The Horn Economic and Social Policy Institute

CONTRIBUTION OF EARLY-AGE CIRCUMSTANCES TO INEQUALITIES IN EDUCATIONAL-ACHIEVEMENT

A Within and Across Age Cohorts Comparative Study for Ethiopia

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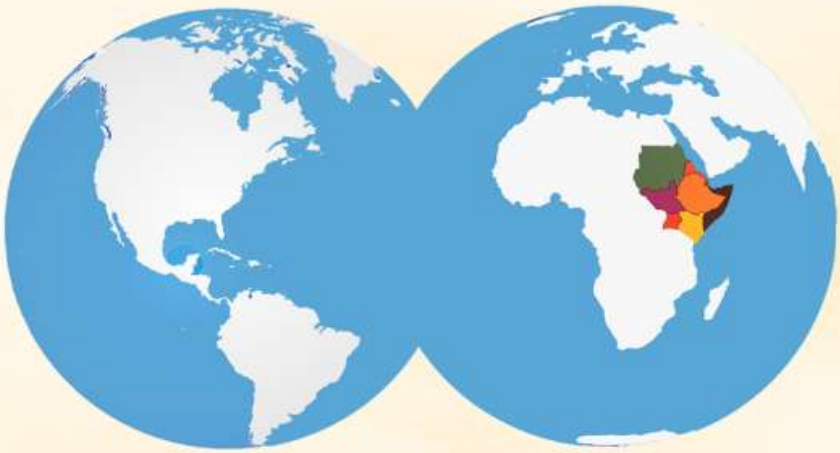

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HESPI **Working Paper 01/17**

The Horn Economic and Social Policy Institute (HESPI)

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Abstract

The academic evaluation system that focuses on rewarding students with high achievements and penalizing the low achievers by only looking at their test scores is misleading and unjust. First, inequality due to predetermined child circumstances should be leveled across children. Inequality that remains is likely to be attributed to children's own effort differentials. Using Young Lives four-round dataset that tracked children of age 1and 8 in 2002 (=age 12 and 19 in 2013), we measured overall educational-achievement inequalities in Ethiopia and further decomposed it into its sources−circumstance and effort. We also observed the dynamics as children grow older. Standardized Test Score/ STS is used to proxy for educational achievements (average z-score in mathematics, PPVT, and language tests). Overall educational achievement inequality is measured with Gini Coefficient, and the decomposition into circumstances and effort is done using General Entropy measures. Despite recent improvements, Early-age circumstances remains a challenge to bringing justice in educational outcomes in Ethiopia. It is found that the Gini coefficient, that measures overall inequality in educational achievement, rests between 0.35 and 0.38 for all survey rounds. And early childhood circumstance explains significant part of later-age educational achievements. At age 12, in 2006, circumstances accounted for at least 31 percent of the overall inequality. In 2013, for the same age, the share of circumstance falls to 21 percent. In the later year, we observed slight reductions in the inequality effects of few circumstance variables such as parental wealth and child site (rural or urban), while the rest of the variables remained significant inequality escalators. Yet, at the age of 19, the share reached to 37 percent to suspect that early-age circumstances have increasing effect as a child grows to full adulthood. Parental wealth and education are found to be the principal drivers of circumstance induced inequalities. We suggest, Ethiopia needs to invest to ensure quality and equitable education beyond a focus on overall educational outreach as evidenced by weak association between grade attainments and test achievements. A targeted intervention to reward effort and to equalize circumstances need to be put in place. Affirmative action in educational admission alone will not help, when about a third of test achievements are explained by circumstances. It rather calls for policies meant to address the root causes of such inequalities.

JEL Classification: *I21, I24*

Keywords: *Achievements; Circumstances; Education; Effort; Ethiopia; Inequality; Opportunity.*

1. Introduction

The academic evaluation system that focuses on rewarding students with high achievements and penalizing the low achievers by only looking at their test scores is misleading and unjust. First, inequality due to predetermined child circumstances should be leveled across children. Inequality that remains is likely to be attributed to children's own effort differentials. In this paper, we measured the extent to which educational achievements are distributed independently of children's predetermined circumstances in Ethiopia. Variation in children's educational achievements (test scores for a given age) may not necessarily reflect variations in children's own academic efforts. Variations in unavoidable circumstances (such as parental characteristics, gender, and location) that abound children's lives may also determine achievements.

Equity is a key feature of Goal 4 of the current global Sustainable Development Goal agenda. It calls for no one to be left behind, but countries will need new and refined guidelines and data tools in order to measure disparities in a comprehensive and comparable way if the goal is to be achieved (UNESCO, 2016).

> "An equitable society is not necessarily a society that makes all people equally happy, or equally rich, or equally educated. It is rather a society that secures for all of its members an equal chance to attain the outcomes they care about." (Ferrera, 2015:4)

> "Equalizing opportunity for educational achievement—requires distributing educational resources in such a way that the differential abilities of children to turn resources into educational achievement are compensated for, where those abilities are determined by circumstances beyond the control of the individual. Differential achievements due to effort, however, should not be "leveled" or compensated for by an equal-opportunity policy." (Roemer, 1998:6)

Fair distribution of educational resources alone will not bring about educational justice. The whole set of issues a child is exposed to could in some ways affect his/her educational performance. The physical and socioeconomic settings of the student will add up to form his circumstances. Household, community, and child level circumstances should be adjusted for inequality of opportunity.

Overall inequality provides information at an aggregate level, which needs further disaggregation for improved policy relevance. Measuring overall inequalities in educational achievement alone has little policy relevance, unless decomposed into its underlying drivers. Inequality decomposition has not been sufficiently made for educational outcomes in Ethiopia. Studies along this line for Ethiopia are mainly on measurement of overall inequalities.

According to Phillippe et al (2009), increase in inequality in Ethiopia was driven mostly by changes in returns to household characteristics, and especially by changes in the returns to education. Tassew and Aregawi (2016) dynamic comparison of educational outcomes in Ethiopia at age 12 in 2006 and same age children in 2013 using Young Lives Dataset (same dataset used in this study) indicated deterioration in mean educational outcomes in latter year. Their view of test achievements by gender, location (rural or urban), and education level of care givers revealed higher mean scores for boys in urban areas and from educated care givers. They concluded institutional factors and household characteristics are more important in explaining achievement variations than children's own characteristics, including gender. The latter study resembles ours in the sense that it looks into achievement variations across different categories. The study makes a good comparison of test achievement differentials across different categories at a descriptive level. The paper, however, doesn't include disaggregation of overall inequalities into subcomponents (such as effort and circumstances) using standard inequality indices.

Using Young Lives four-round dataset that tracked children of age 1 (Young Cohort) and age 8 (Older Cohort) since the year 2002[1]: we measured the overall inequalities in educational achievements in Ethiopia; decomposed it to see the role played by predetermined and unavoidable child circumstances (also called 'Inequality of Opportunity/IOP'). We further looked into the relative importance of certain circumstance indicators and observed the dynamics of circumstance induced inequalities as children grow older. We then checked if educational achievements of children of age 12 in 2006 is different from the same age children observed in 2013.

Standardized Test Score (here in after called STS) of children is chosen as proxy for Educational achievement[2]. The score comprises mathematics, PPVT, and language tests. The STS are then regressed on several circumstance variables (such as parental education; sex of child; parental wealth and education; child's location /urban or rural, and some anthropometric measures. We first predicted STS with only circumstance variables in the models. Predicted STS is then used to categorize the children into homogeneous circumstance deciles. Gini, General Entropy /GE (a), and Atkinson indices are used to measure the inequality. And the GE (0) measure is used for the disaggregation into circumstance and effort.

The paper is structured as follows: The section that follows presents structure of education in Ethiopia. Section 3 presents the methodology. Section 4 and 5, respectively, summarizes the results and concludes the study.

2. Ethiopia's Educational Structure

Educational levels in Ethiopia range from preschool to post graduate. Preschool is provided by the private sector and mainly children from better-off parents in the urban centers have this privilege. Mandatory formal education starts at primary level with two cycles: First cycle (grade 1-4) and second cycle (grade 5-8). Likewise, secondary level is split into General Secondary School (grade 9-10) and Preparatory School (grade 11-12). Two national exams are administered in Ethiopia, first at grade 10 and second at grade 12.

[1] During the fourth survey round (in 2013), the Young Cohort grew to age 12 and the Older Cohort to age 19.
[2] Author's standardization of math, language, and PPVT raw test scores in the Young-lives dataset: Z scores computed for each test and horizontally summed.

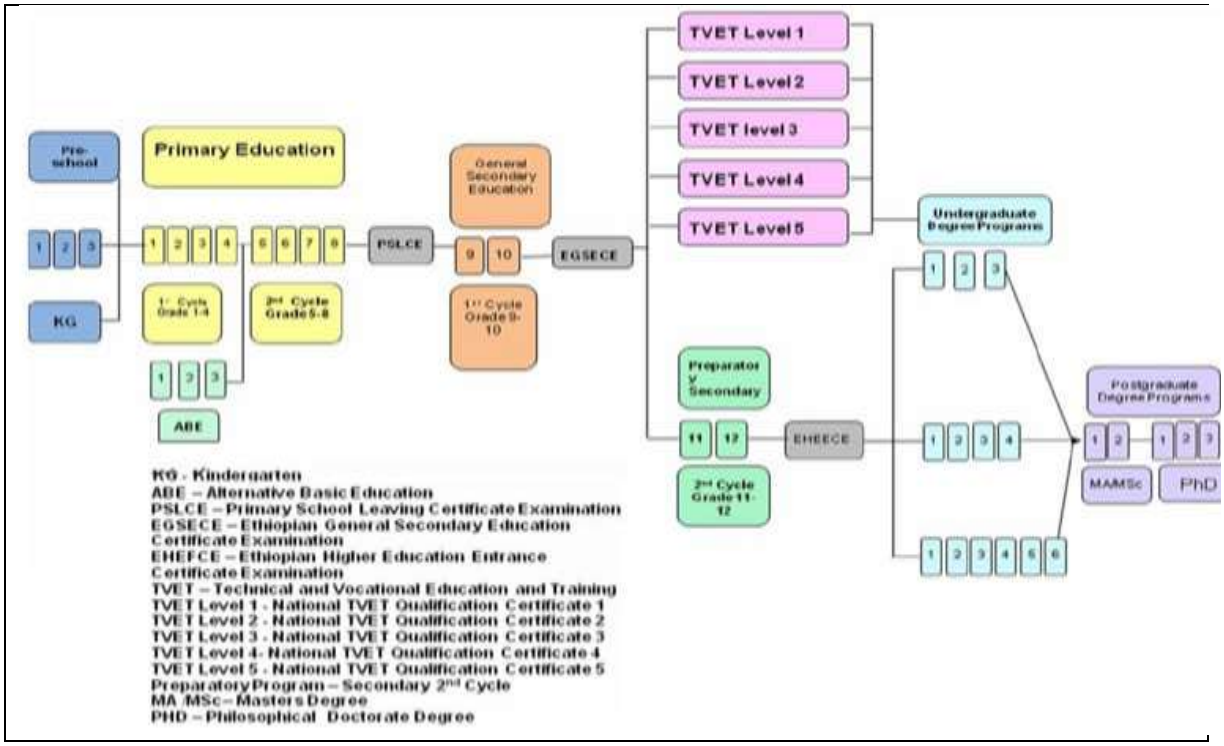

Figure 1 Structure of the Ethiopian Education System (FDRE Ministry of Education, 2014/15: 8)

The first national exam result is the basis for assigning students to Preparatory School Level (well achievers) and to Technical and Vocational Education and Training Centers /TVET (mainly low achievers). The TVET programme has 5 levels depending on length of trainings. Students' achievement in the second round national exam at grade 12 determines who would a join university. The possibility is there for TVET completes to pursue university education conditional to excellent academic records during the TVET and passing of occupational competency tests administered by publicly owned occupational competency assessment and certification centers. Acquiring the competency certificate is also key to determining TVET completes employability.

Table 1 presents key educational indicators for Ethiopia. In 2014/15, Ethiopia achieved 94.3 percent net primary school enrollment. However, for 2010/11- 2014/15, the net enrollments in 1st and 2nd cycle secondary levels remain low i.e. below 20 and 6 percent, respectively.

Table 1 Primary and Secondary Education Indicators for Ethiopia

Indicators	2010/11	2011/12	2012/13	2013/14	2014/15
Net Enrolment Ratios					
1. Primary Education	85	85	85	92	94
2. Secondary Education					
1st Cycle (9-10)	16	17	19	20	20
2nd Cycle (11-12)	4.2%	4.8%	5.3%	5.5%	6 %
Percentage of female students					
1. Primary education	47.5 %	47.8%	47.7%	48%	47%
2. Secondary education (grade 9-10)	44.8%	46.3%	47.3%	47%	48%

Source: FDRE Ministry of Education 2014/15: 14

In 2014/15, females constituted nearly half of the total enrollments in primary, first cycle secondary, and TVET levels in Ethiopia (Table 1 & 2). The picture completely changes for higher education in which, in 2014/15, female enrollment in undergraduate remained at 34 percent and in post graduate level at 19 percent. While the causes behind this require further research, the low females' enrollment in universities could be an indication of inequality of opportunity in favor of males.

Table 2 Basic Statistics for technical and Higher Education in Ethiopia

Indicators	2010/11	2011/12	2012/13	2013/14	2014/15
TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING (TVET)					
Enrolment	371,347				
Number of Schools	505	505	437	1350	919
% of female students	46	47	51	51	52
HIGHER EDUCATION					
Undergraduate Degree					
Enrolment	444,553	494,110	553,848	593,571	729,028
% of female students	26	28	30	30	34
Postgraduate Degree					
Enrolment	20,150	25,660	31,304	33,882	32,567
% of female students	13	20	20	19	19

Source: Extracted from FDRE Ministry of Education, Education Statistics Annual Abstract 2014/15 page 14

Budget allocation is one way to address inequality of opportunity. Education receives about 25 percent of the total government budget of Ethiopia and 46 percent of it was directed to higher education in 2013/14. General education received 47 percent of the budget for education. Between 2009/10 and 2013/14, the budget share of general education grew only by 0.5 percentage points compared to 14 percentage point increase in budget share for higher education (Table 3). This huge budget flow to higher education and admission to it based on scores in the national entrance examination would be acceptable if scores are distributed independent of individual circumstances. In an event that circumstance plays a significant role, there is a need to rethink the justice behind such selection.

Table 3: Educational Budget Allocation in Ethiopia

Indicators	Percentage share in 2009/10	Percentage Share in 2013/14
education budget in total budget	17.5	24.9
general education in total education budget	46.8	47.3
TVET in the total education budget	8.4	6.8
Higher Education in the total education budget	31.7	45.9

Source: FDRE Ministry of Education, 2014/15: 9

The government of Ethiopia introduced the 'General Education Quality Improvement Programme' (GEQIP) in 2010, with the aim of facilitating improvements in the quality of schooling nationally, aiming to bring equity through investment in key inputs such as textbooks and infrastructure. Significant challenges remain, including those concerning access in rural and remote communities and the participation of girls and of those from disadvantaged backgrounds, especially children in pastoralist regions (Caine, 2013).

3. Methodology

Distributional justice cannot be fully judged by inequality in distributional outcomes, since a given outcome can sometimes be judged equitable and in another times not. The basic criteria to judge inequality decomposition is to check if individuals have full, partial, or no control over their circumstances (Ferrera , 2015). Techniques should be applied to make choices independent of circumstances. The common approach to such decomposition are two: These are parametric and non-parametric approaches. We followed the parametric approach which is better suited for small sample size as ours[3].

In parametric approach, an outcome variable is regressed on a set of circumstance variables. Residual from such a regression captures inequalities due to effort differentials (including luck and other innate abilities of individuals). The part explained by circumstance variables will serve as a basis to drive inequality of opportunity/circumstance.

In non-parametric approach, observations are grouped into several homogeneous categories (hereafter called types). Observations with similar circumstances will fall in the same type. Inequality in mean outcome across types captures inequality of opportunity (bad inequality). Whereas inequality within a type is either due to effort differential or due to other unobservable variables such as luck.

Both approaches have their own drawbacks. The non-parametric approach is not efficient; because establishing homogeneous types requires individuals to be similar in several circumstance variables. There is a trade-off between making a type more homogeneous and finding enough observations within a type. This approach can be effective for large dataset, which are not often the case. The parametric approach has also its own downsides, for instance, choice of appropriate functional forms is hardly possible with it.

In this study, the parametric method is used to establish homogeneous categories (types) without compromising much on the sample size. Doing so enables more observation in a category. And we come up with single decomposition result for the outcome variable (in this case: Standardized Test Score).

Model specification:

Parametric approach:

$$EOi = \delta i Ci + \varepsilon j \quad (1)$$

Where:

EOi: Educational Outcome Variable, in this case math test score

Ci : a vector of circumstance variables.

δi : a vector of coefficients for circumstance variables

The predicted value using Model 1 is:

$$\widehat{EOCi} = \hat{\delta} i Ci \quad (2)$$

[3]We recommend to refer Francisco H. G. Ferreira and Jérémie Gignoux (2011) and Bourguignon et al. (2007) for details of such approaches.

Then, for the Standardized Test Score (STS) dataset, a corresponding estimated dataset is established; the estimate captures the test score explained only by circumstances ($\widehat{EOC}$). Using the estimated scores, the observations are grouped into 10 /decile category 'types'. The assumption here is that observations in a type are homogeneous in their circumstances but could be different in their efforts. If difference in educational outcome exists within them, it is likely to be because of effort differentials, assuming other unobservable are uniformly distributed across all individuals (such as luck). Doing so provides a new STS with circumstance smoothened/leveled distribution. We then employed the decomposition techniques that compares inequalities in this smoothed STS Dataset and the original STS Dataset.

For the smoothed distribution the decomposition is:

$\theta_c = I\{\mu_k^i\} / I\{y_k^i\}$ ---------- (3)

Where;

θ_c: The share of circumstances in total inequality

$I\{\mu_k^i\}$: Inequality indices (General Entropy Indices) formulated using circumstance estimated STS Dataset (inequality because of circumstances)

$I\{y_k^i\}$: Inequality indices formulated using the original STS Dataset (=total inequality)

Data Source and Description:

This research has benefited from Young Lives four-round dataset that tracked two age-cohorts of children in Ethiopia. The Young Cohort of age 1 in 2002 (age 12 in 2013) and an Old Cohort of age 8 in 2002 (age 19 in 2013). The subsequent surveys were in 2002 (Round 1); 2006 (Round 2), 2009 (Round 3), and 2013 (Round 4) (Young Lives, 2013).

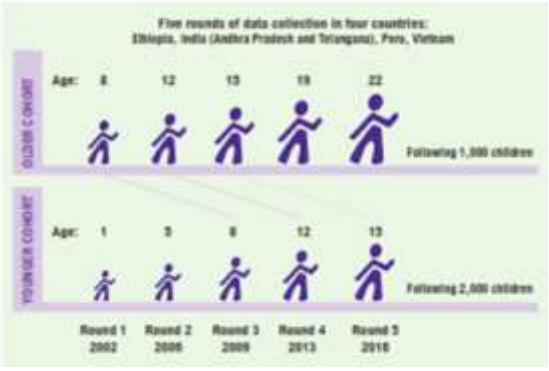

Figure 2: The Young Lives survey rounds basic information: Adapted from Young Lives Survey Design and Sampling in Ethiopia: Preliminary Findings from the 2013 Young Lives Survey (Round 4)

Sampling by the Young Lives:

The survey covers 20 sites in Ethiopia and the sampling was carried out at three stages. First, four regional states – Amhara, Oromia, SNNPR, Tigray, and one city administration (Addis Ababa) – accounting for 96% of Ethiopia's population. Three to five woredas (districts) were selected in each regional state, with a balanced representation of poor and less-poor households, urban and rural areas, and a selection of urban site types: capital city, intermediate city, and small urban areas (district centers). Among the woredas with food deficit status within each region, three were selected with the highest

proportion and one with the lowest proportion. In the third stage, at least one kebele (local administrative area) in each woreda was chosen.

Finally 100 young children and 50 older children were randomly selected within the chosen sites. Districts with food-deficit status were oversampled, and the cost of tracking children in the future was considered to reduce the probability of attrition in remote pastoralist areas. As we observe it, the sample is not randomly selected and there are indeed selection biases. We assumed that distribution of inequality at lower and high income levels follow similar trends. If this assumption holds, then the data do not need to be representative. The validity of our result is subject to this caveat.

4. Results and Inequality Decomposition

4.1. The Descriptive Analysis

Table 4 shows significant disparities in educational attainment of the tracked children. While children at the highest level are pursuing their undergraduate degree studies, the majority are in secondary and primary educational levels. Such attainment gap for the same age is indicative of inequalities in the speed with which a child attains a certain educational level in Ethiopia. Although this preliminary assessment hints high inequality in educational attainment in Ethiopia, it does not fully reflect differences in actual academic performances of children (achievements).

Table 4 Educational Attainments at the Age of 18-19 in 2013 (during the 4th round survey)

School Enrolment	Number of individuals
None	332
Primary Grade 2	1
Primary Grade 3	3
Primary Grade 4	8
Primary Grade 5	8
Primary Grade 6	16
Primary Grade 7	33
Primary Grade 8	60
Secondary First Cycle Grade 9	95
Secondary First Cycle Grade 10	92
Secondary Second Cycle Preparatory Prog	26
Secondary Second Cycle Preparatory Prog	62
First cycle of primary teaching certifi	5
First cycle of primary teaching certifi	2
TVET/1st year	39
TVET/2nd year	17
TVET/3rd year	5
Secondary education, teacher (diploma)	2
Undergraduate degree (1st year, regular	30
Undergraduate degree (2nd year, regular	6
Undergraduate degree (3rd year, regular	3
Undergraduate degree (4th year, regular	1
Undergraduate degree (1st year or equiv	1
Undergraduate degree (2nd year or equiv	2
Undergraduate degree (3rd year or equiv	1
Other, specify	14
Total	864

Educational attainments is poor indicator of achievements in the dataset. The same math question sets asked to children at various grade attainments resulted in little achievement inequality. The test score difference between undergraduate level students and primary levels is only 31 percent i.e.

undergraduates scored 71 percent while primaries 40 percent[4]. Secondary school levels score of 52 percent is also not so far from the primaries.

Table 5 Percent correct answer in math test during the 4th round old cohort

Variable	Observations	Mean	Std. Dev.	Min	Max
Rural	473	43.7	20.9	0	96.4
Urban	353	56.0	19.2	0	96.4
Male	441	52.3	21.3	0	96.4
Female	385	45.2	20.2	0	92.9
Wealth index first round <=0.5	700	46.8	20.8	0	96.4
Wealth index first round >0.5	166	55.7	21.3	0	96.4

Table 5 presents the mean test score for children in the rural (44 percent score) is lower than the score of urban dwellers (56 percent). And the mean score for Females' at 45 percent compared to 52 percent for males' shows that gender also plays a role. Test scores after classifying children based on their parental wealth status (during earlier survey rounds) reveals that children with parental-wealth indices over 0.5 scored 56 percent while those from below 0.5 scored only 47 percent. It is then implied, at a descriptive level, that favored children (in gender, location, and parental wealth) seem to have achieved better than the less favored ones.

4.2. Econometric Results

Table 6 below presents estimates of three separate OLS regression (for Older Cohort of round-2, and Younger & Older cohorts of round-4.)[5]. The estimates help for categorization of individuals into circumstance categories. The estimates also provide evidence on the relative importance of the conventional circumstance variables in determining an individual's educational achievement.

According to the estimates, parental wealth is a persistent determinant of educational achievement at all age categories and survey rounds. Using the estimated model, we compared test score differential of a child from the poorest household and from the richest. Inserting the lowest and highest wealth indices (0.3 and 0.85, respectively) of the row data into the fitted model, we found that in 2006, parental wealth contributed 0.53 (0.3 * 1.769= 0.53) Standardized Test Score/STS to a child of age 12 from the poorest parents while it is 1.5 (0.85* 1.769= 1.5) for a child from the richest parents. This reveals a three-fold test score gap is observed only when the child is from the poorest parents compared to when the child is from the richest category. However, the same analyses for the recent year hinted a declining trend for the effect of parental wealth on educational achievement (Table 6).

[4]The questions sets are uniform and the questions are: 9/8*2/3=?;9.81+7.62=? 52-7=?; 48*5=?;27/3=?;25% of 240=?;243+176=?;18.23-0.2=?;15*9=?; 112+45+467=?)

[5] The standard zscore of mathematics and ppvt tests are computed and summed to find overall standardized test score for round 2 old cohorts and the round 4 young cohorts. Whereas for the round 4 old cohorts language test score is applied in place of the ppvt test (which is dictated by data availability).

Table 6 OLS Estimates of Test Score regressed on child circumstance variables

Explanatory Variables	[6]**Dependent Variable: Standardized Test Score**		
	Round 2	**Round 4**	
	/Old Cohort/ 12 years old	Young Cohort/ 12 years old	Old Cohort/ 19 years old
Parental Wealth Index (PWI)	1.769***	2.161***	1.588***
	(0.425)	(0.304)	(0.531)
Sex (Female)	-0.179*	0.0230	-0.415***
	(0.0958)	(0.0726)	(0.121)
Site (Rural)	-0.613***	-1.095***	-0.388**
	(0.149)	(0.104)	(0.187)
Mother Education	0.0498***	0.0520***	0.0524***
	(0.0141)	(0.0108)	(0.0179)
Father Education	0.0113*	0.0166***	0.0153**
	(0.00614)	(0.00474)	(0.00765)
Region (Reference category Addis Ababa):			
Amhara	-0.868***		-0.468**
	(0.193)		(0.234)
Oromia	-1.155***		-1.136***
	(0.182)		(0.229)
SNNP	-1.194***		-1.278***
	(0.180)		(0.226)
Tigray	-0.193		-0.282
	(0.191)		(0.233)
Z-score Height for Age	0.179***	0.235***	
	(0.0397)	(0.0383)	
Z-score BMI for Age	0.115**	0.0694*	
	(0.0447)	(0.0374)	
Constant	0.890***	0.0906	0.411
	(0.254)	(0.172)	(0.299)
Observations	857	1,374	767
R-squared	0.34	0.42	0.20

Standard errors in parentheses

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

The econometric result also revealed significant relationship between sex and achievement only at later years when children grew to full adulthood. At the age of 12, child's sex has no effect on scores

[6] The young cohort of round 4 survey and the old cohort of round two survey are comparable because they both sampled children of the same age category but across different time horizons.

achieved. This result has been consistent in round 2 Older and round 4 Younger cohorts. However, at later years when the children grow older, the effect of gender emerges in favor of males. For instance, in round 4 of the Older Cohort, the estimated coefficient for sex at minus 0.415 implies females are likely to receive 0.415 less STS than males only for their gender. A rural child of age 12 in 2006 (round 2 Older cohort) was likely to score 0.6 less than an urban child. It gets worse in round 4 younger cohort when the gap reached 1.09. However, the effect of site declines as the age of the children increases. A 19 years old youth receives only 0.38 less test score than his/her urban equivalent.

Parental educations measured using years of schooling completed by a father and/or a mother have both been significant determinant of achievements in all the rounds. It is observed that mother's education is prominent compared to father's education. For instance, a child of age 12 from a mother with 16 years of schooling (undergraduate degree complete) is likely to score 0.8 (0.05*16= 0.8) higher than same age child from a mother of no formal education. Following the same computation, a child from a father with 16 years schooling is likely to score 0.16 (0.01*16= 0.16) higher than a child from a father of no formal education. The significance of maternal and paternal education at later years (age19) declines only slightly compared to estimates made for a child at age 12. Thus, maternal and paternal educations are also persistent determinants of children's educational achievement even at later ages.

Regional comparison of test score indicates that respondents based in Addis Ababa performed better than all regional respondents. All the regions, other than Tigray, recorded far less than Addis Ababa residents.

Generally, the model predicted less than half of the total variation in educational achievements (as the low R^2 for all regressions presented in Table 6 show. Effort is difficult to observe and we made an assumption that what has not been explained by the circumstance variable could be because of efforts. Omitted variable bias is often suspected when the R2 is low, yet we intentionally omitted 'effort' as it is not observable. Variables can only be treated as circumstances if they are pre-determined and entirely exogenous to the individual. We, however, undertook the standard Ramsey omitted variable test and found no evidence of such bias (see test results in Annex 2). This is consistent with Ferreira and Gignoux (2011) claim that it is effort that may influence circumstances, but not the reverse.

4.3. Inequality Decomposition into Circumstance and Effort

According to the smooth distribution (that categorizes children based on similarity in circumstances), of the children aged 12 in 2006, those at the upper 90th percentile in circumstance category achieved nearly 10 fold higher score than those at the lowest 10th percentile (Annex 1). The figure is even worse in 2013 reaching a 12 fold higher. Such gaps, however, lessens as children grow older as indicated in 4th round Older cohort estimates, when the upper 90 percentile scored only 8 fold of the lowest 10th percentile.

According to the findings presented in Table 7, the Gini coefficient that measures overall inequality in educational achievement rests between 0.35 and 0.38 for all survey rounds. The inequality decomposition using the GE (0) measure is to be interpreted as it gives equal weight to inequalities amongst low score achievers and high achievers. According to the GE (0) results, early childhood circumstance explains significant part of later-age educational achievements.

Table 7 Inequality decomposition using the smoothed distribution

Survey rounds and corresponding inequalities	General Entropy Measure and Gini Coefficient				
	GE(-1)	GE(0)	GE(1)	GE(2)	Gini
Round 2 Old					
Total Inequality	2.63	0.35	0.24	0.22	0.38
Inequality after Circumstance is equalized	0.36	0.24	0.19	0.18	
Round 4 Young					
Total Inequality	1.25	0.34	0.23	0.21	0.37
Inequality after Circumstance is equalized	0.46	0.27	0.21	0.20	
Round 4 Old					
Total Inequality	0.59	0.27	0.20	0.18	0.35
Inequality after Circumstance is equalized (due to effort)	0.23	0.17	0.15	0.15	

Survey rounds	Educational Achievement Inequality Decomposition (using the GE(0) measures and overall inequality using Gini Coefficient)		
	Inequality due to circumstances (percent of Overall inequality using GE(0))	Inequality due to effort (Percent of Overall inequality using GE(0))	Overall inequality using Gini coefficient
Round 2 Old	31	69	0.38
Round 4 Young	21	79	0.37
Round 4 Old	37	63	0.35

At age 12 in 2006, circumstances accounted at least 31 percent of the overall achievement variation, respectively. Yet, in 2013, for the same age, the share of circumstance fall to 21 percent. Even at the age of 19, inequality of early-age circumstances persists accounting for 37 percent of the overall variation.

5. Conclusions

This study was aimed at measuring and disaggregating (in to effort and circumstances) educational achievement inequalities in Ethiopia. According to the findings, high inequality in educational attainment in Ethiopia does not fully reflect differences in actual academic performances of children. In Ethiopia, the mean educational achievement of favored children (in gender, location, and parental wealth) have always been better than the less favored ones. A threefold test score gap can exist just because one is from the poorest parents and the other from the richest. Parental wealth is an important determinant of test score at all ages. At the age of 12, child's sex has no effect on scores achieved. However, at later years when the children grow older, the effect of gender becomes a significant determinant in favor of males. This could be due to social pressures and cultural challenges women face as they grow to full adulthood.

Despite recent improvements, early-age circumstances remains a challenge to bringing justice in educational outcomes in Ethiopia. At age 12, in 2006, circumstances accounted at least for 31 percent of the variations in overall achievement. This share falls to 21 percent for the same age child observed in 2013. In the later year, we observed slight reductions in the inequality effects of few circumstance

variables such as parental wealth and child site (rural or urban), while the rest of the variables remained significant inequality escalators. Yet, at the age of 19 (round 4 survey round) the share reached to 37 percent to suspect that early-age circumstances have increasing effect as a child grows to full adulthood.

In line with the Sustainable Development Goals (SDGs), Ethiopia needs to invest to ensure quality and equitable education beyond a focus on overall outreach as evidenced by weak association between grade attainments and test achievements. A targeted intervention to reward effort and to equalize circumstances need to be put in place. Affirmative action in educational admission alone will not help, when about a third of test achievements are explained by circumstances. It rather calls for policies meant to address the root causes of such inequalities. For instance, achievements in tests is highly associated with parental education. These requires compensatory policies to reduce the wealth gap; to understand the transmission channels from parental education to child education and hence instate a policy entry point.

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ANNEXES

Annex 1

Decile dispersion ratio in STS

	Percentile Ratio			
	p90/p10	*p90/p50*	*p10/p50*	*p75/p25*
Round 2 Old				
Total Inequality	10.43	2.1	0.2	3.5
Inequality after Circumstance is equalized	10.31	2.4	0.2	2.6
Round 4 Young				
Total Inequality	10.54	2.2	0.2	3.2
Inequality after Circumstance is equalized	12.56	2.4	0.2	2.6
Round 4 Old				
Total Inequality	8.34	2.0	0.3	3.0
Inequality after Circumstance is equalized (due to effort)	7.42	2.6	0.4	2.3

Annex 2

Omitted Variable Bias test results

Survey rounds	Ramsey Reset Test/ Omitted variable test
Round 2 Old	Ho: model has no omitted variables F(3, 842) = 0.98 Prob > F = 0.4004
Round 4 yound	Ho: model has no omitted variables F(3, 1363) = 1.08 Prob > F = 0.3584
Round 4 old	Ho: model has no omitted variables F(3, 754) = 1.32 Prob > F = 0.2665

Note: All the tests reveal no evidence of omitted variable bais.

Annex 3

Pairwise Correlation of Residuals (Resid), explanatory variables and Dependent variable (Standard Test Score) for Round two survey

	resid	z_sco~st	wi	mumed	daded	zhfa	zbfa
resid	1.0000						
z_score_test	0.8132	1.0000					
wi	-0.0000	0.4326	1.0000				
mumed	-0.0000	0.2882	0.4236	1.0000			
daded	-0.0000	0.1586	0.1076	0.1805	1.0000		
zhfa	-0.0000	0.2128	0.2088	0.1056	0.0430	1.0000	
zbfa	0.0000	0.1217	0.1487	0.0694	-0.0855	0.1669	1.0000

Annex 4

Round 4 Old Cohorts

	resid	z_scor~t	wi	mumed	daded
resid	1.0000				
z_score_test	0.8934	1.0000			
wi	-0.0000	0.2989	1.0000		
mumed	-0.0000	0.2224	0.4472	1.0000	
daded	-0.0000	0.1350	0.1067	0.1901	1.0000

Annex 5

Round 4 Young Cohort

	resid	z_scor~t	wi	mumed	daded	zhfa	zbfa
resid	1.0000						
z_score_test	0.7600	1.0000					
wi	0.0000	0.5601	1.0000				
mumed	-0.0000	0.4663	0.5805	1.0000			
daded	-0.0000	0.2166	0.2119	0.2397	1.0000		
zhfa	-0.0000	0.2755	0.2304	0.1898	0.0751	1.0000	
zbfa	-0.0000	0.2049	0.2344	0.1835	0.0569	0.1556	1.0000

Annex 6

Atkinson indices, A (e),

	Atkinson indices , A(e), e = inequality aversion parameter		
	A(0.5)	**A(1)**	**A(2)**
Round 2 Old	0.10	0.21	0.42
Round 4 Young	0.11	0.24	0.48
Round 4 Old	0.08	0.16	0.32

Annex 7

Young Lives sentinel sites

Cluster ID	District	Short description
1	AddisAbaba	Anovercrowded areainthecenter
2	AddisAbaba	Anindustrialarea
3	AddisAbaba	Aslum area
4	Amhara	Atouristtowninthe region,with some extremelypoorneighborhoods
5	Amhara	Apoorruralcommunity
6	Amhara	AruralareanearLakeTana
7	Amhara	Aruralfood-insecurearea
8	Oromia	AruralareanearlakeZiway
9	Oromia	Adrought-proneruralarea
10	Oromia	Afast-growing town
11	Oromia	A relativelyrichruralareainthe outskirts ofDebrezeittown
12	SNNP	A denselypopulatedruralareagrowing
13	SNNP	A denselypopulatedtown
14	SNNP	Afast-growingbusinessandtouristtown
15	SNNP	A coffee-growingruralareainthe SNNPregion
16	SNNP	Apooranddenselypopulatedruralcommunity inthe SNNPregion
17	Tigray	Adrought-proneruralareahighlydependenton governmentsupport
18	Tigray	Anextremelypoorruralareadependenton the ProductiveSafetyNetScheme
19	Tigray	Asmall,verypoortowninthe Tigrayregion
20	Tigray	A modelruralareainthe Tigrayregionknown forits successinsoiland water conservation

The attrition rate is low compared to other longitudinal studies and is slightly lower than in the other study countries: 2.2% for the Younger Cohort and 8.4% for the Older Cohort since the start of the study.

Attrition between Round 1 and Round 4

	Younger Cohort		OlderCohort	
InitialsampleinRound1 (2002)	1999		1000	
Died	81	4.1%	8	0.8%
Refused	10	0.5%	12	1.2%
Untraceable	3	0.2%	7	0.7%
Livingabroad	30	1.5%	64	6.4%
InterviewedinRound4(2013)	**1875**	**93.8%**	**909**	**90.9%**
Attrition		2.2%		8.4%

Annex 8

General characteristics of the Young Lives sample

Round4(2013)	Younger Cohort		Older Cohort		Total	
	Number	%	Number	%	Number	%
Gender						
Male	990	52.8	488	53.7	1478	53.1
Female	885	47.2	421	46.3	1306	46.9
Total	**1875**		**909**		**2782**	
Location						
Urban	765	40.8	432	47.5	1197	43.0
Rural	1,109	59.2	477	52.5	1586	57.0
WeathIndex						
Bottomtercile	620	33.1	303	50.1	923	33.2
Toptercile	614	32.7	302	49.9	916	32.9
Region*						
AddisAbaba	272	14.5	130	14.3	402	14.4
Amhara	373	19.9	186	20.5	559	20.1
Oromia	378	20.2	185	20.4	563	20.2
SNNPR	472	25.2	217	23.9	689	24.7
Tigray	380	20.3	191	21.0	570	20.5
Caregiver'seducation						
Noeducation	970	51.7	438	48.2	1408	50.6
Lowerprimary	433	23.1	278	30.6	711	25.5
Upperprimary	289	15.4	121	13.3	410	14.7
MorethanGrade8	183	9.8	72	7.9	255	9.2
Religionofchild						
Orthodox	1323	70.6	664	73.0	1987	71.4
Muslim	310	16.6	130	14.3	440	15.8
Protestant	200	10.7	102	11.2	302	10.8
Other	40	2.2	13	1.5	53	1.9

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