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Persistent inequalities in early years' access and learning: evidence from large-scale expansion of pre-primary education in Ethiopia

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ABSTRACT

In Ethiopia, major policy reforms to increase equitable access to pre-primary education were instigated in 2010, leading to a surge in pre-primary school enrolment. This paper investigates the effects of the expansion on who gets access to pre-primary education and on readiness for primary school. We find that inequalities in pre-primary access between advantaged and disadvantaged regions of the country persist following the reforms, with girls less likely to attend school, particularly in more disadvantaged regions. More than half of children enrolled in pre-primary classrooms are below the official age of 6 years. Children from more advantaged backgrounds (those whose parents are literate, have reading materials at home, and live in urban areas) are more likely to participate in pre-primary schools both before and after the reform. Yet pre-primary education could play a role in equalizing opportunities in primary school: we find pre-primary participation to be positively associated with children's reading skills in Grades 2 and 3 of primary school after the expansion. These findings highlight the need to focus policy attention on efforts to reduce barriers to pre-primary access for children in disadvantaged circumstances.

1. Introduction

International evidence shows that investing in early childhood programs can have large economic returns for societies and children, particularly those from socially disadvantaged groups (Engle et al., 2011; Heckman & Masterov, 2007; Walker, Chang, Vera-Hernandez & Grantham-McGregor, 2011; Yoshikawa et al., 2013). Despite increased pressure to invest in such programs, pre-primary education has been neglected in many low- and lower-middle income countries. As a result, only 1 in 5 children has access to pre-primary education in low-income countries (UNICEF, 2019). In recent years, governments and donors have scaled up their commitment to pre-primary education (Black et al., 2017). This commitment is reflected in the United Nations' Sustainable Development Goal on education, which includes an explicit target to achieve universal pre-primary education by 2030, with the aim of improving children's readiness for entry into primary school (Target 4.2, United Nations, 2015). With this emphasis on expanding pre-primary education provision, evidence is needed on whether such expansion is reaching the most disadvantaged as well as its effect on school readiness, particularly in low-income countries that currently are furthest from the Sustainable Development Goal target.

This focus is important in the light of earlier evidence from low and lower-middle income countries, which suggests that the expansion of primary schooling has led to widening disparities in access (Lewin & Sabates, 2012; Rose, Sabates, Alcott & Ilie, 2017). Emerging evidence also indicates that participation in pre-primary education is highly unequal (Baum, Hernandez & Orchard, 2019; Delprato, Dunne & Zeitlyn, 2018; Woodhead, Ames, Vennam, Abebe & Streuli, 2009). However, little is known about how nationwide pre-primary education reforms affect access, or about subsequent learning outcomes in primary school. Given the Ethiopian government's recent policy reforms aimed at rapidly increasing pre-primary education provision, it provides an important case for understanding the process of such an extensive reform within a

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Table 1
Overview of some regional characteristics in Ethiopia.

	Region	Multi-dimensional Poverty Index[a]	Population (million)[b]	Population of preschool-aged children (million)	Primary net enrolment ratio[c]	Primary gender parity index[d]
Group 1	Addis Ababa	0.085	3.27	0.20	105.8	1.18
	Dire Dawa	0.338	0.44	0.03	87.2	0.91
	Harari	0.333	0.23	0.02	97.6	0.85
Group 2	Tigray	0.537	5.06	0.39	109.7	0.94
	Amhara	0.588	20.40	1.73	103.7	0.96
	Oromia	0.592	33.69	3.09	97.0	0.87
	SNNP	0.574	18.28	1.60	109.1	0.89
Group 3	Afar	0.663	1.72	0.13	48.4	0.90
Emerging	Somali	0.647	5.45	0.52	72.3	0.78
	Benishangul-Gumuz	0.584	1.01	0.09	96.1	0.84
	Gambella	0.474	0.41	0.03	113.8	0.92

[a] Multi-dimensional poverty index: Poverty index based on the health, living standards, quality of education, and empowerment indicators (Oxford Department of International Development, 2017).
[b] Population: 2015 population projection based on 2007 population census in Ethiopia (Ethiopian Central Statistical Agency, 2015).
[c] Primary net enrolment ratio: Total number of students of the official age group for primary education who are enrolled in primary education, expressed as a percentage of the corresponding population (MoE, 2016/17).
[d] Gender parity index: Ratio of number of female students to male primary school students (MoE, 2016/17).

low-income country context. The paper, therefore, makes an important contribution to existing academic literature, and also provides policy insights for the Ethiopian government and other low-income countries on the importance of paying attention to equity in the expansion of pre-primary education provision.

Ethiopia adopted a new National Policy Framework for Early Childhood Care and Education in 2010 to promote young children's access to early childhood programs. With increased government involvement, the gross enrolment rate in pre-primary education surged from 5% to 46% over a 6-year period. The intention of the policy reform was to offer a cost-effective model of pre-primary education to promote school readiness with respect to learning and grade progression of children, and to reach those from the most marginalized communities (Ministry of Education, 2010).

Given the impressive rise in pre-primary enrolment, we examine whether this has been accompanied by reducing disparities in pre-primary access and improving early learning outcomes in primary school, as anticipated by the policy reform. First, using Ethiopia's nationwide school census data, we explore the extent to which children from different backgrounds-according to location, gender, and age groups-participate in pre-primary education. Second, using regionally representative early grade reading assessment data collected from 5 regions in Ethiopia, we analyze the association between pre-primary participation and reading skills in Grades 2 and 3 of primary school, focusing on changes before and after the reform period. This analysis is vital to assess whether national and SDG policy targets related to children's school readiness are being achieved through a large-scale expansion of pre-primary education, with a particular focus on leaving no one behind. We conclude by discussing the policy implications with respect to expanding pre-primary education equitably in low- and lower-middle income countries.

2. Background

2.1. Educational inequalities in Ethiopia

Over the past two decades, Ethiopia has made remarkable progress towards universal primary education. Despite considerable growth in primary enrolment and a narrowing of the gender gap, inequalities in access remain for children from poor families, children with parents with lower levels of education, and children from rural areas or least developed regions of the country (Woldehanna, Gudisa, Tafere & Pankhurst, 2011; Ministry of Education, 2017).

Some evidence also points to children's learning outcomes in primary school, which were already far below expected levels (American Institutes for Research, 2016; National Educational Assessment and Examinations Agency (NEAEA) 2016). Children from disadvantaged backgrounds, for example related to household wealth, gender, and geographical location, are least likely to be learning the basics (see, for example, Iyer, Rolleston, Rose & Woldehanna, 2020; Rolleston, James & Aurino, 2013). Notably, Tesema and Braeken (2018) found that regional inequalities in academic achievement are related to differences in socioeconomic and school environmental factors. Ethiopia is the second-most populous country in sub-Saharan Africa, and given that large, within-country discrepancies can be expected, attention is needed to identify regional variations in educational access within the country.

Table 1 provides an overview of some regional characteristics across the 11 regions in Ethiopia. The current regional structure, which was formulated in 1991, reflects the country's decentralized political system. The regional division was roughly based on ethnolinguistic criteria. Heterogeneity remains within regions, with respect to historical legacies, ethnicity, language, geography, and socioeconomic status. These characteristics are also reflected in the variations in primary school access across regions. Since there are regional imbalances that have been historically inherited, the government introduced the Emerging Regions Development Program in 2007, as a first step towards poverty alleviation in 4 regional states: Afar, Somali, Benishangul-Gumuz, and Gambella. Based on the key indicators presented, the 11 regions can be classified into 3 groups: (1) Addis Ababa, Dire Dawa, and Harari; (2) Tigray, Amhara, Oromia, SNNP; and (3) Afar, Somali, Benishangul-Gumuz, and Gambella. The third group is assigned to 'emerging regions' by the government, and Afar and Somali regions are largely dominated by pastoralist areas.

2.2. National policy reform of pre-primary education in Ethiopia

Recognizing the variations in terms that are often used interchangeably, in this paper, we use the term "pre-primary education" to refer to the broad range of organized, site-based early learning programs for children aged 4 years and above, up to the start of primary education. Where documents such as government policies refer to other terminology such as early childhood education, we adopt this.

Pre-primary education in Ethiopia has traditionally targeted children aged 4 to 6, before they officially enter Grade 1 at age 7. Historically, it has been provided on a small scale by the

Table 2
Types of pre-primary education provision in Ethiopia.

	Kindergarten	O-Class	Child-to-Child
Formal or informal	Formal	Formal	Informal
Duration	Up to three years	One year	Up to three years (part-time)
Main source of funding	Private; tuition-based	Government	UNICEF & Government
Main implementer	Private sector	Government	UNICEF & Government
Teacher	Private teacher	O-Class public school teachers	Older children
Target age group	4–6 years	6 years	4–6 years

Source: Table adapted from the *Journeys to Scale* (UNICEF, 2016).

private sector, and non-governmental and faith-based organizations. Ethiopia's 1994 Education and Training Policy initially acknowledged the provision of pre-primary education for the "all-round development of the child in preparation for formal schooling" (Government of Ethiopia, 1994). However, until 2010, pre-primary education had not been integrated into public education provision, with funding not allocated to this sub-sector. As a result, the supply of pre-primary education provision was offered by kindergartens, a three-year program for 4 to 6-year olds, mostly run by the private sector or non-governmental organizations. Kindergartens have conventionally been separate structures (not linked with primary schools), and mainly located in urban towns and cities. By 2010, kindergarten served less than 5% of 4- to 6-year-old children, most of whom were from relatively wealthy backgrounds (Ministry of Education (MoE) 2011).

Since 2007, a group of policy actors, including government officials, advocating for the expansion of pre-primary education emerged. There were two key drivers for this movement. First, as a result of global pressure to achieve Education for All, the government was concerned about low and unequal provision of pre-primary education. Specifically, the Education for All goals encouraged equitable service provision by 'expanding and improving comprehensive early childhood care and education, especially for the most vulnerable and disadvantaged children' (UNESCO, 2000). Second, political leadership was apparent, with the state minister for general education being instrumental in supporting the development of a multi-sectoral early childhood care and education strategy. As a result, an Early Childhood Care and Education Task Force was formed. This included government officials from the education, health, and social protection sectors, together with UNICEF, NGOs, civil society organizations, and academic partners.

Momentum for the expansion of pre-primary education was formalized in 2010 when the Government of Ethiopia developed a National Policy Framework for Early Childhood Care and Education. This Framework promotes the development of accessible, equitable and quality pre-primary education for all children, particularly those from disadvantaged backgrounds, and aims to ensure that pre-primary education is incorporated into all relevant national policies and programs (Ministry of Education (MoE) 2010). With a particular focus on increasing access to pre-primary education, the policy promoted the introduction and expansion of various forms of service delivery, including 'O-Class' and Child-to-Child provision. O-Class has been the main focus of government provision in the Framework, with pre-primary classes linked to government primary schools. This initially targeted the 6-year-old population - the year before children are officially expected to start primary school - with the intention of expanding pre-primary education gradually to ages 4–5. The Child-to-Child program, supported by UNICEF, relies on peer tutoring (i.e., young children with older siblings or peers) to develop early learning competencies. Table 2 summarizes the characteristics of the three predominant types of pre-primary education now in existence in Ethiopia, including kindergarten, O-Class, and Child-to-Child.

Attention to pre-primary education was further reflected in the fifth Education Sector Development Program (2015/16–2019/20), in which the government set an ambitious target for achieving universal pre-primary education for 6-year-olds by 2020 (Ministry of Education (MoE) 2015). With the government's promotion of the full provision of accessible and affordable pre-primary education, the plan stressed that, "quality, targeted, early childhood care and education provision will be used as a tool to increase equity in the education system. (…) By focusing early childhood care and education expansion first in the areas with lower educational attainment (…), the government will seek to improve the performance of children who can benefit the most from the support to transition more successfully into Grade 1" (p. 77).

With a massive influx of young children into the education system, it is inevitable that many challenges affecting equitable access and quality of pre-primary education provision have arisen. These include, for example, the lack of trained facilitators/teachers; limited availability of curriculum and teacher guides; a lack of adequate classroom facilities; insufficient developmentally-appropriate learning materials and playgrounds; and insufficient pay for teachers, among others (Rossiter, Hagos, Rose, Teferra & Woldehanna, 2018; Teferra & Hagos, 2016; Woodhead, Rossiter, Dawes & Pankhurst, 2017).

2.3. Prior evidence on pre-primary education in Ethiopia

Empirical evidence of pre-primary education in low- and lower-middle income countries is limited (Gove, 2017; Spier, Leenknecht, Carson, Bichay & Faria, 2019), and only a small number of studies have addressed pre-primary education in Ethiopia. These studies have primarily captured the period before the expansion of pre-primary education, and are mainly confined to an urban context. They are, therefore, most likely to measure the effect of attending private kindergarten, which primarily serves richer families who can afford their fees. For example, using longitudinal data from the Young Lives study in Ethiopia, researchers found that urban children who attended pre-primary school performed better in receptive vocabulary and maths assessments at age 8 (Woldehanna, 2011; Woldehanna & Gebremedhin, 2012). Using data from children who were 6 years old in 2000, a study also found that those who participated in pre-primary education were 25% more likely to complete secondary education at the appropriate age than who did not attend (Woldehanna & Araya, 2017).

During the post-reform period, two studies have examined school readiness of Ethiopian children living in the Oromia region using a locally adapted, global instrument of early childhood development that measures early literacy, early numeracy, socio-emotional, and motor skills of preschool-aged children. Dowd, Borisova, Amente and Yenew (2016) found that children who participated in pre-primary education, regardless of its type (including community-based and O-Class provision) showed significant improvement in early literacy and numeracy skills compared with those who did not attend pre-primary education. Wolf et al. (2017) also revealed that enrollment in pre-primary education was a strong predictor of children's development in four areas: early numeracy, early literacy, motor development, and socio-emotional development. Notably, the influence of

participation in pre-primary education on school readiness, measured after the expansion of pre-primary education, was larger in magnitude than family factors such as household assets and parents' education.

2.4. The current study

In the context of the recent Ethiopian government's pre-primary education reforms, we pose an overarching question: "Has the large-scale expansion of pre-primary education narrowed or reinforced inequalities in access and children's school readiness?". We first consider trends in pre-primary enrolment in Ethiopia following the major policy reform, focusing on the one triggered by the 2010 National Policy for Early Childhood Care and Education among other initiatives, with particular attention to equity. Using school census data, we assess changes in the distribution of pre-primary access to determine whether the enrollment trends are similar or different across sub-groups as defined by geographic location (region), gender, and age. We look at the trends by age, given the government has set a policy target to reach all 6-year-olds specifically as a priority to allocate their limited resources efficiently and effectively.

In addition, using available data from Early Grade Reading Assessments, we examine the determinants of pre-primary participation, and the association between participation in pre-primary education and children's school readiness, measured by oral reading fluency in Grades 2 and 3 of primary school, with a comparison before and after the policy reform.

In summary, we aim to answer the following research questions:

(1) To what extent do children from different backgrounds (including by location, gender, and age group) participate in pre-primary education after Ethiopia's large-scale expansion of pre-primary education?
(2) Have the determinants of pre-primary participation, and its association with reading skills in Grades 2 and 3, changed following the large-scale expansion of pre-primary education?

3. Methods

3.1. Data

To answer these research questions, we draw on two key quantitative data sources. To respond to the first research question, we use the Ethiopian Ministry of Education's nationwide school census data from the Education Management Information System (EMIS). This database comprises a comprehensive list of about 36,000 government primary schools in Ethiopia, with a number of characteristics updated annually. We analyze data from 2010/11 to 2016/17 to identify changes in pre-primary enrolment before and after the reform period. For the overall trends in pre-primary enrolment, we use the EMIS data from all 11 regions in Ethiopia and three different types of pre-primary education provision (see Figs. 2 and 3). We also use the EMIS data for the analysis of differences in enrolment patterns by sub-groups such as districts or age groups. For this analysis, we focus on a sub-set of rural districts in 8 regions in which O-Class is likely to be the main type of pre-primary education provision (see Figs. 4 and 5).

To respond to the second research question, we use data from the Early Grade Reading Assessment (EGRA) to conduct a cross-sectional, multivariate analysis of determinants of pre-primary participation and early grade reading skills, measured by oral reading fluency. EGRA is a school-based assessment of early literacy, which was introduced and locally adapted in Ethiopia in 2010. The EGRA datasets were obtained through the USAID Reading Network and USAID Ethiopia. We use two EGRA datasets administered in 2010 (pre-reform) and 2016 (post-reform) to 9121 and 8332 students in Grades 2 and 3 of primary school, respectively, from five regions in Ethiopia, including Tigray, Amhara, Oromia, Somali, and Southern Nations, Nationalities, and People's Regions (SNNP, Sidamu Afoo language only). These five regions cover 94% of Ethiopia's 4–6-year-old population. An advantage of using EGRA data is that the surveys straddle the period of pre-primary education reform, and were administered to representative samples from the same five largest regions over the two time periods. This enables us to compare changes in the determinants of pre-primary participation, and its association with early grade reading skills before and after the policy change. A *common-person* research design (Masters, 1985) was adopted to equate test items from the 2010 and 2016 EGRA instruments, meaning that the same students took part in more than one version of the assessment during the test development process to detect any differences that could be attributed to instrument characteristics, rather than to student characteristics. This process verified the comparability of two test instruments, as well as different administration methods between 2010 and 2016, namely, paper-based versus tablet-based approaches (American Institutes for Research, 2016).

Our analysis includes the following variables from the EGRA datasets:

Pre-primary participation: For the first dependent variable, children were asked to report retrospectively whether s/he had ever been enrolled in pre-primary (i.e., kindergarten, O-Class, or Child-to-Child) classes. We categorized students as having attended pre-primary school if they had attended any of these programs, regardless of the type of provision. Pre-primary participation is thus defined as including a broad set of center-based or classroom-based provisions, including in formal and informal, public and private institutions.

Oral reading fluency: For the second dependent variable, we used oral reading fluency as a measure of early grade reading skills. This approach has been used across a number of different contexts around the world, including in low-income contexts such as Ethiopia (Dubeck, Jukes & Okello, 2012). Oral reading fluency is administered to children one-to-one, with an assessor asking a student to read a passage out loud for a period of time, typically one minute. A student's score is calculated with standardized scores (z-scores) within the sample, based on the number of words read correctly per minute. Previous studies found a high correlation between oral reading fluency and reading comprehension in the U.S. (Fuchs, Fuchs, Hosp & Jenkins, 2001; Hale et al., 2011; McCallum, Sharp, Bell & George, 2004) and Kenya (Piper & Zuilkowski, 2015; Piper, Schroeder & Trudell, 2016). In terms of criterion validity, which compares oral reading fluency with the results of other reading assessments, Vagh (2012) found the EGRA oral reading fluency was highly correlated with the Annual Status of Education Report (ASER) reading test in India, with the correlation coefficients between 0.90 and 0.94.

Child and household characteristics: A range of child and household characteristics, collected from a student's questionnaire, are included as independent variables in the analysis. Drawing on evidence from Ethiopia, on the factors that have been found to relate to pre-primary participation (Vandemoortele, 2018; Woldehanna, 2016), the following characteristics were included: age, gender, father's literacy, mother's literacy, reading materials at home, rural location, and whether the same language is used in the home and at school (see Table 3 for descriptive statistics). In addition, the grade that the child had reached, and the region in which they live, is also taken into account in the model. It was not possible to include a direct measure for socioeconomic status as this was not included in the 2016 EGRA dataset, due to concerns

Table 3
Descriptive statistics of early grade reading assessment 2010, 2016.

	2010		2016		2010			2016		
	Average		Average		Pre (a)	No-Pre (b)	(a)-(b)	Pre (a)	No-Pre (b)	(a)-(b)
	m	(SD)	*m*	(SD)	*m*	*m*	*Diff.*	*m*	*m*	*Diff.*
Pre-primary Attendance	0.14	(0.35)	0.38	(0.49)	–	–	–	–	–	–
Age	10.14	(2.06)	9.84	(1.68)	9.98	10.17	−0.19*	9.43	10.09	−0.66***
Female	0.50	(0.50)	0.49	(0.50)	0.48	0.50	−0.02	0.51	0.48	0.03**
Rural	0.82	(0.38)	0.79	(0.41)	0.66	0.85	−0.19**	0.71	0.84	−0.13***
Mother Tongue textbook	0.75	(0.43)	0.71	(0.45)	0.80	0.74	0.06	0.77	0.68	0.09***
Book at home	0.21	(0.41)	0.44	(0.50)	0.30	0.20	0.10***	0.53	0.38	0.15***
Mother's literacy	0.38	(0.49)	0.47	(0.50)	0.50	0.36	0.14***	0.60	0.38	0.22***
Father's literacy	0.52	(0.50)	0.72	(0.45)	0.64	0.50	0.14***	0.81	0.66	0.15***
Same language of instruction	0.90	(0.30)	0.94	(0.23)	0.85	0.91	−0.06	0.94	0.95	−0.01
ORF (cwpm)	21.78	(21.35)	21.25	(20.93)	23.79	21.42	2.37	23.85	19.66	4.19***
Observations	9,121		8,332		1,245	7,876		2,989	5,343	

Notes. Sampling weights are used to ensure regional representativeness of the sample.
*** $P<0.01$, ** $P<0.05$, * $P<0.1$.

of poor validity given it would have to rely on self-reporting by 8- and 9-year-old children. However, the survey includes indicators for mother's and father's literacy, and the provision of reading materials at home, which are potentially associated with socioeconomic status (Zuilkowski, Mccoy, Jonason & Dowd, 2019).

3.2. Analytical strategy for determinants of pre-primary participation and early grade reading skills in primary school

We use logistical regression models to identify the determinants of pre-primary participation. The estimates are presented by odds ratios, which indicate the direction and statistical significance of the relationship. Average marginal probabilities are also provided to ease interpretation. The odds ratio represents the odds (or likelihood) of attending a pre-primary school given a one-unit increase in the explanatory variable, such as student characteristics. Numbers greater than 1 indicate increased odds, and numbers less than 1 indicate decreased odds. Marginal probabilities represent the probability of the outcome occurring, and are similar to predicted values in linear regression models, but are calculated when all other predictors are at their mean values. The odds ratios along with marginal probabilities at the mean are reported in Table 5.

We then use a multivariate, ordinary least squares regression model to identify the association between pre-primary participation and children's scores in oral reading fluency. The results of this estimation are reported in Table 6.

For both models, we included the entire set of covariates presented in Table 3. All the models also include region dummies to account for between-region differences, recognizing that the patterns of pre-primary participation and oral reading fluency could vary across regions. Given that children are nested by region, we alternatively ran multi-level analysis including two region-level characteristics: a multi-dimensional poverty index, and the share of children enrolled in pre-primary education (analysis available upon request). This model did not affect the results and so we present the model with region dummies. We also include dummies for the grade that the child reached (Grades 2 or 3).

4. Results

We begin by addressing our first research question on the extent to which children from different backgrounds participate in pre-primary school before and after the large-scale expansion of pre-primary education. Fig. 1 shows the number of children who enrolled in kindergarten, O-Class, and Child-to-Child programs from 2008/09 to 2016/17. Around one million children were enrolled in O-Class in the first year of the government's introduction of the reform, which was nearly three times the number who had enrolled in kindergarten the year before.

Over the six years from 2010/11 (immediately before the reform) to 2016/17, the gross enrolment ratio (GER) for all 4- to 6-year-olds multiplied from 5% to 46% (Ministry of Education (MoE) 2017). O-Class enrolments almost tripled over this period, and so is the main driver of the rapid expansion in pre-primary education. As a result, O-Class had served 2.6 million children by 2016/17, catering for about three-quarters of all children who had enrolled in pre-primary education.

Despite rapid growth in the national average enrolment shown in Fig. 1, Fig. 2 illustrates a huge variation in enrolment growth across regions. Prior to the reform, the enrolment rate was extremely low in all regions, with the exception of the more urbanized areas of Addis Ababa, Dire Dawe and Harari, where non-state kindergartens were more likely to be prevalent.

The immediate effects of the reform were uneven. In Afar, Amhara, Oromia, Somali, Benishangul-Gumuz, and Gambella, less than 17% of target children were enrolled in 2011/12. By contrast, SNNP and Tigray reached enrolment rates of 32% and 47% respectively. This suggests that regions were unequally prepared to respond to the 2010 National Policy Framework.

By 2016/17, the two regions (Tigray and SNNP) that were already in a strong position continued to expand access to preschool, approaching a gross enrolment ratio of 93% and 72%, respectively. Amhara made progress towards enrolling about 50% of its children in preschool. Benishangul-Gumuz, Oromia, and Gambella also made some progress, reaching about 30% of preschool-aged children in 2015/16. In contrast, little growth was apparent in two historically disadvantaged regions, Afar and Somali, where less than 10% of children enrolled in pre-primary education.

Another dimension of potential unequal access relates to gender. A persistent enrolment gap was observed in favor of boys, although this appeared less severe than inequalities stemming from the location (Fig. 3). The gender parity index (GPI), which measures the ratio of females to males in school enrolment, has widened slightly from 0.94 to 0.92 between 2010/11 and 2016/17. Compounded by regional disparities in pre-primary access, gender gaps are most noticeable in the 'emerging' regions, with the most significant differences in Somali (0.88) and Benishangul-Gumuz (0.90) in 2016/17.

We further examine how the supply of O-Class provision is distributed across regions. The first indicator we look at is the share of primary schools with O-Class provision by region, recognizing

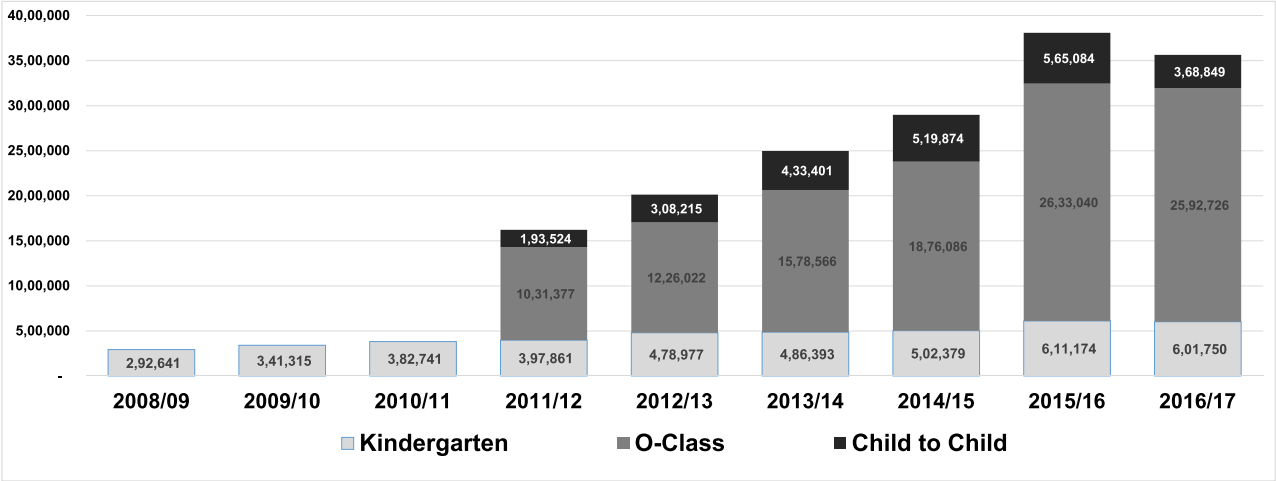

Fig. 1. Enrolment shares by pre-primary education types, 2008/09 to 2016/17
Source: Ministry of Education of Ethiopia, Education Statistics Annual Abstracts 2008/09 to 2016/17.

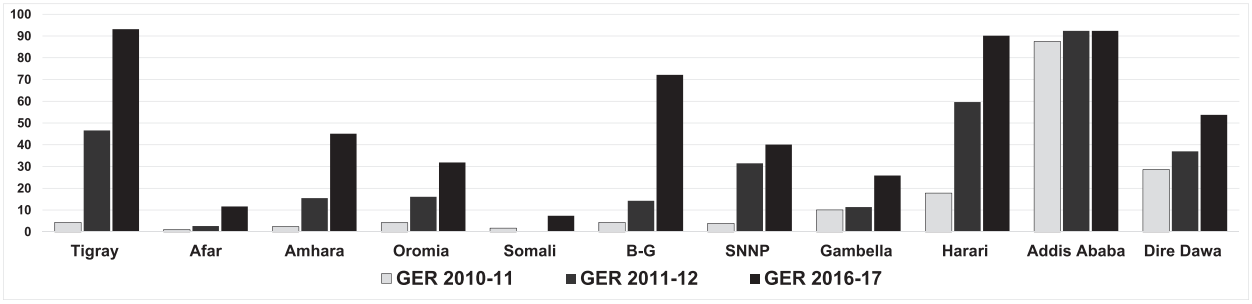

Fig. 2. Gross enrolment ratio in pre-primary education, by region, 2010/11–2016/17
Notes: The gross enrolment ratios compare current enrolment data with an extrapolation of age-specific population data from the 2007 census. The figure includes enrolment rates from three types of pre-primary, including kindergarten, O-Class, and child-to-child program.
Sources: Ministry of Education of Ethiopia, Education Statistics Annual Abstracts 2010/11 & 2016/17.

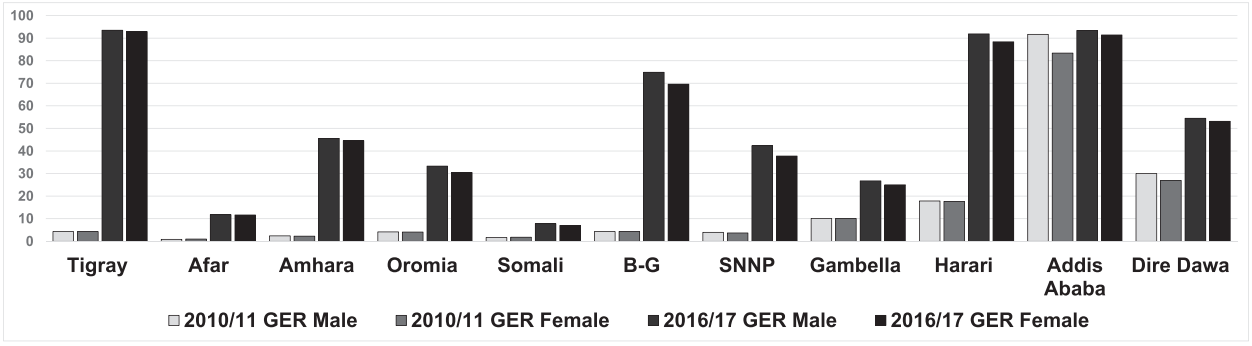

Fig. 3. Gross enrolment ratio in pre-primary education by gender, 2010/11–2016/17
Sources: Ministry of Education of Ethiopia, Education Statistics Annual Abstracts 2010/11 & 2016/17.

that the Ethiopian government aims to have an O-Class in each government school to provide a path to achieving at least one year of early learning for every child before they start Grade 1. For this analysis, we use information from a sub-set of 625 'rural' districts (*woredas*) from 8 regions in Ethiopia, for which O-Class is likely to be the main form of pre-primary education provision.

Fig. 4 presents the share of primary schools with an O-Class for each of these eight regions between 2014/15 and 2016/17. The line at 1.0 indicates full coverage, meaning that there is an O-Class in every primary school. Five years after O-Class was introduced in 2010, there was a steep increase in the share of primary schools establishing an O-Class. Notably, the coverage of O-Class had reached nearly 80% in Tigray, Amhara, Oromia, Benishangul-Gumuz, and SNNP by 2016/17, meaning that at least four out of five schools offered O-Class in these regions. By contrast, coverage was low in three of the four emerging regions: in Afar, Gambella, and Somali, only about one in three schools established an O-Class. Thus, despite government policies of affirmative action towards emerging regions, including longstanding programs of 'special support' in the education sector (Khan, Faguet, Gaukler & Mekasha, 2014), three emerging regions have the lowest rates of O-Class coverage.

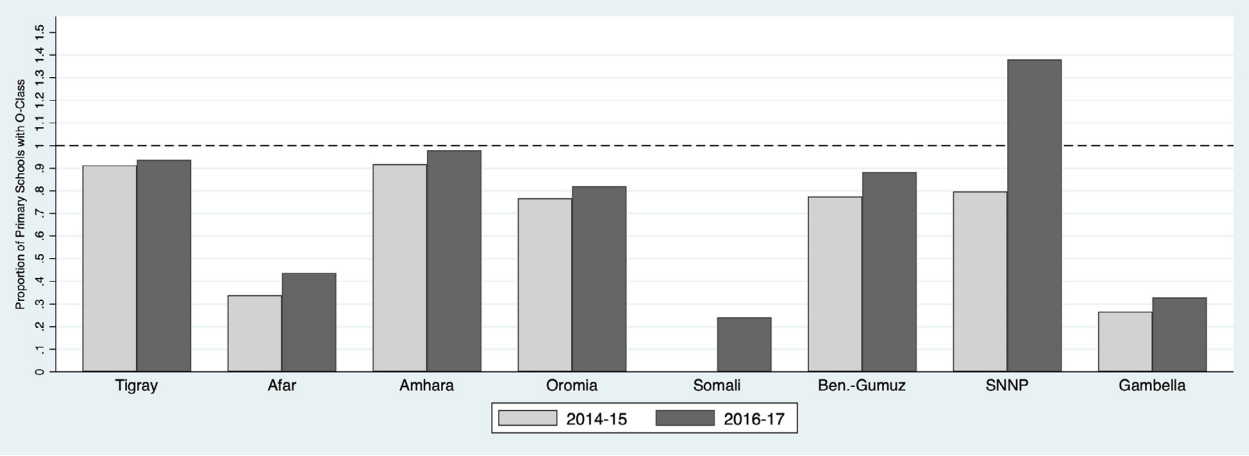

Fig. 4. Share of primary schools with an O-Class, by region, 2014/15 and 2016/17
Notes: The sample includes 625 'rural' districts (*woredas*) from 8 regions in Ethiopia. Somali did not have data for 2014/15. In SNNP, some O-Classes were established away from school sites (e.g., in agricultural or community centers), and so this has resulted in the number of O-Classes exceeding the number of primary schools in 2016/17. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
Sources: Authors' calculation based on Education Management and Information System data (MoE, 2014/15 & 2016/17).

Table 4
Relationship between educational attainment and O-Class coverage by district, 2016/17.

Districts' G2/G1 enrolment ratio	< 0.55	0.60 to 0.70	> 0.90
Districts' O-Class coverage	62 percent	76 percent	91 percent

Notes. The sample includes 625 'rural' districts (*woredas*) from 8 regions in Ethiopia. The pairwise correlation coefficient is $r\ (1597) = 0.172$ ($P < 0.001$).

Pre-primary education is often seen as a means to address problems of high dropout rates in Grade 1 of primary school (Crouch & Merseth, 2017; Weatherholt, Jordan, Crouch, Barnett & Pressley, 2019). Improving grade progression through the early years of primary schooling has also been an important rationale for the introduction of pre-primary education in Ethiopia. Table 4 shows the relationship between the primary Grade 2 to Grade 1 enrolment ratio and O-Class coverage among districts (*woredas*). We use this ratio as a proxy of smooth grade progression across the 625 rural districts included in this analysis. As Table 4 indicates, there is a small but positive relationship between higher O-Class coverage and progression from Grade 1 to Grade 2. While it is not possible to identify causality in the relationship, this potentially implies that higher O-Class coverage is positively associated with early grade progression, consistent with the findings from a previous study in Uganda (Weatherholt et al., 2019). It also implies that O-Class expansion is occurring first in areas of the country that already have better grade progression and resources, while the schools and woredas which need it most continue to have lower rates of O-Class coverage.

As noted, the intention has been for the initial expansion of O-Class to focus on 6-year-olds. Even where there is an O-Class in a nearby school, the enrolment of 6-year-olds depends on a number of factors, including policies for enrolment within regions which may not prioritize access for 6-year-olds; demand among families which may depend on awareness of the availability and benefits of pre-primary education; as well as on barriers such as travel requirements and priorities for time-use among children (Tafere & Pankhurst, 2015).

Fig. 5 shows that only 42% of children enrolled in O-Class are 6-year-olds, the age targeted by the government, while more than half are under-age (4-year-olds and 5-year-olds). Tigray is the exception, where more than 90% of those enrolled in O-Class are 6-year-olds. In the other seven regions included in our analysis, the proportion of 6-year-olds in O-Class is low, varying from 25% in Somali to 48% in Benishangul-Gumuz. Each region has a small share of over-age children, ranging between 1 and 9 percent.

The large proportion of under-age children in pre-primary classes could mean that GER targets are being achieved, even though not all children receive at least one year of early learning before entering Grade 1. For example, while SNNP might have reached a GER of 70%, a significant step towards achieving national targets, only an estimated 50% of 6-year-olds participated in O-Class. Similarly, in Gambella, which has achieved a GER of 55%, only around 20% of 6-year-olds participated in O-Class. If some younger children spend more than one year in O-Class, the GER will inflate the reality of the reach of pre-primary education.

In summary, pre-primary education enrolment rates have risen rapidly, particularly for O-Class. As has been shown, however, this has been achieved with limited coverage of O-Class among schools in more disadvantaged regions, and with less than half of those enrolled from the target population of 6-year-olds.

4.1. Determinants of pre-primary participation and early grade reading skills

Having identified patterns and trends in access to pre-primary school, we now turn to our second area of investigation, namely the determinants of pre-primary participation, and early grade reading skills in Grades 2 and 3 of primary school. For this analysis, we draw on EGRA data from 2010 to 2016 to determine whether pre-primary access is similarly driven by students' sociodemographic characteristics, such as gender, location, family wealth and parents' education across the two time periods, which relate to before and after the reforms. Descriptive statistics from the 2010 and 2016 EGRA are presented in Table 3. Between 2010 and 2016, the pre-primary enrolment rate increased from 14% to 38% in the EGRA sample, which is less steep but consistent with the enrolment trends captured by the school census data (EMIS) over the same period (from 5% to 46%). The difference can in part be explained by the different areas covered by the two sources. EGRA is a regionally representative sample drawn from five selected regions, which excludes some urban areas where enrolment tends to be higher, whereas the EMIS is a nationwide school census.

Table 5 presents results from logitistic regression models that examine the determinants of pre-primary participation before (2010) and after (2016) the expansion. The child's age and gen-

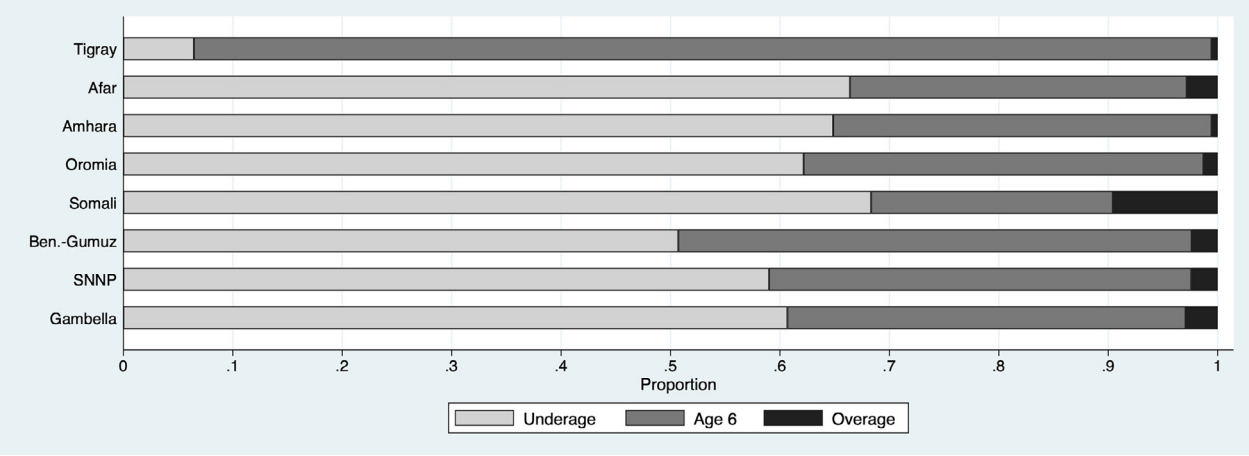

Fig. 5. O-Class children according to age group, by region, 2016/17.
Source: Authors' calculation based on Education Management and Information System data (MoE, 2016/17). The sample includes 625 'rural' districts (*woredas*) from 8 regions in Ethiopia. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table 5
Determinants of pre-primary attendance, 2010 and 2016.

	2010			2016		
	Odds Ratio	(SE)	Marginal Prob.	Odds Ratio	(SE)	Marginal Prob.
Age	0.90	(0.13)	−0.01	0.86	(0.17)	−0.03
Female	0.86	(0.09)	−0.02	1.03	(0.07)	0.01
Father's literacy	1.24**	(0.16)	0.02*	1.33***	(0.11)	0.05***
Mother's literacy	1.36***	(0.18)	0.04**	1.72***	(0.12)	0.10***
Reading materials at home	1.73***	(0.21)	0.06***	1.83***	(0.12)	0.11***
Rural location	0.45***	(0.06)	−0.09***	0.63***	(0.06)	−0.09***
Same language home/school	0.61**	(0.13)	−0.01	0.42***	(0.08)	−0.08***
Constant	0.99	(0.87)		30.10***	(33.87)	
Grade dummies	Yes			Yes		
Region dummies	Yes			Yes		
Observations	9121			8332		

Notes. All models include sampling weight. Robust standard errors clustered at the school level in parentheses. Marginal probabilities present marginal effects at the mean. Coefficients omitted for grade and regional dummy variables. *** $P<0.01$, ** $P<0.05$, * $P<0.1$.

der are not found to be associated significantly with pre-primary participation in either time period, suggesting limited gender bias in pre-primary participation at an early age. However, the results show that family characteristics play a significant role in determining pre-primary participation in both 2010 and 2016. Father's and mother's literacy and having reading materials at home were strongly associated with a higher probability that a child would attend preschool, with the marginal probabilities nearly doubling between 2010 and 2016. Having reading materials at home was the strongest predictor for pre-primary participation after the reform: this was associated with a 6 and 10 percentage point higher probability of pre-primary school participation in 2010 and 2016, respectively. Children with a literate mother had a 3 and 10 percentage point higher probability of attending pre-primary school than children with an illiterate mother in each of the time periods. Mother's literacy was a stronger determinant of pre-primary participation than the father's literacy.

Urban or rural residency was also a strong predictor for pre-primary participation. In both 2010 and 2016, children living in rural areas were about 9 percentage points less likely to attend pre-primary school than those in urban areas. The variable on the same language being used at home and at school was found to be a non-significant predictor of pre-primary participation in 2010, but it gained significance in 2016. According to the sub-group analysis by region (available upon request), after the massive expansion, reading materials at home remained as the strongest determinant of pre-primary participation in Tigray, Somali and SNNPR, while mother's literacy was the strongest determinant in Amhara and Oromia.

Overall, therefore, it appears that variables potentially associated with socioeconomic status, such as parental literacy and the availability of books at home, affect pre-primary participation both before and after the reform. Despite the expansion of enrolment in rural areas, living in these locations continues to be negatively associated with pre-primary participation. As such, despite the growth in pre-primary enrolment, the factors affecting who is able to participate have not changed, suggesting that concerns about unequal access to pre-primary schooling remain.

We next explore the association between pre-primary participation and early grade reading performance using Ordinary Least Squares (OLS) regression (Table 6). Results demonstrate that pre-primary participation is associated with learning gains of 0.20 standard deviations (SD) in oral reading fluency, on average, after controlling for other student characteristics in 2016 (after the large-scale expansion). In 2016, there is also a stronger association between pre-primary education and oral reading fluency for children aged 8 and 9, namely those who are enrolled at the appropriate age for their grade, compared with those who are under- or over-age in Grades 2 and 3. By contrast, before the expansion in 2010, pre-primary participation was not significantly associated with student reading performance, after taking account of other factors. Gender, father's literacy, living in a rural area, and having reading materials at home are consistently strong predictors for student performance in 2010 and 2016. Analysis by each region

Table 6
Determinants of oral reading fluency, 2010 and 2016.

	2010		2016	
	Oral Reading Fluency	(SE)	Oral Reading Fluency	(SE)
Pre-primary	0.02	(0.07)	0.20***	(0.04)
Age	0.09*	(0.05)	0.03	(0.08)
Female	−0.15***	(0.05)	0.11***	(0.03)
Father's literacy	0.14***	(0.05)	0.15***	(0.03)
Mother's literacy	−0.02	(0.05)	0.03	(0.03)
Reading materials at home	0.29***	(0.08)	0.26***	(0.03)
Rural location	−0.34***	(0.09)	−0.30***	(0.08)
Same language home/school	0.09	(0.13)	0.03	(0.09)
Constant	−1.26***	(0.28)	−0.81*	(0.42)
Grade dummies	Yes		Yes	
Region dummies	Yes		Yes	
R^2	0.20		0.26	
Observations	9121		8332	

Notes. All models include sampling weight. Robust standard errors clustered at the school level in parentheses. Coefficients omitted for grade and regional dummy variables. Oral reading fluency in standardized score (z-score). *** $P<0.01$, ** $P<0.05$, * $P<0.1$.

displays similar patterns to the average associations (The results by region are available upon request).

In summary, children from more advantaged households consistently have a higher chance to attend pre-primary school both before and after the reform, and pre-primary participation is a strong determinant of students' early grade reading skills after the reform but not before.

5. Discussion

This study aimed to examine the extent to which the large-scale expansion of pre-primary education has influenced children's access to pre-primary education during the major education reform in Ethiopia. Given the government's target of achieving equitable access for all 6-year-old children prior to primary schooling (Ministry of Education, 2015), a further aim was to determine if early learning opportunities were distributed equitably across subgroups with respect to geographical location, gender, and age.

Overall, our analysis shows that, despite rapid and consistent growth in national average enrolment, there is huge variation in enrolment growth and pre-primary coverage across regions and age-appropriate enrolment. Only a small proportion of the target group of 6-year-old children attend preschool, with those from disadvantaged areas less likely to do so, and under-age enrolment is common in some regions. The reform appears, therefore, to have benefited areas that are better resourced. However, the schools and the communities which are likely to need pre-primary education the most – and which the government has identified as priority for the services – have lower rates of coverage of O-Class. Our findings mirror emerging evidence from low- and lower-middle income countries of unequal expansion of primary schooling in the Millennium Development Goal and Education for All period between 2000 and 2015 (Lewin & Sabates, 2012; Rose, 2015). This suggests that expansion alone has limited ability to reduce disparities in educational opportunity for the most vulnerable children.

Why might this variation in expansion have occurred? One reason might be that expansion has happened faster in communities which conventionally provided substantial support for pre-primary provision even before the reform. As such, their preferences and demands are likely to have influenced the expansion of pre-primary education. Top-down planning and weak information flow among stakeholders at different levels of the system may lead to regional disparities in enrolment growth, linked to variations in community awareness, support, and resources for the establishment of early learning programs (Rossiter et al., 2018).

Another plausible explanation is that insufficient public financing has been committed to pre-primary education, which is a global problem, especially in low- and middle-income countries (Richter et al., 2017; Zubairi & Rose, 2017). In Ethiopia, given that the share of federal budget on pre-primary education within total education budget has remained at just 3% after the major reform, it is plausible that a link exists between the level of resources of each region, and their ability to be responsive to the policy. While we cannot directly infer the cause of the disparity in the uptake of pre-primary education by location, our findings support the value of giving further consideration to targeting public funding towards vulnerable populations.

While the average gender gap in enrolment is less severe than regional variance, it is most noticeable in disadvantaged regions, suggesting a potential double disadvantage. It is plausible that other dimensions of disadvantage such as poverty and disability intersect with gender to reinforce unequal access within regions, although available school census data do not allow us to provide such evidence.

With respect to age-appropriate enrolment in preschool, we find some evidence that under-age enrolment in O-Class is prevalent across all regions (with the exception of Tigray), regardless of their resource levels or regulations. As such, despite the national policy aimed at admitting 6-year-olds to O-Class, in most regions, the majority of 6-year-olds are not yet benefiting from this provision. Children who have entered early may be more likely to stay in O-Class for more than a year, before progressing to Grade 1 of primary school, thus taking the space of eligible children.

The multi-age structure of O-Class also has potential implications for the quality of provision. O-Class is designed to be developmentally appropriate for 6-year-olds, and so multi-age classes often with younger children can weaken the link between curriculum and age-appropriate pedagogy. Problems in age-appropriate enrolment and progression are observed in some other low- and lower-middle income countries, but have been found to be more likely to be associated with over-age enrolment in pre-primary education (Alcott, Banerji, Bhattacharjea, Nanda & Ramanujan, 2018 for India; Oxford Policy Management, 2018 for Liberia). In Liberia, for example, nearly two thirds of students enrolled in pre-primary education are aged 6 or older. Even though many principals, families, and government officials are aware of this problem, they have not identified over-age enrolment as a priority, nor have they allocated any resources to address this. Similarly, in Ethiopia, there

are currently no specific measures, such as sensitization of communities, or strict regulations, to address the issue of under-age enrolment. Thus far, no in-depth study has explored issues related to under-age enrolment in pre-primary education in Ethiopia, and future research should pay attention to the potential causes and consequences of this.

Our findings also suggest that urban-rural location and parental literacy continue to be powerful predictors of pre-primary participation, even in the context where overall enrolment has increased rapidly. This is aligned with previous research in Kenya and Tanzania, showing that between 1996 and 2007 children of educated mothers and those from more affluent households are more likely to have attended preschool, irrespective of the level and change in national average enrolment rates (Bietenbeck, Ericsson & Wamalwa, 2017). These findings have implications for pre-primary education policies in low- and lower-middle income countries, and in particular, for policies designed to achieve the SDG target of universal pre-primary access. Increasing pre-primary participation will not be achieved unless barriers to pre-primary uptake for the most vulnerable children populations are identified and addressed, taking account of both supply and demand-related constraints.

Our study finds a strong association between pre-primary participation and reading skills in the early grades of primary school for the post-reform period, but not for the pre-reform period. This may seem counterintuitive, given that there was a sudden influx into the system of many previously excluded young children, which could be expected to put pressure on the ability to ensure they are prepared for primary school. One plausible explanation could be the potential improvement in the level of parents' education and their socioeconomic status, which coincided with the massive expansion of pre-primary education: between 2005/06 and 2015/16, Ethiopia's economy experienced strong growth averaging 10.3% a year, compared to a regional average of 5.4% (World Bank, 2018). Between 2011 and 2016, female and male literacy rates also increased from 27% to 40%, and from 48% to 62%, respectively (Central Statistical Agency 2012; Central Statistical Agency 2016). Similarly, in the EGRA samples, there was a greater increase in parents who were literate and who had books at home amongst children who were enrolled in pre-primary education, compared with those who were not. A previous study reveals that these characteristics are also strong predictors for early grade reading fluency in Ethiopia (Dowd, Hassen, Mohammed, Gebreegziabher & Kefey, 2011). In other words, the beneficiaries of economic growth in Ethiopia are likely also to be the beneficiaries of pre-primary education reform. Meanwhile, those who remained among the more disadvantaged in socioeconomic terms were more likely to have been left behind in terms of pre-primary education expansion.

Although previous evidence in Ethiopia showed positive and significant relationships between pre-primary participation and child outcomes before the pre-primary education reform (Woldehanna & Araya, 2017; Woldehanna & Gebremedhin, 2012), our findings from the pre-reform cohort did not show such significant relationships. This could be attributed to the different sample composition of the two studies. Sample children in previous studies were mainly based in urban contexts, whereas the EGRA 2010 sample used in this study was predominately rural, in line with the characteristics of the national population. Also, rural children were more likely to attend community-based preschools run by NGOs or religious organizations, which were likely to provide lower-quality services than urban kindergartens run by the private sector. For example, community-based preschools in rural areas are typically taught by a single teacher with no formal training, except for perhaps in religious education, and who hosts students either in his/her own home, or in the open air (Woodhead, 2009). This could partially explain why there is no significant relationship between pre-primary education and early grade reading outcomes before the reform in our study. Due to the absence of data on the quality of pre-primary education, we were unable to explore this further.

Our findings reaffirm previous evidence from one region in Ethiopia (Dowd et al., 2016; Wolf et al., 2017), extending this to 5 regions of the country where 94 percent of Ethiopia's 4- to 6-year-old children live following the reform. Both our study and the previous studies identify that participation in pre-primary education (including O-class) was a strong predictor of the improvement in children's learning and development outcomes.

5.1. Limitations

There are several limitations to this work that are important to note, and to consider for future research on this topic in the future. First, the school census data (EMIS) used in the paper is the best available source of population-level information about pre-primary enrolment during the reform period. However, while they provide descriptive information on enrolment patterns of about 7 million preschool-aged children, these are not able to provide an explanation of the observed trends.

Second, the associations between participation in pre-primary education and oral reading fluency in this study cannot directly be seen as causal. Although EGRA provides a wide range of data on students' early grade reading skills and child- and household-level characteristics, our estimates may be biased if unobserved characteristics contribute to the differences in early learning outcomes between children who have attended pre-primary school and those who have not. In particular, given that this assessment was administered in schools, information about household characteristics is somewhat limited compared to household-based surveys, notably with respect to the household's socioeconomic status.

Third, a lack of data on pre-primary education characteristics, such as types and quality, limits the conclusions that can be drawn in this study, about the meaningful pathways from pre-primary school to learning outcomes in primary school. There are concerns that quality could be compromised as access expands, especially in resource-constrained settings (Spier et al., 2019). In this respect, some evidence cautions that adding a pre-primary class to existing primary schools can lead to a downward extension of poor quality and under-resourced schooling for younger children (Dawes, Biersteker & Hendricks, 2012). Although we might find that a region or a population sub-group has achieved higher pre-primary enrolment since the reform, we cannot assess the quality of the pre-primary education provision this group receives, and whether or not it leads to better developmental outcomes for children. Given that low-quality pre-primary education could actually be detrimental to child development (Engle et al., 2011; Wolf et al., 2018), we need to interpret the findings with caution. However, the positive association between pre-primary participation and reading skills in Grade 2 and 3 following the expansion, even once children's background characteristics are taken into account, suggests that pre-primary provision is benefiting those who are able to access it.

6. Conclusions and implications

In summary, our study contributes to the literature on pre-primary education in low- and lower-middle income countries by showing that, even after the massive expansion in pre-primary enrolment in Ethiopia, inequalities in access to pre-primary education remain. Our evidence further shows that participation in pre-primary education is associated with better early grade reading skills in primary school after the government's reform. This suggests that children from disadvantaged backgrounds who are still less likely to have participated in pre-primary education do not

have the same opportunity to progress in the early years of primary school.

Overall, the positive relationship between pre-primary participation and children's performance in primary school after the massive expansion reaffirms the importance of pre-primary education in improving children's school readiness. Improving equitable access to quality provision will remain imperative, given evidence from low- and middle-income countries, which shows high-quality pre-primary education could have a positive effect on child development (Engle et al., 2011).

The results of our study suggest some implications for policymakers in Ethiopia, as well as other low- and lower-middle income countries that are considering how best to scale up pre-primary education programs to meet the United Nations' SDG target. In low-income countries, pre-primary enrolment has remained stagnant at just 20% on average. Ethiopia's experience indicates that rapid expansion is possible and can benefit school readiness. This suggests that other low-income countries would also benefit from expanding their provision. However, the analysis in this paper indicates that they would benefit from paying particular attention to ensuring that pre-primary provision reaches the most vulnerable. As the paper identifies, countries are likely to benefit from tackling disadvantage from these early years with respect to narrowing gaps in learning outcomes in primary school.

Disclosures

We have no conflicts of interest to disclose.

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CRediT authorship contribution statement

Janice H. Kim: Conceptualization, Methodology, Formal analysis, Writing – original draft, Visualization. **Belay H. Hailu:** Investigation, Writing – review & editing. **Pauline M. Rose:** Funding acquisition, Supervision, Conceptualization, Methodology, Writing – original draft. **Jack Rossiter:** Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Visualization. **Tirussew Teferra:** Investigation, Writing – review & editing. **Tassew Woldehanna:** Funding acquisition, Investigation, Supervision, Writing – review & editing.

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