Global Inequalities in Human Capital Formation: Provision of Pre-Primary Education Based on Data for 163 Countries

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Abstract

Inadequate age-appropriate preparation to start primary school is one of key factors of persisting educational inequalities. Attending pre-primary educational programs has been shown to boost school readiness and success in primary school by many studies that focused on individual programs, countries, or small groups of countries. However, until now, national policies that assure equal access to early child education have not been evaluated on a global scale. By converting qualitative national reports into quantitative global data, this study created a new, unique, cross-country comparable dataset on policies of pre-primary education provision for 163 countries. The data are analyzed to examine how the provision of pre-primary education varies across country income levels and world regions and also to assess its association with pre-primary school enrolment and primary school graduation rates. Findings show global gaps in providing young children an opportunity to be prepared for entering primary education: a minority of countries (43%) provides tuition-free pre-primary education; only 3% of countries that do so are low-income. Estimated regressions indicate that for low- and low-middle-income countries, tuition-free and tuition-free and compulsory provisions of pre-primary education were positively associated with higher net enrolment rates at pre-primary and with increased graduation rates at primary levels. Policy implications are subsequently described.

Keywords: educational policy, pre-primary education, development, primary school completion, comparative education, graduation rate, enrolment rate
1. Introduction

Following a series of global commitments to increase access to primary education throughout the twentieth century and early 2000s,\(^1\) the world has made significant progress in increasing primary enrolment rates, while simultaneously reducing the gender gap in enrolment. In developing regions, the primary school net enrolment rates increased from 83% in 2000 to an estimated 91% in 2015, while the total number of out-of-school children of primary school age fell by nearly half over the same time period (United Nations, 2015). In eleven countries in Sub-Saharan Africa, primary enrolment rates rose at least 20 percentage points from 1999 to 2012 (UNESCO, 2015).

Evidence suggests that eliminating tuition fees has been one of the most important drivers of primary enrolment increases, particularly in low-income environments (Kattan, 2006). For example, a 2007 evaluation of 32 low-income countries that instituted school user fees as a component of the Structural Adjustment Programs of the 1980s revealed that countries experienced increases in enrolment after eliminating these fees, and that countries with well-planned strategies of removing fees experienced little or no adverse effect on the quality of education (Nielsen, 2009). Studies of individual countries find similar results. A year after Malawi introduced free primary education in 1994, enrolment rates increased 51%; in Burundi, which eliminated tuition in 2006, net primary school enrolment rose from 41% in 2000 to 94% in 2010 (UNICEF and the World Bank, 2009; UN Statistics Division, 2013). Eliminating fees may also reduce socioeconomic gaps in education access, suggesting school fees are particularly

\(^1\) See, e.g., the Universal Declaration of Human Rights, Art. 26 (UN General Assembly, 1948); the U.N. Convention on the Rights of the Child, Art. 28 (UN General Assembly 1989); Millennium Development Goal 2, Achieve Universal Primary Education (UN General Assembly, 2000); Education for All goals (UNESCO, 1990 and 2010).
significant barriers for lower-income families. In Uganda, for example, after fee abolition in 1997, the difference in primary school attendance rates between the bottom and the top quintiles decreased from 43 percentage points (46% versus 89%) in 1992 to just 11 percentage points (78% versus 89%) in 1997 (Deininger, 2003). A comparison of enrolment rates in Burundi, where primary school fees were removed in 2005, and Democratic Republic of the Congo, where they were removed only in 2010, showed significantly faster and greater increase in enrolment in the former as compared to the latter (UNESCO, 2014a). The vast majority of countries, more than nine in ten, have legislated tuition-free at the primary level, and just 15 nations have yet to make primary education free and compulsory (Heymann, 2013; de Guzman Chorny et al., 2014).

Yet despite notable gains in enrolment, too few students are completing primary school. In its review of global progress towards the MDGs in the area of education, UNESCO reports that between 1999 and 2011, the fraction of children that remain in school from the first to the last grade of primary school remained unchanged at 75%. The latest data available, for the school year ending in 2012, show no improvement globally with the same wide variation by region and income. In sub-Saharan Africa, just 56% of children that enroll in primary school reach the last grade. The rate in South and West Asia was slightly higher 64% but still far below North America and Western Europe, 95%. In low-income countries, just 55% of children who start elementary school reach the last grade compared with 78% in middle-income nations and 96% in high-income countries (UNESCO, 2015). The most recent report from the Education for All movement, a partnership of four UN agencies and the World Bank, identified inadequate completion as one of the main challenges to achieving universal primary education (UNESCO,
2015). While there is some evidence showing that making primary school compulsory supports completion (Zhang and Minxia, 2006; Brunello et al., 2009), given the persistent gap between enrolment and completion rates, it is critical to identify the other promising policies and approaches that best support students to finish primary school in order to truly fulfill the global community’s commitment to expanding education for all.

Improving access to and completion of pre-primary school may be a part of the solution. This theory finds support in both the vast literature on early childhood development, which has established that early education has a significant effect on children’s cognitive development and learning outcomes later in life (Shonkoff and Phillips, 2000; Heckman, 2006; Knudsen et al., 2006; Grantham-McGregor et al., 2007), as well as a range of studies specifically examining the impacts of pre-primary completion on primary achievement and graduation rates. For example, in 89 percent of 65 countries served by the Programme for International Student Assessment (PISA), longer periods of pre-primary education raised educational outcomes regardless of socio-economic background (OECD, 2011). In a longitudinal study in Argentina, a year of public pre-primary school attendance was associated with an increase of 23 percent of the standard deviation of the distribution of test scores in Spanish and mathematics in primary school (Berlinski et al., 2009). Attendance in preschool for at least a year was associated with higher fourth grade test scores in mathematics, reading, and social sciences in a cross-sectional study of 159,000 children in Chile (Cortázar, 2015). Similar results were found in Nepal where at least 95 percent of the 935 children who attended various early child development programs received dramatically better year-end examination scores than children who did not come from such programs (Save the Children, 2003). Likewise, studies in Ghana and Cape Verde
documented a positive association between preschool attendance and raw test scores (Jaramillo and Tietjen, 2001). Furthermore, a three-year study in rural Bangladesh revealed significantly higher first and second grade primary school achievement by 180 graduates of 30 pre-primary programs compared to children who did not attend pre-primary schools (Aboud and Hossain, 2011). Strong positive associations between preschool completion and decreased grade-repetition rates in primary school were observed in Brazil by a cross-sectional study based on national surveys (World Bank, 2001) and in the United States in a small-scale controlled experiment that involved 111 children (Barnett and Masse, 2007). A longitudinal retrospective analysis over five years in Uruguay found that children who had attended a pre-primary educational program were more likely to be enrolled in primary school than their siblings who had not (Berlinski et al., 2008). Much evidence is also available showing that pre-primary education especially benefits poor children for both OECD and non-OECD countries (see Havnes and Mogstad (2011) for Norway; Deming (2009) for the US; Dumas and Lefranc (2010) for France; Mingat and Seurat (2011) for Madagascar; or Martinez et al. (2012) for Mozambique).

However, to ensure that children reap the benefits of early education, including the potential impacts on primary completion, they first must enroll in a pre-primary education. By contrast to the evidence base on factors shaping primary enrolment, little is known about which policy choices have the greatest impact on pre-primary enrolment. Given the success of tuition-free policies at the primary level, it is worth examining whether making pre-primary school tuition-free has a correspondingly positive impact on pre-primary access.
Previously, there has been no quantitative, comparable monitoring of important details about the provision of pre-primary education. UNICEF and the World Bank gather basic information and provide country reports on provision of pre-primary education (UNESCO, 2015). Yet important dimensions of pre-primary education data—including whether provision is free and corresponding duration of provision—is not available in a readily comparable form. Furthermore, although the studies described above suggest a positive association between pre-primary education and primary outcomes in some individual countries, little is known about how pre-primary shapes primary outcomes across low- and middle-income countries.

Comparative studies across large numbers of countries come from OECD countries only. While studies in non-OECD countries use comparison groups of those children who did not attend pre-primary education programs, they examine the effect of pre-primary educational programs using either small samples or within-country cohort experiences. To our knowledge, there have been no studies to date examining on a global scale the impact of increased access to free pre-primary school on primary completion.

This paper represents the first effort to address three questions: Where does the world stand on preparing children for success in primary school by providing pre-primary education? Is there a relationship between free provision and rates of enrolment in pre-primary education on a global scale? Does provision of free pre-primary education play a role in primary school completion based on the global data?

To answer these questions, first, we assess the status of pre-primary education provision in 163 countries based on the sources available as of 2015. We examine the availability and duration of free pre-primary education and investigate how pre-primary
education provision varies by country income and world region. Next, we utilize the latest
available data to examine whether free pre-primary education provision is associated with
school enrolment at the pre-primary level. Finally, we analyze the relationship between the
provision of free pre-primary education and primary education completion.

2. Data

2.1. Data sources

To identify which countries have made pre-primary education tuition-free, we created a
new global database that captures policies on the provision of pre-primary education at a
national level. The quantitatively comparable data were created from reviewing and coding
national government reports to UNESCO International Bureau of Education and the
International Conference on Education Reports. These reports were used as our main source
because they provide comparable qualitative data on the largest number of nations. The
reports contained a comprehensive discussion of national educational systems, including
description of educational principles, educational laws and basic regulations, administration
and management, structure and organization, and educational process. When data were
incomplete or unavailable through these sources, we supplemented them with information
available through the following sources: World Bank SABER country reports (on education
policy for two Sub-Saharan African countries, one low- and one upper-middle-income),
International Council for Open and Distance Education country profiles (on education policy for
four small Pacific lower-middle-income countries), official documentation accessible through
Planipolis (to corroborate unclear information in the reports), a portal of education plans from
UNESCO member states (on education policy for one Sub-Saharan African lower-middle-income
country and four Latin American lower-middle- and upper-middle-income countries), and
Eurydice-Network (on education policy in one European high-income country and one Central
Asian low-income country). The information in the reports and documents was systematically
coded into a set of quantitative variables. To assure comparability, a coding framework was
established to capture provision details and allow meaningful comparisons across programs
instituted by different nations. At least two researchers separately reviewed sources for each
country and compared coding decisions to confirm standard interpretation and to reduce
potential for human error or inconsistency.

To increase comparability of policies across countries, we took into account that nations
refer to pre-primary education using different terms, including early childhood education,
nursery school, pre-primary program, preschool, kindergarten, or preparatory school. We used
UNESCO’s International Standard Classification of Education definition of pre-primary
education, or Level 0 education, which is “ISCED level 0 programmes target children below the
age of entry into ISCED level 1. There are two categories of ISCED level 0 programmes: early
childhood educational development and pre-primary education. The former has educational
content designed for younger children (in the age range of 0 to 2 years), whilst the latter is
designed for children from age 3 years to the start of primary education.” (UNESCO, 2012). If
the entrance age to primary school is five, we examined the educational programs provided for
children aged three and four. If the first year of primary education is termed a “reception year”
or similarly, we considered it a part of primary education and it was not captured as a pre-
primary program in the dataset. When reports contain pre-primary education policy
information on subnational level, our data reflect provisions that apply to the majority of
territorial units in the country.

The data on national enrollment and graduation rates were obtained from the UNESCO
Institute of Statistics Data Centre (UNESCO IS, 2015).

The data on countries’ per capita income, level of urbanization, geographic region, and
national income level were drawn from the World Development Indicators Data (World Bank,
2015a).

2.3. Sample characteristics

The sample examined for pre-primary education aspects consists of the 163 UN member
states for which recent data were available in the UNESCO reports or other sources. The sample
includes 84% of all UN countries (Table 1). Overall, the distribution of countries by income and
region in our sample is comparable to the income and region distribution for all 193 UN
member states. Compared to all UN member states, the sample of countries with pre-primary
education data had a slightly higher percentage of upper-middle-income (28% in our sample vs.
27% in all UN member states) and high-income (28% vs. 26%) countries and a slightly lower
percentage of low-income countries (15% vs. 18%). Our sample also included a slightly higher
percentage of countries from the Americas region (20% vs. 18%) and Europe and Central Asia
(31% vs. 28%), and slightly lower percentage of countries from the Middle East and North Africa
(9% vs. 10%) and Sub-Saharan Africa (21% vs. 25%). Although it would be ideal to include the
data for all 163 countries to analyze the relationships between pre-primary education provision
and A) pre-primary enrolment and B) primary school completion, the availability of outcome
and control variables data reduced our sample to 121 countries for the former analysis and to
64 countries for the latter.

**Table 1: Characteristics of countries used in the analyses by level of income and world region**

<table>
<thead>
<tr>
<th>Level of income</th>
<th>Sample in descriptive analysis of pre-primary provision (n=163)</th>
<th>Sample in pre-primary net enrolment rate regression (n=121)</th>
<th>Sample in primary graduation rate regression (n=64)</th>
<th>UN member states (n=193)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>15%</td>
<td>15%</td>
<td>19%</td>
<td>18%</td>
</tr>
<tr>
<td>Lower-middle</td>
<td>29%</td>
<td>22%</td>
<td>38%</td>
<td>29%</td>
</tr>
<tr>
<td>Upper-middle</td>
<td>28%</td>
<td>32%</td>
<td>34%</td>
<td>27%</td>
</tr>
<tr>
<td>High</td>
<td>28%</td>
<td>31%</td>
<td>9%</td>
<td>26%</td>
</tr>
</tbody>
</table>

**Geographic region**

<table>
<thead>
<tr>
<th>Region</th>
<th>Sample in descriptive analysis of pre-primary provision (n=163)</th>
<th>Sample in pre-primary net enrolment rate regression (n=121)</th>
<th>Sample in primary graduation rate regression (n=64)</th>
<th>UN member states (n=193)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Americas</td>
<td>20%</td>
<td>22%</td>
<td>34%</td>
<td>18%</td>
</tr>
<tr>
<td>East Asia and Pacific</td>
<td>16%</td>
<td>12%</td>
<td>13%</td>
<td>16%</td>
</tr>
<tr>
<td>Europe and Central Asia</td>
<td>31%</td>
<td>33%</td>
<td>14%</td>
<td>28%</td>
</tr>
<tr>
<td>Middle East and North Africa</td>
<td>9%</td>
<td>10%</td>
<td>9%</td>
<td>10%</td>
</tr>
<tr>
<td>South Asia</td>
<td>4%</td>
<td>3%</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>21%</td>
<td>21%</td>
<td>25%</td>
<td>25%</td>
</tr>
</tbody>
</table>

**Notes:**
1. All percentages are rounded to the nearest whole number. Some percentages may not always sum exactly to 100% as a result of rounding.
2. National income and regional groupings used are based on 2011 World Bank classifications.
3. Descriptive sample includes all countries with data on pre-primary education policy data from UNESCO between 2006 and 2011.

**2.4. Description of variables**

In this section, we describe outcome, key independent, and control variables used in the analyses. For a summary of descriptive statistics see Supplementary Table 1.

**2.4.1. Outcomes examined**

*Pre-primary net enrolment rate* is defined as the number of children who are reported to have enrolled in pre-primary school (regardless of age) expressed as a percentage of the number of age-appropriate children in the population. We utilized net enrolment rates as a
commonly used measure of school enrolment: a high net enrolment rate indicates a high
degree of coverage for the official school-age population of children. Compared to gross rates,
net rates do not include enrolment of under- and over-aged children.

*Primary gross graduation rate* is defined as the number of children who are reported to
have graduated from primary school (regardless of age) expressed as a percentage of the
population at the theoretical graduation age for primary school. Net primary school graduation
rates data were not available from the UNESCO Institute of Statistics at the time of our study.

2.4.2. Key independent variables

*Free pre-primary education* is a binary variable indicating whether a country provided at
least one year of pre-primary education, using the UNESCO definition of pre-primary (Level 0)
education, and charged no tuition or educational fee (although other fees could be charged for
such things as meals or field trips). This variable measures the policy in place irrespective of the
degree of implementation or the percentage of relevant age-eligible population that is enrolled
in a pre-school program. Comprehensive data on enrolment rates and degree of
implementation are not available at the global level at present. Another variable indicates the
number of years that free pre-primary education is provided: zero, one year, and two years or
more.

*Pre-primary education provision in the year relevant to the cohort with recent
graduation rate data* is a binary variable indicating whether free pre-primary education was
provided in the year when, based on the number of years of primary school and the year of
primary graduation rate data, the students age-eligible to graduate primary school would have
been entering their last (or only) year of pre-primary school. In order to determine the relevant year of pre-primary education provision, the following calculation was performed:

\[ G_i - D_i - 1, \]

where \( G_i \) is the most recent year for which data on primary gross graduation rates were available from UNESCO (see Data Sources) for country \( i \), and \( D_i \) is duration of primary school, in years as of 2011. The data on the duration of primary education were drawn from the WORLD Policy Analysis Center Global Education database.\(^2\) We subtracted 1 from the difference of \( G_i \) and \( D_i \) in order to obtain the year prior to the year when the relevant cohort would have been entering primary school. Although two years pre-primary may have a greater impact, using one year prior to the start of primary school yields a conservative estimate of the effect of pre-primary education on primary completion. A binary variable indicates whether pre-primary education was free or not during the relevant year.

2.4.3. Control variables

Research suggests that a country’s level of national economic development and level of urbanization both strongly influence educational enrolment and graduation rates.

*National income* is proxied by per capita GDP. The per capita GDP is measured in current US dollars. To account for the difference in the impact of income at the lower and the higher ends of the national income spectrum, the natural logarithm of per capita GDP was utilized.

\(^2\) For more details on database sources and methodology please refer to http://worldpolicyforum.org/topics/education/policies.
Urbanization is defined as percentage of population living in an urban area. Rates of urban population refer to the number of people living in an urban area as defined by national statistical offices expressed as a percentage of the total population estimates.

For analysis of the relationship between provision of pre-primary education and pre-primary net enrolment rates, we controlled for country GDP and urbanization in the year in which enrolment is measured. For modeling the relationship between pre-primary education provision and graduation at primary level, averages of values over the period from one year prior to start of primary school (or potential entry to last year of pre-primary education) to the latest year when primary school graduation data are available were used.

2.5. Analytic approach

We conducted two sets of analyses. First, we described the status of pre-primary education provision globally, by region, and by country level of income. Second, we investigated the relationship between provision of tuition-free pre-primary education and pre-primary net enrolment rates and the relationship between provision of tuition-free pre-primary education and primary school completion.

2.5.1. Examining global availability of pre-primary education

We calculated the percentage of countries with a national policy guaranteeing tuition-free pre-primary education. In addition, we generated the frequency distribution of the duration of tuition-free pre-primary education policies. We then examined provision by national income and geographic region.
2.5.2. Examining the relationship between free education provision and enrolment at pre-primary level

We examined the relationship between the provision of free pre-primary education and national net enrolment rates. We examine whether the provision of at least one year of free pre-primary education has a statistically significant positive association with net enrolment rates in pre-primary educational programs. We fit a linear regression model in which our dependent variable was the national net pre-primary enrolment rate for the most recent available year from 2011 to 2014, and our key predictor variable was an indicator of free pre-primary education provision in the most recent year between 2006 and 2011. Specifically, we fitted a regression of national pre-primary net enrolment rates on provision of pre-primary education (binary indicator “Is at least one year of tuition-free pre-primary education available?”). The natural logarithm of per capita GDP and rates of urban population were included as control variables in both models (see Table 4).

2.5.3. Examining the relationship between free pre-primary education provision and primary school completion

A multivariate regression model was used to investigate whether the provision of free pre-primary education was associated with an increase in primary school graduation rates. Because the distribution of dependent variables was negatively skewed, we explored data transformations using the Box-Cox technique but the conversion did not improve the distribution. We then utilized an extension of the linear model, quantile regression as a convenient, useful way for modeling data with unequal variation as it places no restrictions on the error distribution assumption (Koenker and Hallock, 2001). Another advantage of utilizing
the quantile regression is its ability to give a more complete picture of whether there is a
stronger relationship between variables in the different portions of distribution by directly
estimating coefficients for each quantile in the distribution. We could investigate whether the
effect of free pre-primary education provision was greater for low-income countries. We used a
bootstrap technique to estimate 50th and 25th quantile regressions as it has been shown to
provide robust results and is generally preferred as more practical than asymptotic techniques
(Hao and Naiman, 2007). The estimated coefficient for a given quantile is interpreted as the
difference in the median gross enrolment rate for a one unit change in the explanatory variable.

We fit a model in which our dependent variable was the primary school graduation rate
for the most recent available year from 2009 to 2014, and our key predictor variable was an
indicator of whether a policy of free pre-primary education was in place in the year when the
cohort for which we had graduation rate data would have entered pre-primary school. It would
be interesting to analyze the impact of compulsory pre-primary education as well as free and
compulsory pre-primary education, however, reliable global data on the compulsory nature of
pre-primary education is not currently available. The natural logarithm of per capita GDP and
rates of urban population were included as control variables.

3. Results

3.1. Global provision of pre-primary education

Our analysis shows that provision of pre-primary education is far from universal. Fewer
than half (43%) of countries studied provide at least one year of tuition-free pre-primary
education, whether compulsory or not (see Table 2). 25% of all the countries studied provide
two or more years of free pre-primary education.

Table 2: Global provision of pre-primary education

<table>
<thead>
<tr>
<th>Total</th>
<th>No free pre-primary education</th>
<th>Free pre-primary education</th>
</tr>
</thead>
<tbody>
<tr>
<td>163</td>
<td>93</td>
<td>70</td>
</tr>
<tr>
<td>100%</td>
<td>57%</td>
<td>43%</td>
</tr>
<tr>
<td>1 year</td>
<td>2 years</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>43%</td>
<td>57%</td>
<td></td>
</tr>
</tbody>
</table>

Note: All percentages are rounded to the nearest whole number.

We find significant variation in the provision of pre-primary education by region. Based on the available data, in Europe and Central Asia, 68% of countries provide at least one year of tuition-free pre-primary education (see Figure 1). In the Americas, the percentage is slightly higher at 75%. In comparison, a smaller fraction of countries in South Asia (17%), Sub-Saharan Africa (9%), Middle East and North Africa (20%), or East Asia (19%) offer at least one year of tuition-free pre-primary school. At least two years of free pre-primary education “with developmentally appropriate curriculum and classrooms, and quality assurance mechanisms” is preferred by the World Bank Systems Approach for Better Education Results (SABER) framework for early childhood development (Neuman and Devercelli, 2013). When it comes to providing two years or more of free pre-primary education, the highest prevalence is among countries in Europe and Central Asia (40%) and Latin America (37%).
In addition to regional differences, there are marked disparities in provision of free pre-primary education across income levels (see Figure 2.) Provision of at least one free pre-primary year is much more common in high-income (60%) and upper-middle-income (61%) countries. A much lower proportion of low-middle-income countries provide at least one year of free pre-primary education (26%). Similarly, only a small percentage of low-income countries provide at least one year of free pre-primary education (12%).
3.2. Relationship between free pre-primary education provision and pre-primary net enrolment rates

Our analysis shows that the provision of free pre-primary education was associated with higher net enrollment rates at the pre-primary level and that the relationship was statistically significant (see column II, Table 4). Provision of at least one year of tuition-free pre-primary education was associated with an average increase in net enrolment rates at the pre-primary level of almost 17% even after controlling for per-capita GDP.

Note: National income levels are based on 2011 World Bank classifications.

Figure 2: Percent of countries in each income level that have different types of pre-primary education provision
Table 4: The relationship between free education provision and net enrolment rates at pre-primary level

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
</tr>
</thead>
<tbody>
<tr>
<td>At least one year of pre-primary education is free</td>
<td>16.66***</td>
<td>(3.84)</td>
</tr>
<tr>
<td>Natural log of per-capita GDP</td>
<td></td>
<td>11.82***</td>
</tr>
<tr>
<td>Percent of population living in urban area</td>
<td>0.04</td>
<td>(0.11)</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td>-58.70***</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>121</td>
</tr>
<tr>
<td>R²</td>
<td></td>
<td>0.62</td>
</tr>
</tbody>
</table>

Notes:
1. Standard errors are reported in parentheses.
2. For summary statistics see Supplementary Table 1.
3. *, **, *** refer to p≤0.05, p≤0.01, and p≤0.001, respectively.

3.3. Relationship between free pre-primary education provision and primary gross graduation rates

Table 5 contains results from the quantile regressions modelling primary gross graduation rates as a function of pre-primary education provision. The pre-primary education provisions utilized in this analysis reflect the policies applicable during the one year immediately preceding primary school for cohorts from countries with available data on gross graduation rates from primary school. Columns II, III, and IV of Table 5 contain results from the full model, 50th, and 25th quantile regressions, correspondingly, in which free pre-primary education was used as the key independent variable. The estimated coefficient for pre-primary education provision is the percentage point increase in the median primary gross graduation rate for nations providing free pre-primary education after controlling for national GDP and
percent of population living in an urban area. Limited availability of data on primary school
duration and gross graduation rates reduced the sample in this analysis to 64 countries.

Table 5: The relationship between free pre-primary education and primary school gross
graduation rates

<table>
<thead>
<tr>
<th></th>
<th>β full</th>
<th>0.50 quantile</th>
<th>0.25 quantile</th>
</tr>
</thead>
<tbody>
<tr>
<td>One year of tuition-free pre-primary education was available for subsequently graduating primary cohort</td>
<td>10.27</td>
<td>10.27</td>
<td>19.54**</td>
</tr>
<tr>
<td>Natural log of per-capita GDP</td>
<td>13.22**</td>
<td>13.22**</td>
<td>13.59***</td>
</tr>
<tr>
<td>Percent of population living in urban area</td>
<td>-0.08</td>
<td>-0.84</td>
<td>-0.25*</td>
</tr>
<tr>
<td>Constant</td>
<td>-29.27</td>
<td>-29.27</td>
<td>-35.10**</td>
</tr>
<tr>
<td>Observations</td>
<td>64</td>
<td>64</td>
<td>64</td>
</tr>
<tr>
<td>Pseudo $R^2$</td>
<td>0.20</td>
<td>0.20</td>
<td>0.43</td>
</tr>
</tbody>
</table>

Notes:
1. Standard errors are reported in parentheses.
2. For summary statistics see Supplementary Table 1.
3. *, **, *** refer to p≤0.05, p≤0.01, and p≤0.001, respectively.

Availability of one year of free pre-primary education was found to be positively
associated with an increase in primary graduation rates in the 25th quantile of the estimated
model (p≤0.01). Provision of one year of tuition-free pre-primary education for the
subsequently graduating primary cohort was associated with a 19.54 percentage point increase
in the average graduation rates from primary school, when compared to countries in which
that year of pre-primary education was not available tuition-free. Notably, the countries in the
25th quantile distribution of primary gross graduation rates are either low- or lower-middle-
income, primarily in Sub-Saharan Africa (see Supplementary Table 2).
4. Discussion

To date, little evidence on pre-primary provision and its association with primary education outcomes is available on a global scale. In this article we evaluated the global provision of pre-primary education based on the latest policy data available for 163 countries. We employed regression analyses to examine the associations between provision of free pre-primary education and 1) pre-primary net enrolment rates and 2) primary gross graduation rates. Globally, we found there are substantial gaps in the provision of free pre-primary education, and in multivariate analyses we found that provision of at least one year of free pre-primary education is associated with increased pre-primary enrollment and primary education graduation rates.

4.1 Main findings

Around the world, fewer than half the countries with available data make at least one year of pre-primary education financially accessible by providing tuition-free programs. Just under 25% of countries globally offer free pre-primary for two or more years. This study also highlighted substantial variation in the provision of free pre-primary education by national income, which often leaves children in the poorest countries deprived of the opportunity for early learning. Only a small minority of countries that make pre-primary education free are low-income. Our analysis also illustrates the global accessibility gap between primary education and pre-primary preparation. As of 2014, 159 countries had made primary education free and compulsory (de Guzman Chorny et al., 2014). Yet fewer than half (44%) of the countries that provide free primary education also offer at least one year of free pre-primary as of 2015. We
also found that provision of free pre-primary education was associated with increased pre-
primary enrollment rates: availability of at least one year of free pre-primary education was
associated with an average increase in enrollment of 17%.

In addition, our analyses revealed that provisions of free pre-primary education was
associated with improved rates of primary completion. Our findings on the positive association
between access to free pre-primary education and primary school gross graduation rates are
consistent with a growing number of studies conducted in various contexts on both national
and sub-national scales showing that preschool attendance is associated with subsequent
educational success (Aboud and Hossain, 2011; Save the Children, 2003; Barnett and Masse,
2007; Berlinski et al., 2008, 2009; Cortázár, 2015; Jaramillo and Tietjen, 2001; OECD, 2011;
World Bank, 2001). Further, we found that the associations are strongest for nations with the
lowest rates of graduation from primary schools, which are low- and low-middle-income
countries.

4.2 Policy implications

While the world has come a long way toward achieving universal primary education,
progress is uneven. Rates of primary school completion in the poorest countries lag behind the
rest of the world, and the gap between wealthy and economically disadvantaged children in
many countries is increasing (UNESCO, 2015). Important to children’s success in primary school
is that they enter their classrooms with the social and cognitive skills necessary to fully take
advantage of and thrive in the educational environment. Understanding the global provision of
pre-primary education, factors that increase enrollment in these programs, and the degree to
which provision of free pre-primary education is linked to higher rates of primary school
completion can inform efforts to increase universal primary education across all nations.

Studies suggest that high-quality education programs in the years prior to starting
primary school improve cognitive and developmental outcomes and school readiness as well as
long-term education and employment outcomes (Shonkoff and Phillips, 2000; Heckman, 2006;
Knudsen et al., 2006; Grantham-McGregor et al., 2007). Research also shows that the potential
benefits from participating in pre-primary schooling are even greater for poor and
disadvantaged children. Moreover, disparities that children face as early as primary school can
lay the foundation for life-long inequalities (Walker et al., 2011). At the same time, research
indicates that investments during early childhood years are one of the most effective strategies
for alleviating economic inequalities over a lifespan (Heckman, 2006; Knudsen et al., 2006).
However, progress toward increasing pre-primary enrolment has been slow and uneven. For
example, while the global average pre-primary education gross enrolment rate reached 50% in
2011, it was only 18% in sub-Saharan Africa (UNESCO, 2014b). While data from individual
countries (Kazakhstan, Mexico, and Ghana) indicate that the factors associated with higher
enrolment in primary school are also important to increasing enrolment in pre-primary
education – specifically, providing education at no cost (UNESCO, 2015)—little research has
been done on a global scale to investigate the role of national provision of free pre-primary
education on enrollment rates at the pre-primary level.

National commitments to extend free education to pre-primary years can alleviate
disadvantage and inequalities and play an important role in reducing within-nation disparities,
thus supporting nations to move from surviving to thriving. Is it feasible to extend free
education for one or more pre-primary years in countries that struggle to meet other social
priorities? Numerous countries’ experiences support an affirmative response. While there are
many complex issues of scaling-up small programs (Wolfensohn Center for Development at
Brookings, 2009), effective pre-primary education programs at scale exist in developing
countries from diverse regions, with different governing and economic development
approaches. For example, in Vietnam, after the passage of a 1999 law expanding provision of
public preschools, enrolment among three- to five-year olds, particularly in urban areas,
increased markedly (Heymann, 2006). In Cuba, the universality of pre-primary education was
achieved by 2000 (Tinajero, 2010). Kazakhstan made pre-primary education free and
compulsory in 1999 (Shaeffer, 2015). Two years of free and compulsory pre-primary education
have been provided in Ghana since 2007 (RTI International, 2011).

However, though guaranteeing free pre-primary school holds promise, experiences with
tuition-free education and its benefits for enrolment at the primary level raise a point of
cautions. When spending on education is fixed, enrolling more children in schools lowers the
funds available for each student, potentially lowering educational quality. Yet research
suggests that simultaneous increases in educational expenditures can help mitigate this risk. In
Morocco, for example, decade-long reforms in both areas - assuring free access and increasing
educational expenditures - were followed by a rise in primary enrolment rates to 96% for girls
and to 95% in rural schools (World Bank, 2013). In addition to maintaining quality in a context
of rising enrolment, evidence from randomized evaluation in Afghanistan also indicates that
expenditures in rural school constructions helped increase enrolment rates by 42% (Burde and
Linden, 2013). Beyond increased funding, social policy intervention programs that are
intertwined with schooling have been also shown to increase enrolment as they attract demand from the poorest families. Examples include countries in sub-Saharan Africa (Gelli et al., 2007), Latin America (Stampini and Tornarolli, 2012), and Asia (World Bank, 2015b).

This study’s findings should be interpreted with the following limitations in mind. Because we used available cross-sectional data, our analysis can only establish association and not causation for the relationship between the type of provision and enrolment rates at pre-primary and graduation rates at primary levels of education. Studies of outcomes over time in the countries before and after the abolition of pre-primary tuition are needed to demonstrate causation. In addition, global data availability for gross graduation rates in and duration of primary education significantly reduced our sample size, from 163 to 64. Data on potential other explanatory variables, such as comparable, globally available national-level data directly related to the quality of pre-primary education, such as data collected by the World Bank on educational environment or age appropriateness of curriculum, are currently available only for a handful of countries and could not be included in our analysis without significant loss of power.

While progress has been made in the last decade for moving pre-primary education forward in important ways, supported and led by several UN bodies, additional efforts to gather quantitative, comparable data on a global basis over time would further enhance our understanding of the potential benefits of pre-primary education on the productivity of the next generation, and the contribution that pre-primary education provision can have on reducing inequality. Little is known about the specific impacts of different models and the quality of pre-primary programs. Valuable next steps include gathering quantitatively
comparable global data on the type of models in place and the quality of pre-primary programs, including teacher training requirements, student and teacher absenteeism, time of active involvement in the learning activities, age-appropriateness and inclusiveness of curriculum, availability of learning materials, school fees, and quality of school’s physical environment, as well as developing the methods of monitoring and research. To more comprehensively assess whether increasing participation in pre-primary affects primary completion in contexts where these interventions could have the greatest impact, it is necessary to examine whether the types of pre-primary programs that low-income countries can provide will be of sufficient quality to contribute to better primary outcomes. Future research will require the longitudinal household level data to enable analyses of the causal impact of pre-primary education on completion of primary and secondary education, as well as on subsequent individual socio-economic achievements. Multilevel analysis could rely on the household level data to study existing within-nation inequalities in the access to pre-primary education.

Acknowledgment

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References


Save the Children (2003). What’s the Difference? An ECD Impact Study from Nepal. Children’s Environments Research Group, UNICEF. Available at:


### Supplementary Table 1. Summary statistics of variables used in regression analyses

<table>
<thead>
<tr>
<th>Variable name</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Minimum</th>
<th>Maximum</th>
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<td></td>
<td></td>
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<tr>
<td><strong>Dependent</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Pre-primary education net enrolment rates, 2011 (in %)</td>
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<td>56.36</td>
<td>30.04</td>
<td>1.04</td>
<td>99.63</td>
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<td><strong>Independent</strong></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Is pre-primary education free? (yes=1)</td>
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<td>0.48</td>
<td>0.50</td>
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<td><strong>Control</strong></td>
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<td></td>
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<td>Logarithm of per capita GDP (in $1,000)</td>
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<td>8.85</td>
<td>1.53</td>
<td>5.48</td>
<td>11.97</td>
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<tr>
<td>Percent of population living in urban area (in %)</td>
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<td>58.64</td>
<td>23.20</td>
<td>10.91</td>
<td>98.81</td>
</tr>
<tr>
<td><strong>Assessing relationship between free pre-primary education provision and primary school gross graduation rates</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dependent</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross graduation rates from primary school (in %)</td>
<td>64</td>
<td>80.24</td>
<td>22.87</td>
<td>20.83</td>
<td>100.00</td>
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<tr>
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<tr>
<td>Was at least 1 year of pre-primary education free for cohort entering primary school? (yes=1)</td>
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<td>0.28</td>
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<td>Logarithm of per capita GDP (in $1,000)</td>
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<td>1.18</td>
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<td>11.40</td>
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<td>Percent of population living in urban area (in %)</td>
<td>64</td>
<td>48.63</td>
<td>22.43</td>
<td>8.94</td>
<td>98.81</td>
</tr>
</tbody>
</table>
**Supplementary Table 2. List of countries in the 25th quantile distribution of primary school gross graduation rates**

<table>
<thead>
<tr>
<th>Country</th>
<th>Level of income</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angola</td>
<td>Lower-middle-income</td>
<td>Sub-Saharan Africa</td>
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<tr>
<td>Bangladesh</td>
<td>Low-income</td>
<td>South Asia</td>
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<tr>
<td>Benin</td>
<td>Low-income</td>
<td>Sub-Saharan Africa</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>Low-income</td>
<td>Sub-Saharan Africa</td>
</tr>
<tr>
<td>Burundi</td>
<td>Low-income</td>
<td>Sub-Saharan Africa</td>
</tr>
<tr>
<td>Cameroon</td>
<td>Lower-middle-income</td>
<td>Sub-Saharan Africa</td>
</tr>
<tr>
<td>Republic of the Congo</td>
<td>Lower-middle-income</td>
<td>Sub-Saharan Africa</td>
</tr>
<tr>
<td>Djibouti</td>
<td>Lower-middle-income</td>
<td>Middle East &amp; North Africa</td>
</tr>
<tr>
<td>Guinea</td>
<td>Low-income</td>
<td>Sub-Saharan Africa</td>
</tr>
<tr>
<td>Mali</td>
<td>Low-income</td>
<td>Sub-Saharan Africa</td>
</tr>
<tr>
<td>Niger</td>
<td>Low-income</td>
<td>Sub-Saharan Africa</td>
</tr>
<tr>
<td>Rwanda</td>
<td>Low-income</td>
<td>Sub-Saharan Africa</td>
</tr>
<tr>
<td>Uganda</td>
<td>Low-income</td>
<td>Sub-Saharan Africa</td>
</tr>
<tr>
<td>Vanuatu</td>
<td>Lower-middle-income</td>
<td>East Asia &amp; Pacific</td>
</tr>
</tbody>
</table>