaprate toilets available	Type of water supply	Toilet type
Addis Ababa	2019	100.0%	19.3%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	17.5%	100.0%	25.1%	100.0%	100.0%	100.0%
	2020	100.0%	5.7%	34.0%	100.0%	100.0%	43.3%	42.9%	100.0%	22.3%	12.1%	29.1%	6.1%	100.0%	100.0%
	2021	100.0%	5.2%	11.5%	11.1%	100.0%	23.4%	100.0%	100.0%	100.0%	100.0%	100.0%	4.8%	100.0%	7.1%
Afar	2019	100.0%	3.7%	100.0%	100.0%	100.0%	33.7%	100.0%	100.0%	46.5%	100.0%	86.9%	100.0%	100.0%	100.0%
	2020	100.0%	12.3%	35.3%	100.0%	100.0%	68.4%	94.9%	100.0%	45.0%	25.4%	86.1%	21.8%	100.0%	100.0%
	2021	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	55.6%
Amhara	2019	67.7%	22.1%	100.0%	100.0%	100.0%	44.7%	100.0%	100.0%	82.4%	100.0%	83.1%	100.0%	100.0%	100.0%
	2020	67.8%	52.3%	75.4%	100.0%	100.0%	86.2%	84.7%	67.5%	82.6%	57.1%	83.3%	56.0%	100.0%	100.0%
	2021	100.0%	36.6%	69.6%	37.0%	100.0%	80.3%	100.0%	100.0%	100.0%	100.0%	100.0%	24.3%	100.0%	20.7%
Benishangul-Gumuz	2019	100.0%	1.6%	100.0%	100.0%	100.0%	17.0%	100.0%	100.0%	28.1%	100.0%	25.3%	100.0%	100.0%	100.0%
	2020	100.0%	1.6%	14.5%	100.0%	100.0%	22.3%	42.4%	100.0%	25.6%	5.7%	23.7%	52.6%	100.0%	100.0%
	2021	100.0%	12.5%	32.6%	21.0%	100.0%	51.4%	100.0%	100.0%	100.0%	100.0%	100.0%	16.8%	100.0%	27.3%
Dire Dawa	2019	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	2020	100.0%	4.6%	18.4%	100.0%	100.0%	48.3%	27.6%	100.0%	100.0%	5.7%	100.0%	4.6%	100.0%	100.0%
	2021	100.0%	8.4%	25.3%	21.7%	100.0%	54.2%	100.0%	100.0%	100.0%	100.0%	100.0%	8.4%	100.0%	7.2%
Gambella	2019	100.0%	0.8%	100.0%	100.0%	100.0%	12.3%	100.0%	100.0%	27.2%	100.0%	37.2%	100.0%	100.0%	100.0%
	2020	100.0%	7.1%	32.6%	100.0%	100.0%	75.7%	98.5%	100.0%	23.2%	24.0%	35.2%	22.5%	100.0%	100.0%
	2021	100.0%	15.6%	33.7%	27.8%	100.0%	61.1%	100.0%	100.0%	100.0%	100.0%	100.0%	24.8%	100.0%	47.0%
Harari	2019	100.0%	17.4%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	15.9%	100.0%	36.2%	100.0%	100.0%	100.0%
	2020	100.0%	1.4%	10.1%	100.0%	100.0%	24.6%	63.8%	100.0%	15.9%	10.1%	36.2%	5.8%	100.0%	100.0%
	2021	100.0%	3.0%	29.9%	28.4%	100.0%	32.8%	100.0%	100.0%	100.0%	100.0%	100.0%	10.4%	100.0%	19.4%
Oromia	2019	100.0%	2.9%	100.0%	100.0%	100.0%	10.7%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	2020	100.0%	2.8%	17.9%	100.0%	100.0%	6.8%	100.0%	100.0%	100.0%	6.1%	100.0%	100.0%	100.0%	100.0%
	2021	100.0%	5.1%	18.6%	100.0%	100.0%	7.2%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	3.5%
Sidama	2019	100.0%	2.2%	100.0%	100.0%	100.0%	3.4%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	2020	100.0%	3.6%	7.5%	100.0%	100.0%	12.3%	55.5%	100.0%	100.0%	3.1%	100.0%	2.6%	100.0%	100.0%
	2021	100.0%	10.9%	12.3%	13.0%	100.0%	18.7%	100.0%	100.0%	100.0%	100.0%	100.0%	9.9%	100.0%	12.0%
SNNP	2019	100.0%	13.1%	100.0%	100.0%	100.0%	17.4%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	2020	100.0%	9.8%	14.4%	100.0%	100.0%	25.9%	52.7%	100.0%	100.0%	8.8%	100.0%	9.5%	100.0%	100.0%
	2021	100.0%	11.9%	21.4%	14.5%	100.0%	28.2%	100.0%	100.0%	100.0%	100.0%	100.0%	9.3%	100.0%	5.4%
Somali	2019	100.0%	9.6%	100.0%	100.0%	100.0%	50.5%	100.0%	100.0%	67.0%	100.0%	76.2%	100.0%	100.0%	100.0%
	2020	100.0%	4.9%	10.5%	100.0%	100.0%	39.8%	62.7%	100.0%	68.9%	3.7%	77.2%	5.9%	100.0%	100.0%
	2021	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	88.7%
SWEPR	2019	100.0%	17.9%	100.0%	100.0%	100.0%	20.8%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	2020	100.0%	7.1%	11.0%	100.0%	100.0%	21.4%	56.2%	100.0%	95.7%	4.7%	100.0%	5.8%	100.0%	100.0%
	2021	100.0%	19.9%	24.9%	18.0%	100.0%	34.1%	100.0%	100.0%	100.0%	100.0%	100.0%	11.7%	100.0%	5.2%

This method of gathering information to create a variable representing if a certain resource was 'available' was repeated for data on the presence of a functional library or pedagogical centre, and electricity source information.

In all cases, if one variable was missing for all schools in some years, other strategies were employed, including an extrapolation of information from previous years. For example, if a school had a toilet in 2019 and 2020, it was considered likely that the school also had a toilet in 2021. If a school never had a toilet previously, then in 2021 it was considered likely that the school still did not have a toilet. This removes a variability of variables which could bias coefficients in regression results, but avoids dropping observations especially from the Afar, Oromia, Somali, Southern Nations, Nationalities and Peoples (SNNP), and SWEPR regions.

Other variables where there was too much missing data and no deductions could be made were excluded from the analysis. For example, data on the availability of a radio or sports facility was missing for at least 50 per cent of schools in many regions and years, and therefore excluded.

Teacher characteristics data on gender and qualifications was complete in all years. However, there were some missing data for other variables for Dire Dawa, Afar and the Somali region in specific years. The number of periods each teacher taught was partly complete; however, in some cases they were all 0 (teacher taught zero periods in all levels of primary education). Missing teacher characteristics are harder to reconcile than school characteristics. It would be necessary to identify the same teacher across several years of the data set, fill in possible missing variables, and then aggregate the information at the school level. This would bring a fuller understanding of how teacher characteristics changed. Reconciling over 500,000 teachers without unique and stable identifiers was not possible to achieve. For this reason, the only variables included in the regression analysis were gender and qualification level. Other variables in EMIS included teacher rank, age, subject taught and number of periods taught by teachers. However, these could not be included in the analysis due to missing data.

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Table 11: Percentage of schools with missing infrastructure data

REGION	Year	Availability pedagogical centre and coordination	Functional pedagogical centre and coordination available	Availability pedagogical centre	Permanent centre available	School principal is permanent	Available PTSA	School receives a grant	Available special needs education	Available strategic plan	Availability of electricity	Library is functional	Available library	Available mobile centre	Radio is functional	Radio is not functional	Available school radio	Available sports facility	Available sports field	Number of broadcasts	Electricity source
Addis Ababa	2019	12.6%	9.4%	6.3%	14.8%	16.1%	100.0%	6.7%	100.0%	3.1%	100.0%	13.0%	4.9%	100.0%	100.0%	100.0%	100.0%	100.0%	0.4%	100.0%	100.0%
	2020	14.2%	10.5%	3.6%	19.4%	10.9%	100.0%	5.3%	100.0%	4.5%	1.6%	13.0%	3.6%	100.0%	27.5%	48.2%	10.9%	100.0%	1.6%	100.0%	100.0%
	2021	100.0%	10.3%	3.2%	100.0%	15.1%	100.0%	10.7%	4.0%	4.8%	0.4%	12.7%	3.2%	100.0%	27.8%	48.0%	11.1%	100.0%	100.0%	0.0%	0.4%
Afar	2019	82.0%	77.5%	15.0%	45.6%	14.2%	100.0%	11.0%	100.0%	10.5%	2.7%	85.3%	11.2%	100.0%	100.0%	100.0%	100.0%	100.0%	9.0%	100.0%	100.0%
	2020	81.2%	76.1%	6.0%	42.8%	4.8%	100.0%	2.2%	100.0%	2.6%	1.4%	84.0%	2.2%	100.0%	97.5%	98.6%	10.7%	100.0%	1.0%	100.0%	100.0%
	2021	100.0%	100.0%	100.0%	100.0%	8.7%	100.0%	5.6%	3.2%	2.8%	0.8%	100.0%	100.0%	100.0%	97.5%	98.5%	10.1%	100.0%	100.0%	0.0%	0.1%
Amhara	2019	40.3%	29.9%	14.6%	45.9%	9.8%	100.0%	6.7%	100.0%	6.6%	15.0%	81.6%	13.6%	63.5%	100.0%	100.0%	100.0%	100.0%	10.4%	100.0%	100.0%
	2020	32.7%	23.2%	6.8%	46.1%	1.0%	100.0%	1.3%	100.0%	1.0%	7.0%	64.8%	5.2%	63.6%	42.3%	49.8%	20.9%	100.0%	2.8%	100.0%	100.0%
	2021	100.0%	21.8%	5.8%	100.0%	1.9%	58.7%	2.1%	0.8%	0.7%	2.1%	58.5%	4.5%	100.0%	41.3%	49.0%	19.7%	97.8%	100.0%	0.0%	0.7%
Benishangul-Gumuz	2019	33.7%	21.0%	3.8%	12.1%	5.1%	100.0%	3.5%	100.0%	3.5%	0.2%	51.6%	3.8%	47.0%	100.0%	100.0%	100.0%	100.0%	3.5%	100.0%	100.0%
	2020	30.1%	16.3%	0.7%	9.5%	1.6%	100.0%	0.0%	100.0%	0.0%	0.2%	49.7%	0.5%	45.0%	60.2%	59.3%	2.2%	100.0%	0.2%	100.0%	100.0%
	2021	100.0%	20.8%	9.0%	100.0%	3.3%	28.6%	1.7%	1.9%	1.7%	0.2%	49.5%	8.9%	100.0%	59.5%	58.7%	1.4%	50.2%	100.0%	0.0%	0.0%
Dire Dawa	2019	26.9%	23.9%	4.5%	100.0%	0.0%	100.0%	1.5%	100.0%	0.0%	100.0%	32.8%	1.5%	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%	100.0%	100.0%
	2020	41.4%	37.9%	14.9%	100.0%	3.4%	100.0%	0.0%	100.0%	1.1%	6.9%	43.7%	9.2%	100.0%	57.5%	60.9%	32.2%	100.0%	5.7%	100.0%	100.0%
	2021	100.0%	38.6%	9.6%	100.0%	6.0%	100.0%	4.8%	6.0%	4.8%	1.2%	38.6%	4.8%	100.0%	57.8%	61.4%	30.1%	100.0%	100.0%	0.0%	0.0%
Gambella	2019	73.9%	67.4%	73.6%	27.6%	11.5%	100.0%	41.4%	100.0%	9.2%	6.1%	69.7%	65.5%	35.2%	100.0%	100.0%	100.0%	100.0%	10.3%	100.0%	100.0%
	2020	68.2%	43.4%	49.8%	22.8%	1.1%	100.0%	29.2%	100.0%	2.6%	3.0%	61.8%	40.1%	33.0%	35.2%	35.2%	12.4%	100.0%	0.4%	100.0%	100.0%
	2021	100.0%	28.9%	32.6%	100.0%	3.3%	30.4%	31.1%	0.7%	0.7%	0.4%	42.2%	21.1%	100.0%	33.7%	33.7%	8.9%	41.9%	100.0%	0.0%	0.0%
Harari	2019	13.0%	8.7%	0.0%	13.0%	0.0%	100.0%	1.4%	100.0%	1.4%	100.0%	13.0%	0.0%	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%	100.0%	100.0%
	2020	10.1%	7.2%	0.0%	13.0%	0.0%	100.0%	0.0%	100.0%	0.0%	0.0%	11.6%	0.0%	100.0%	65.2%	75.4%	0.0%	100.0%	0.0%	100.0%	100.0%
	2021	100.0%	9.0%	1.5%	100.0%	17.9%	35.8%	17.9%	17.9%	17.9%	0.0%	10.4%	1.5%	100.0%	65.7%	76.1%	0.0%	100.0%	100.0%	0.0%	0.0%
Oromia	2019	34.9%	32.4%	5.2%	15.6%	100.0%	100.0%	5.9%	100.0%	6.1%	0.2%	58.1%	4.2%	100.0%	100.0%	100.0%	100.0%	100.0%	4.7%	100.0%	100.0%
	2020	37.2%	34.0%	1.3%	11.2%	100.0%	100.0%	0.7%	100.0%	2.9%	0.0%	47.3%	0.0%	100.0%	32.5%	60.6%	3.9%	100.0%	0.3%	100.0%	100.0%
	2021	100.0%	32.0%	4.0%	100.0%	100.0%	0.9%	0.2%	100.0%	0.9%	0.4%	43.2%	3.9%	100.0%	27.2%	58.8%	0.6%	100.0%	100.0%	0.0%	0.4%
Sidama	2019	100.0%	100.0%	4.7%	100.0%	8.3%	100.0%	7.5%	100.0%	100.0%	1.9%	100.0%	4.5%	100.0%	100.0%	100.0%	100.0%	100.0%	4.6%	100.0%	100.0%
	2020	39.2%	39.5%	2.5%	100.0%	3.1%	100.0%	1.8%	100.0%	13.0%	0.4%	41.2%	0.3%	100.0%	47.7%	66.9%	47.7%	100.0%	0.4%	100.0%	100.0%
	2021	100.0%	35.3%	10.1%	100.0%	3.9%	100.0%	2.7%	0.6%	3.0%	0.1%	37.1%	9.3%	100.0%	45.3%	65.5%	45.3%	100.0%	100.0%	0.0%	0.0%
SNNP	2019	100.0%	100.0%	6.9%	100.0%	12.5%	100.0%	10.2%	100.0%	100.0%	10.4%	100.0%	6.3%	100.0%	100.0%	100.0%	100.0%	100.0%	6.6%	100.0%	100.0%
	2020	62.2%	60.4%	7.1%	100.0%	4.4%	100.0%	2.6%	100.0%	21.9%	3.9%	59.8%	4.2%	100.0%	36.9%	58.1%	36.9%	100.0%	3.6%	100.0%	100.0%
	2021	100.0%	43.9%	7.9%	100.0%	5.6%	100.0%	3.8%	1.0%	3.4%	0.2%	42.4%	6.5%	100.0%	33.7%	55.9%	33.7%	100.0%	100.0%	0.0%	0.1%
Somali	2019	59.6%	64.4%	22.4%	74.0%	21.2%	100.0%	27.3%	100.0%	18.2%	13.7%	61.5%	20.2%	76.4%	100.0%	100.0%	100.0%	100.0%	15.1%	100.0%	100.0%
	2020	52.1%	54.1%	11.1%	75.4%	13.4%	100.0%	18.3%	100.0%	11.9%	4.5%	53.4%	7.2%	77.5%	78.7%	78.3%	23.0%	100.0%	4.1%	100.0%	100.0%
	2021	100.0%	100.0%	100.0%	100.0%	37.6%	77.0%	40.9%	29.8%	32.1%	1.7%	100.0%	100.0%	100.0%	79.0%	78.5%	24.3%	100.0%	100.0%	0.0%	1.2%
SWEPR	2019	100.0%	100.0%	9.5%	100.0%	12.6%	100.0%	10.7%	100.0%	100.0%	13.9%	100.0%	8.4%	100.0%	100.0%	100.0%	100.0%	100.0%	8.6%	100.0%	100.0%
	2020	70.1%	63.9%	14.2%	100.0%	13.6%	100.0%	11.7%	100.0%	29.4%	12.1%	69.3%	12.1%	100.0%	48.2%	66.6%	48.2%	100.0%	6.9%	100.0%	100.0%
	2021	100.0%	52.8%	9.8%	100.0%	15.6%	99.3%	13.8%	2.2%	6.3%	0.5%	59.9%	8.1%	100.0%	44.4%	64.0%	44.4%	99.5%	100.0%	0.0%	0.1%

Table 12: Percentage of teachers with missing information

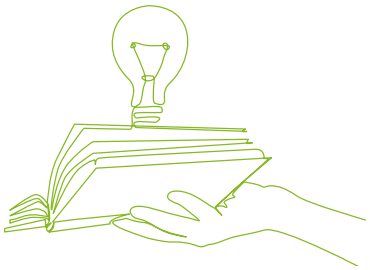
REGION	Year	Gender	Status (full time or part time)	Subject specialization	Highest education level	Subject specialization 2	Periods taught: O Class	Periods taught: G1 to G4	Periods taught: G5 to G8	Periods taught: G1 to G6	Periods taught: G7 to G8	Rank	Year of birth	Total number of teachers
Addis Ababa	2019	0.0%	0.0%	50.0%	5.5%	11.6%	98.9%	58.1%	48.2%	-	-	-		13897
	2020	0.0%	32.3%	3.1%	3.4%	80.1%	97.7%	-	-	0.2%	0.3%	32.3%	32.8%	17280
	2021	0.0%	-	-	0%	-	0.0%	-	-	0.2%	0.0%	-	-	17929
Afar	2019	0.0%	0.0%	71.8%	25.5%	31.9%	94.5%	0.3%	0.3%	-	-	-		4941
	2020	0.0%	16.9%	12.7%	13.2%	76.9%	93.1%	-	-	0.0%	0.0%	16.9%	17.3%	5607
	2021	0.0%	-	-	0%	-	0.0%	-	-	0.0%	0.0%	-	-	5625
Amhara	2019	0.0%	0.0%	53.5%	0.2%	4.9%	100.0%	0.0%	0.0%	-	-	-		130843
	2020	0.0%	60.6%	3.5%	0.0%	73.8%	99.9%	-	-	0.4%	0.7%	60.6%	98.5%	143383
	2021	0.0%	-	-	0%		0.0%	-	-	0.0%	0.0%	-	-	152367
Benishangul-Gumuz	2019	0.0%	0.0%	27.9%	0.1%	5.3%	10.7%	0.0%	0.0%	-	-	-		7027
	2020	0.0%	6.2%	4.1%	0.1%	54.6%	0.0%	-	-	0.0%	0.0%	6.2%	6.3%	7180
	2021	0.0%	-	-	0%		0.0%	-	-	0.0%	0.0%	-	-	7315
Dire Dawa	2019	0.0%	0.0%	43.4%	21.9%	5.2%	0.0%	0.0%	0.0%	-	-	-		2029
	2020	0.0%	8.6%	0.9%	3.9%	57.8%	93.4%			0.0%	0.0%	8.6%	8.6%	2363
	2021	0.0%	-	-	0%		0.0%	-	-	0.0%	0.0%	-	-	2262
Gambella	2019	0.0%	0.0%	75.9%	0.0%	3.0%	98.4%	0.0%	0.0%	-	-	-		3348
	2020	0.0%	5.1%	2.1%	0.2%	57.7%	98.5%	-	-	0.0%	0.0%	5.1%	5.7%	3810
	2021	0.0%	-	-	0%		0.0%	-	-	0.0%	0.0%	-	-	3650
Harari	2019	0.0%	0.0%	48.9%	0.1%	12.3%	93.0%	0.0%	0.0%	-	-	-		1621
	2020	0.0%	9.0%	3.8%	2.2%	55.3%	92.6%			0.0%	0.0%	9.0%	9.7%	1880
	2021	0.0%	-	-	0%		0.0%	-	-	0.0%	0.0%	-	-	1831
Oromia	2019	0.0%	0.0%	46.7%	0.0%	6.3%	0.0%	0.0%	0.0%	-	-	-		158829
	2020	0.0%	2.3%	0.0%	0.0%	80.8%	0.0%	-	-	0.0%	0.0%	2.3%	2.3%	162701
	2021	0.0%	-	-	0%		0.0%	-	-	0.0%	0.0%	-	-	164760
Sidama	2019	0.0%	0.0%	8.9%	0.0%	0.9%	0.0%	8.9%	8.9%	-	-	-		120771
	2020	0.0%	7.2%	2.1%	1.3%	52.9%	92.7%	-	-	0.0%	0.0%	7.2%	8.2%	96573
	2021	0.0%	-	-	0%		0.0%	-	-	0.0%	0.0%	-	-	77186
SNNP	2019	0.0%	0.0%	100.0%	0.5%	89.4%	99.6%	100.0%	100.0%	-	-	-		7062
	2020	0.0%	100.0%	63.0%	16.4%	99.2%	97.3%	-	-	0.0%	0.0%	100.0%	100.0%	12566
	2021	0.0%	-	-	0%		0.0%	-	-	0.0%	0.0%	-	-	8659
Somali	2019	0.0%	0.0%	100.0%	0.5%	89.4%	99.6%	100.0%	100.0%	-	-	-		7062
	2020	0.0%	100.0%	63.0%	16.4%	99.2%	97.3%	-	-	0.0%	0.0%	100.0%	100.0%	12566
	2021	0.0%	-	-	0%		0.0%	-	-	0.0%	0.0%	-	-	8659
Sidama	2020	0.0%	100.0%	0.4%	0.7%	68.8%	94.6%	-	-	0.3%	0.1%	100.0%	100.0%	33337
	2021	0.0%	-	-	0%	-	0.0%	-	-	0.0%	0.0%	-	-	33024
SWEPR	2021	0.0%	-	-	0%	-	0.0%	-	-	0.0%	0.0%	-	-	25212

Note: '-' refers to data not received by the DMS research, but does not necessarily mean this data is not collected by EMIS.

To test how much bias replacing values could be introduced to the regression due to missing data – either because regions are excluded otherwise or because replacing values may misrepresent the realities on the ground – and ensure robustness in the main specification (**equation 3** in **section 3**), the same regression presented in the report was run with a data set that did not replace any variable or make any kind of assumptions to replace values and therefore excludes regions.

This means the class size variable was no longer available for 2019, as the number of sections per grade was not available in 2019. Two robustness checks were run:
(1) a comparison between a regression using a data set with replaced values and another without replaced values using only the years of 2020 and 2021, including class size; and (2) a comparison between a regression using a data set with replaced values and another without replaced values, excluding class size but including 2019, 2020 and 2021 (see **Table 13**).

In the first robustness check, there are two variables where results differ completely: library and percentage of female teachers in a school, which in this model represents boys taught by female teachers.



Library is a negative association when there is replacement of values, and not statistically significant without replacement of values. Percentage of female teachers is negatively associated when there is replacement of values, and not statistically significant without replacement of values (**Table 13**, **columns 1** and **2**). It should be noted, however, that percentage of female teachers does not englobe any replaced values. Therefore, while libraries could be influenced by a misrepresentation of realities due to replacing values, it is likely that the percentage of female teachers is biased by an over-representation of certain regions when others are excluded from the regression analysis (such as an over-representation of Oromia, an underrepresentation of Afar and an exclusion of Benishangul-Gumuz, as presented in **Table 14**).

Other differences between regression results relate to the size of the coefficients, even for variables where there was no replacement of values, like the percentage of children that are overage, proportion of qualified teachers for the level taught, or if schools offer the full primary and middle school cycle. These biases could be due to replacing variables (such as in school feeding availability) or because excluding regions overrepresents others (such as proportion of overaged students).

Table 13: Two robustness checks using school FE model and including interaction term for same student-teacher gender effects

	Robustness check 1: 2020 and 2021 with class size		Robustness check 2: 2019, 2020 and 2021 without class size	
	(1)	(2)	(3)	(4)
	With replaced values	Without replaced values	With replaced values	Without replaced values
Student characteristics				
Student gender (girls = 1; boys = 0)	-1.171***	-1.262***	-1.350***	-1.456***
% students overage	-1.562***	-1.229***	-2.796***	-2.478***
Teacher characteristics				
% female teachers	-0.014*	0.003	-0.038***	-0.036***
% female teachers X girls = 1	0.067***	0.070***	0.060***	0.064***
% of teachers are qualified for level taught	0.641	1.133	3.700***	2.972***
School characteristics				
School offers full cycle	0.236	0.111	1.100***	1.764***
PTR	-0.222***	-0.217***	-0.216***	-0.209***
Class size	-0.139***	-0.138***	-	-
School received a grant †	-0.877*	-1.209**	0.373**	0.774***
School offers feeding †	10.833*	15.003**	-1.806***	-1.170***
School develops strategic planning †	1.114**	1.621***	-0.864***	-0.743**
School has at least one toilet †	0.274	0.341	1.429***	0.260
School has a library †	-0.415*	-0.397	-0.068	0.087
School has a pedagogical centre †	-0.28	0.074	-0.073	0.252
Year FE	Yes	Yes	Yes	Yes
Grade FE	Yes	Yes	Yes	Yes
School FE	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes
R-squared	0.346	0.355	0.289	0.308
Observation	504,128	447,172	786,188	666,292
Schools	28,784	26,836	30,136	28,919

† indicates variables that had some replacement of values in the case of the missing values data set.
*** p<0.01, ** p<0.05, * p<0.1
Source: EMIS data in 2019, 2020 and 2021. Calculations made by authors.

In the second robustness check, only toilet availability results differ completely. Using a data set with replaced values, toilet availability has a positive association whereas in a data set without replaced values it is not statistically significant. Similar to the first check, most differences relate to the size of coefficients, even for coefficients from variables where there was no replacement of values, like percentage of children that are overage (see **Table 13, columns 3** and **4**).

Aligned with the first robustness check, these differences could be due to biases in replacing variables (in the case of the toilet data, which there were replaced values) or an overrepresentation of certain regions when others are excluded from the regression analysis (**Table 14**). Smaller differences in coefficients in the second robustness check, such as in schools offering feeding, could also indicate that with more years of information, the replacement of values bias could have been reduced.

Table 14: Regional representation in samples used in regression analysis

	Robustness check 1			Robustness check 2		
REGION	Observation regional representation	With replaced values	Without replaced values	Observation regional representation	With replaced values	Without replaced values
Addis Ababa	0.81	0.54	0.58	0.81	0.65	0.73
Afar	1.47	1.18	0.67	1.48	1.18	0.9
Amhara	28.24	26.38	29.45	27.93	26.37	30.57
Benishangul-Gumuz	1.1	0.95	0	1.25	1.21	0.69
Dire Dawa	0.24	0.23	0.23	0.24	0.16	0.17
Gambella	0.61	0.17	0.19	0.61	0.15	0.17
Harari	0.2	0.19	0.19	0.2	0.2	0.21
Oromia	42.38	48.98	52.14	42.96	49.16	54.43
Sidama	3.37	3.55	1.81	3.29	3.51	1.23
SNNP	12.91	12.63	11.86	12.82	12.1	8.14
Somali	4.1	1.37	1.25	3.79	1.36	1.41
SWEPR	4.58	3.86	1.64	4.62	3.95	1.34
Total observations	632,221	504,128	447,172	958,621	765,117	666,292

Source: EMIS data in 2019, 2020 and 2021. Calculations made by authors.

While these results generally align between their own comparison group, the first robustness check differs from the main results presented in this report. This could be due to the shorter window of analysis, highlighting the importance of looking at more years of data over a longer timeframe. At the same time, while the second robustness check generally aligns to the main results, they differ in coefficient size because class size is not included, possibly indicating that is an important variable to include in the regression model.

As an additional step to the robustness check, two probability models to explain some characteristics of observations excluded from the analysis due to missing variables were run. A POLS and a logit were run using the specification below.

$$Observation\ dropped_i = Region_i + Year_i + \\ + Rural_i + Grade_i + \varepsilon_i$$

Where *Observation dropped* is a dummy variable that equals 1 when an observation i at the school-gender-grade level was not included in the regression because of a missing variable. Region indicated the region this observation is coming from, Year indicates the year the observation is coming from and could be 2019, 2020 or 2021, Rural is a dummy variable that equals 1 when the observation is coming from a rural location and 0 when it is coming from an urban location, and Grade indicates which grade this observation is coming from (grades 1–7).

Calculating the marginal effects, the logit results indicate that, compared to observations in urban schools, observations from rural schools have an increased probability of being dropped from the regression due to missing data by 0.63 percentage points.[24] This is aligned to the POLS model, where observations from rural schools are 7 percentage points more likely to be excluded from the analysis.

Similarly, compared to Addis Ababa, observations from Gambella, the Somali region and SWEPR are more likely to be excluded, while observations from Amhara and Oromia are more likely to be included in the regression analysis. Looking at grade-level data, there is an overrepresentation of data in grades 1 and 2 compared to all other grades. The results of these regressions indicate that the missingness of variables is not random and that rural schools, as well as schools in Gambella, the Somali region and SWEPR, may have more challenges during annual EMIS data collection and reporting.

[24] Marginal effects show how much the predicted probability of an outcome changes, on average, when a variable increases by one unit, holding other factors constant.

Table 15: Characteristics of observations excluded from the regression due to missing variables, using the data set in robustness check 2

	POLS	Logit
Region		
Addis Ababa (omitted)	-	-
Afar	0.198***	0.856***
Amhara	-0.138***	-0.684***
Benishangul-Gumuz	0.230***	0.975***
Dire Dawa	0.142***	0.628***
Gambella	0.430***	2.058***
Harari	-0.103***	-0.497***
Oromia	-0.258***	-1.553***
Sidama	0.364***	1.654***
Snnp	0.182***	0.787***
Somali	0.363***	1.641***
Swepr	0.422***	1.999***
Year		
2019 (omitted)	-	-
2020	-0.172***	-1.176***
2021	-0.031***	-0.189***
Location		
Rural	0.007***	0.042***
Grade		
Grade 1 (omitted)	-	-
Grade 2	-0.001	-0.009
Grade 3	-0.003*	-0.023**
Grade 4	-0.015***	-0.098***
Grade 5	-0.023***	-0.151***
Grade 6	-0.030***	-0.197***
Grade 7	-0.030***	-0.204***
Constant	Yes	Yes
R-squared	0.276	-
Pseudo R-squared	-	0.2302
Observation	958,621	958,621

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

Source: EMIS data in 2019, 2020 and 2021, data set that does not replace values used in robustness test 2. Calculations made by authors.

Note: The coefficients from the POLS regression can be interpreted as the percentage difference in the likelihood that an observation is dropped from the regression due to missing variables, in comparison to the omitted variable in their relative category. For example, observations from Afar are 0.2 percentage points more likely to be dropped from the regression in comparison to observations from Addis Ababa. Coefficients from the logit model cannot be interpreted the same way, only when marginal effects are calculated. Results from marginal effects of the logit model were analysed by authors and are aligned the POLS model coefficients.

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