SOCIOECONOMIC STATUS AND EARLY CHILDHOOD COGNITIVE SKILLS: IS LATIN AMERICA DIFFERENT?

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ABSTRACT

This paper documents disparities in cognitive development- as measured by PPVT test scores- between children from high and low-SES households in two different phases of childhood (pre and post early school years) in four developing countries. Intercontinental evidence on the timing, shape, pattern and persistence of these disparities is provided. Our analysis suggests that disparities found at age 5 persist into the early school years across all four countries. However, both the degree of persistence and the magnitude of the gap varies: the main result is that Peru stands out, not only as one of the countries with the largest cross-section disparity in cognitive achievement between rich and poor (of around 1.20 to 1.34 SD) at any given age, but mostly as the country with the highest persistence in cognitive achievement. The latter suggests lower opportunities for convergence in cognitive achievement between rich and poor over time. I also find that gradients in nutritional status (as measured by height-for-age) present similar patterns to the ones discussed for the PPVT, with the size of the gap in HAZ for 5-year-old Peruvian children being twice as much as that of the other three countries; suggesting that this is a channel that should be further explored.

KEYWORDS: cognitive skills, Latin America, inequality

1. INTRODUCTION

Household poverty has been associated as one of the main risk factors for a child to have poor nutrition and stimulation (Walker et al, 2011). Moreover, research from a number of developed (Connolly et al. 1992; Currie and Thomas 1999; Feinstein 2003; Robertson and Symons 2003; Case and Paxson 2008, Heckman et al 2010) and developing countries (Hoddinott et al, 2008; Maluccio et al, 2009; Behrman et al, 2009 and Walker et al, 2011) find that poor nutritional status and low levels of cognitive development in early childhood are important determinants of fewer years of schooling, less learning while in school, lower cognitive skills and worse health in adolescence (including mental health) and adulthood, lower probabilities of employment, lower earnings, lower wage rates and more criminal activity. This evidence points towards the fact that disadvantages found at early ages will result in the inter-generational transmission of poverty and inequalities.

Latin America (LAC hereafter) is the most unequal region in the world (Gasparini and Lustig, 2011 and IDB, 2011). One simple and intuitive measure of inequality is the ratio of the income or consumption of households at the 90th percentile of the distribution to those at the 10th percentile. Using data from around 2000, and ranking countries by this ratio, 14 of the 15 countries in the world with the highest levels of inequality are found in Latin America. Moreover, much of LAC's inequality is associated with inequality of opportunities, not just outcomes. That is, a substantial fraction of the inequality in incomes that is observed is determined by socioeconomic status (i.e., characteristics such as race, place of birth, wealth or the education levels of one's parents).

Understanding socioeconomic status (SES hereafter) "gradients" in cognitive skills early in a child's life is therefore a crucial step towards understanding the inter-generational transmission of poverty and inequality. The persistence between parents and children's outcomes is well documented (Black and Devereux, 2010), with the magnitude of the intergenerational (IG) correlation varying dramatically across countries and regions. In particular, Hertz et al. (2007) provide a survey of parent-child schooling correlations for a sample of 42 countries using comparable data and find that the correlation is 0.66 in Peru, 0.40 in Vietnam and 0.10 in Ethiopia (no data is available for India). Parent-child wages correlation show similar figures. Moreover, decompositions have shown that part of the observed IG correlation can be explained by the fact that parental SES strongly predicts cognitive and non-cognitive skills and health (Black and Devereux, 2010), [1] which is what motivates my interest in the SES-cognitive skills link in the first place.

Until very recently there were no comparable data on cognitive development of young children (0-6 years of age) for most developing countries (Young Lives, 2000) and therefore not much research exists on disparities in cognitive development by SES; when they arise, whom they affect and how they evolve as children age. Fernald et al (2011) and Naudeau et al (2011) use single cross-sections of data from low-income countries, while related research from Ecuador (Schady 2007, 2011) showed substantial differences in cognitive development at young ages between children of higher and lower socioeconomic status. Additionally, the SES "gradients" in

[1] Blanden, Gregg, and Macmillan (2007) examines the role of non-cognitive skills and ability for intergenerational income persistence in Britain. In their work, they demonstrate that covariates can account for approximately half of the estimated intergenerational income elasticity (of .32), with a sizeable portion attributable to cognitive and non-cognitive skills that work through educational attainment. Moreover, it has been fairly well established that better infant health has a positive causal effect on later adult outcomes (Currie and Moretti, 2003)

vocabulary increased between 3 and 5 year of age. However, the analysis from Ecuador included only households in the poorest half of the nationwide distribution of a composite measure of wealth, was limited to relatively young families, and only covered rural areas; with survey measurements only 2 years apart. The more related study to ours is Schady et al (2011) in which wealth gradients in five Latin-American countries (including Peru) are studied and in which substantial differences in the PPVT are found; and where these differences seem to persist as children age. However, none of these papers have provided intercontinental evidence on the persistence of PPVT scores using longitudinal data nor have they highlighted any significant disparities between countries.

Therefore, the contribution in this paper is the investigation of the relationship between SES and an important component of cognitive development—receptive language ability—for children 55 through 102 months of age in 4 developing countries in which the Young Lives (YL) study has collected extensive data. Specifically, I will provide intercontinental evidence on the persistence of PPVT scores using longitudinal data. I will also analyze whether the shape, timing, the pattern and persistence of these disparities is different or similar in Peru as compared to the other three YL countries in two different phases of childhood (pre and post early school years). As far as I know, no analysis has been done in this respect so far. 2 An understanding of what children are most likely to show deficits in cognitive development, at what ages these deficits become apparent and how they evolve as children age is indispensable for the formulation of appropriate policies.

I am most interested in, Peru because it is the 21st most unequal country in the world with a Gini of 0.48 (World Development Report, World Bank, 2005), and none of the other YL countries is anywhere close to that position in the ranking. [3] Not surprisingly, existing analysis of Round 1 and Round 2 data from YL shows that socioeconomic gradients between socioeconomic status (as measured by mother or father's education or wealth) and early childhood skills (as measured by the Peabody Picture Vocabulary Test) are present at age 5 (Sanchez, 2009). [4] However, this analysis has been done only for children 55 to 75 months. Extending the analysis (with the availability of Round 3 data) will give us a better picture of how these differentials evolve, particularly once these children are in school. Maybe differentials fade away due to the equalizing effect of schools, but this is an empirical question I will attempt to answer.

I will draw on the literature on SES and health (Currie, 2009; Currie et al, 2007 and Case et al, 2002, McGovern, 2011) and SES and cognitive skills (Victora et al, 2003; Halpern et al. 1996, Stein et al 2005), and particularly I will built on the work of Schady (2007, 2011) and Schady et al (2011) for the descriptive section. For the regression analysis I build on Todd and Wolpin (2007) value-added production function approach which allows us to go beyond all previous empirical studies on this topic.

Results show that although differences in cognitive skills between SES are present in all countries, they do arise more starkly in Peru, with a gap of around 1.20 to 1.34 SD between the poorest and the richest quartiles. For Peru, which has norms provided by test developers, these

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[2] An additional contribution is to see whether previous results from LAC hold for a nationally representative sample (like the Peruvian one) and with a survey that covers a longer period (there are about 4 years between Round 2 and 3 of our data, while in previous studies there were only 2 years).

[3] Urban India is found in the 84th place, Vietnam in the 87th, rural India in the 119th and Ethiopia in the 121st place in this ranking.

[4] These gradients have been found in other countries in Latin America, including in Brazil (Victora et al, 2003; Halpern et al. 1996), Ecuador (Schady, 2007, 2011) and Guatemala (Stein et al, 2005); but also in India (Lopez Boo, 2009).

differences imply developmental lags of up to 1 year at age 5. Using the value added regressions which exploit the longitudinal data, I find that Peru shows the highest coefficient of past PPVT on current PPVT, showing that *ceteris paribus* convergence between the rich and the poor will happen at a much slower speed in Peru than in the other 3 countries unless accompanied by appropriate policies. I also find that gradients in HAZ (height-for-age) show a similar pattern

The structure of the paper is as follows: in Section 2 I present the Analytical approach, Economic Framework and some brief descriptive analysis of the data. Section 3 presents the regressions, while section 4 discusses the results.

2. ECONOMIC FRAMEWORK AND DESCRIPTIVE ANALYSIS

2.1 Analytical approach

I use data for the 8,000 children in YL younger cohort data set speaking the majority language of the region or country (Amarigna in Ethiopia, Telugu in India, Spanish in Peru and Vietnamese in Vietnam) following Cueto et al (2009). It is worth noting that samples are not representative of each country. Moreover, in the case of India, the sample comes from one region from this country: Andhra Pradesh. For all countries the urban-rural divisions of the samples follow the same criteria given the identical sample designs of the YL study but I pool the data to obtain more precise estimates.

A major strength of our study is the use of a common measure of child cognitive development: performance on the widely-used Peabody Picture Vocabulary Test. Raw scores on this test, given by the number of items answered correctly, can be used to compare children of the same age but not to compare children of different ages. I therefore present results based on the following standardization of PPVT scores: separately by country, I constructed internally-standardized, age-specific z-scores by subtracting the month-of-age-specific mean of the raw score and dividing by the month-of-age-specific standard deviation. These results can be used to make comparisons within countries, including among children of different ages, but are not informative about differences across countries. I then use this method to see SES gaps within countries, and then compare those SES gaps (in SD) across countries. I restrict

I used wealth as a proxy of SES. I also sorted children into quartiles of the household wealth distributions and compared outcomes for children in the top and bottom quartiles. The wealth index score is a measure of the household's physical capital, and it is the simple average of three factors: housing quality, consumer durables and services. The "housing quality component" is based on the number of rooms per person in the household and the main materials used for the walls, roof and floor. The "consumer durable component" is based on the number of assets owned by the household (e.g. radio, refrigerator, bicycle, television etc, car), excluding productive assets. The "services component" is based on whether or not the dwelling has electricity, whether or not drinking water is piped into the dwelling, the type of toilet facility (private or shared with other households) and the main type of fuel used. The wealth index for each household is a score between 0 and 1. [5]

Lastly, I built a balanced panel of children present in both waves 2 and 3 of the YL data to analyse the evolution of the gaps in PPVT by SES. Specifically, I inspected age patterns in wealth gradients in child development using nonparametric regressions. [6] I split the sample in two: households in the first quartile of wealth and those in the fourth quartile. These results are presented in Figure 2. The nonparametric regressions smooth out average PPVT scores by age and make patterns more apparent. Similar methods have been used extensively in the literature in economics[7]; and, more recently, medicine. [8] Standard errors and confidence intervals for the

[5] Because associations between PPVT scores and wealth could differ between urban and rural areas, I calculated separate wealth indices and conducted separate analyses for urban and rural areas as a robustness test .

[6] Fan J, Gijbels I. *Local polynomial modelling and its applications.* Chapman and Hall, London, 1996.

[7] Deaton A. *The analysis of household surveys: A microeconometric approach to development policy*. Johns Hopkins University Press for the World Bank, 1997 and Case A, Lubotsky D, Paxson C. Economic status and health in childhood: The origins of the gradient. *American Economic Review* 2002; **92**(5):1308-1334.

[8] Park Y, Hunter DJ, Spiegelman D, Bergkvist L, Berrino F, van den Brandt PA, et al. Dietary fiber intake and risk of colorectal cancer: A pooled analysis of prospective cohort studies. JAMA 2005; 294(22):2849-2857. Moscicki A, Shiboski S, Hills NK, Powell KJ, Jay N, Hanson E, et al. Regression of low-grade squamous intraepithelial lesions in

nonparametric regressions were constructed by bootstrapping.[9] Lastly, I run value added production functions as explained in the next sub-section.

2.1.1 Economic Framework for the regression analysis

The educational production function literature commonly adopts value-added specifications when data on lagged inputs are missing or incomplete (see, e.g., Tamura 2001, Todd and Wolpin, 2007). In its most basic form, the value-added specification relates an achievement outcome measure to contemporaneous measures of school and family inputs and to a lagged (baseline) achievement measure. Then, if lagged cognitive skills (PPVT at age 5) is a sufficient statistic for input histories and unobserved ability, estimating that equation would give us consistent estimates of the production function of cognitive skills today (PPVT at age 8).

Following Todd and Wolpin (2007), our goal is to identify the relation between cognition and nutrition, and current (at age 8) and past (at age 5) cognition.

$$\theta_{it} = f\,(\text{nutrition, parental investment, controls}) \qquad (1)$$

$$\theta_{it} = \alpha_{it} + \beta H_{it} + \gamma X_{it} + \delta\, \mu_{it} + \varepsilon_{it} \qquad (2)$$

Where θ_{it} are cognitive skills of child i in time t, which depend on: child's nutrition status at the beginning of the period (H_{it}), the family's characteristics (X_{it}), and the child's ability (μ_{it}). The assumptions for the estimation are that: only contemporaneous inputs matter for the production of current cognitive skills (or inputs are unchanging over time) and contemporaneous inputs are uncorrelated with unobserved ability and unobserved inputs. Parents will then maximize utility derived from consumption (c), leisure (l) and their child's achievement (θ):

$$\text{Max}\ \ h, i\ U(c, l, \theta) \qquad (3)$$

subject to: a production function of cognitive skills (θ_t), $\theta_t = f\,(\theta_{t-1}, i_t, H_t, X_t, \mu_t)$, a production function for next period nutrition status $H_{t+1} = g(H_t, i_t, X_t, \mu t)$, a time constraint, where h are the total number of hours worked and l is leisure $l_t = 1 - h_t$ and a budget constraint. And where i_t are family inputs.

Given wages and prices, parents choose how much to work in the market, how much to invest in their child's production of cognitive skills and their child's nutrition. I assume that investment in nutrition only affects the child's nutrition status at the end of the period; and I assume that the production function has a value-added form, and it can be written as:

$$\theta_{it} = \alpha\, it + \beta Hit + \gamma Xit + \psi\theta\, it\text{-}1 + \delta\, \mu it + \varepsilon it \qquad (4)$$

young women. Lancet 2004; 364(9446):1678-83. Fleming S, Thompson M, Stevens R, Heneghan C, Plüddemann A, Maconochie I, et al. Normal ranges of heart rate and respiratory rate in children from birth to 18 years of age: A systematic review of observational studies. Lancet 2011; 377(9770):1011-18.

[9] Efron B, Tibshirani, RJ. An introduction to the bootstrap. New York: Chapman & Hall, 1993

2.2 SES and cognitive skills

Differences in language development between richer and poorer children within countries are large and statistically significant (t tests available upon request), both at age 5 and age 8. Figure 1 shows that these differences are biggest in Peru in both waves. In wave 2 there is a 1.29SD gap between the first and the fourth quartiles, followed at the distance by Ethiopia (1.19SD), Vietnam (0.88SD) and India (0.50SD)[10]. In Round 3, both Ethiopia and Peru present the widest gap (1.37SD and 1.34SD, respectively), but these two are not significantly different from each other.

[10] In the case of India, I have to note that caste of the children might be the best indicator to portrait Indian social inequalities rather than the wealth distinction I make in this paper.

Figure 1. Peabody Picture Vocabulary Test z-scores at age 5 and 8 by country and quintile of expenditure

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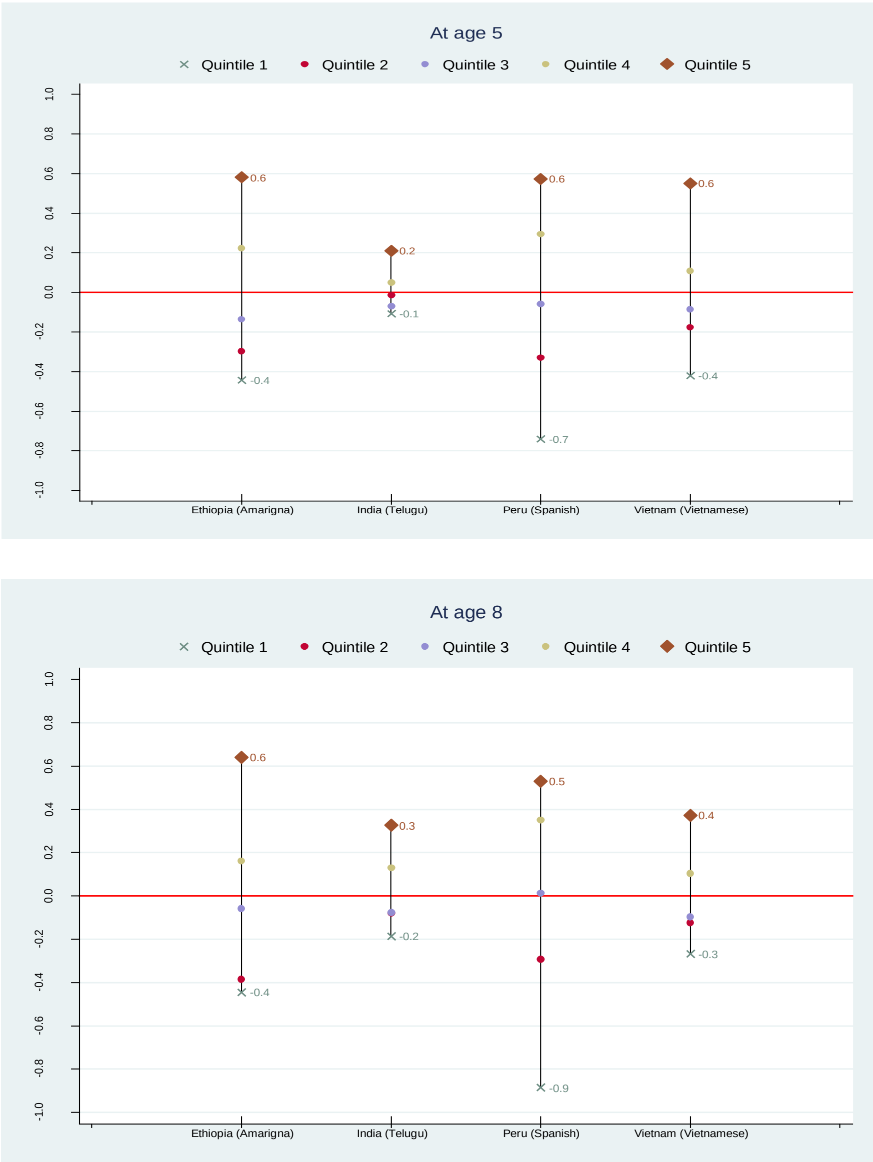

In Figure 2 I investigate age patterns in wealth gradients in child development using nonparametric regressions on the full panel sample. I split the sample in two: households in the first quartile (solid blue line) of wealth and those in the fourth quartile (solid red line) to do the graphs. The dotted redlines are the confidence interval for the fourth quartile, and the blue ones for the first quartile. These internally-standardized scores suggest that the bulk of the difference between poorer and less poor children is apparent by age 5 (around 60 months) in all four countries. [11] Looking at externally-standardized scores (only available for Peru, not reported but available upon request), I observe that by the time children are 5 ½ to 6 years of age, the poorest children in Peru are 35-40 points (approximately 2 ½ SD or 1 year) behind the reference population (see also Schady et al, 2013). [12] Unfortunately, it is not possible to perform this calculation for the other 3 countries as there are no externally-referenced tests in Vietnamese, Telugu or Amarigna.

In round 2, there is yet another peculiarity about Peru: Figure 2 shows that the gap starts somehow 'small' (0 to 0.5 SD) at age 55-58 months and reaches quite rapidly more than 1 SD by age 62 months. In all the other three countries, the gap starts at a certain level (1SD in Ethiopia for instance) and stays around that same level over time. This widening gap in this particular section of the age range in Peru is due to both the poorer children falling behind over time, and the richer ones progressing faster (up until age 63 months). However, after age 67 there seems to be some catch up between the rich and the poor, although the catch up it is not present anymore in Round 3. [13] In general, however, there is no clear pattern of a systematically widening gap, which contradicts the evidence in Schady (2007, 2011) for the Ecuadorian data (the only longitudinal data on PPVT I am aware of besides the YL data).

Round 3 data on the same children, shows that the wealth gradients that are apparent among 4-5 year old children continue to be apparent as these children enter the first years of primary school in all countries. On the other hand, the poorest children do not appear to fall further behind either. For all 4 countries, the gap between the PPVT score of children living in a household in the first quartile of the wealth distribution and those in the fourth quartile seems pretty stable over time once children are in school.

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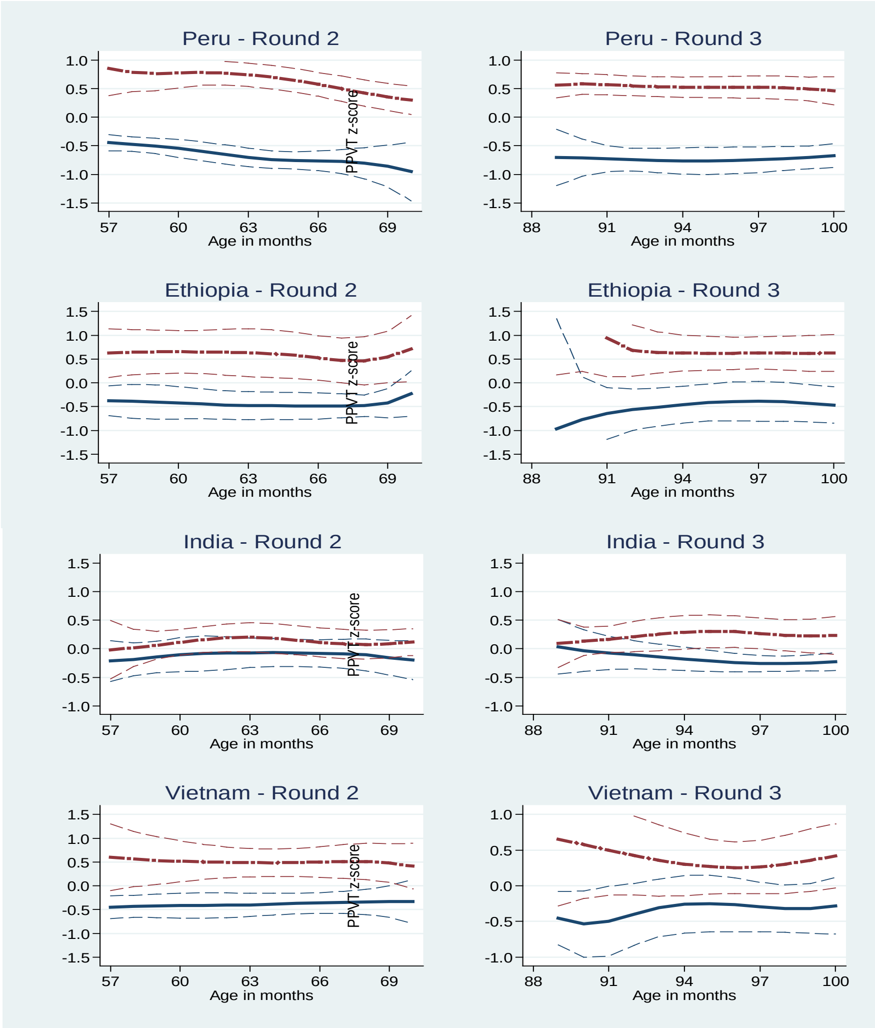
[11] Pre-school attendance rates in the four countries are quite similar in all countries; moreover the coefficient of preschool is not significant in our regressions.

[12] The calculation of the relative delays follows the next steps. First, I calculated the average raw score, by month of age, separately for children in urban and rural areas, and separately for children in the poorest and richest quartiles. Second, I used the tables provided by the PPVT (TVIP in Spanish) test developers to identify the age in months at which this raw score corresponds to a score of 100 in the reference population. The difference in the age at which children in our samples and children in the reference population attain the same vocabulary level is our estimate of the months delayed. Third, I report the difference in months delayed between children in the first and fourth wealth quartiles. The calculation of the relative delays gives equal weight to each month of age, within a country and by place of residence (urban or rural).

[13] As a robustness test, I have pooled the two rounds of data for each country and regress PPVT on wealth quartiles and the interactions of wealth quartiles with month dummies. The sum of the coefficient of the fourth quartile and its interaction with the coefficient of any given age month is the estimate of the disparity in PPVT between fourth and first quartile (i.e., the first quartile is the excluded dummy) at the given age. These coefficients were all statistically significant, positive and showed the same patter as the ones described in this paper.

Figure 2. Panel data analysis of PPVT age patterns: 4 Young Lives countries



Notes: As in all calculations in this paper, regressions are restricted to the panel of children observed on both rounds 2 and 3. The nonparametric regressions of PPVT score (internally standardized for main language group) on age in months, by wealth quartile (Q1 vs. Q4). The bandwidth of the regressions is 5. Data for children 88-91 months in Round 3 in Ethiopia have confidence intervals that are too wide to be reported (because of small sample size at those ages, given that when restricted to children with first language being Amarigna the sample from Ethiopia reduces in half of the total size), and that is why they have been dropped. The same applies for India for children 55-58 months.

Comment [T2]: revisar

2.3 SES and nutrition

Looking for some hypotheses behind the particular trend found in Round 2 for Peru, I look at one variable that has been shown to be the most important determinant of cognitive development: the (WHO standardized score of) height-for-age (HAZ hereafter), a proxy of chronic malnutrition, known to be strongly related with mental functioning, particularly during the first five years of life (Alderman, 2000, WHO, 2000; among many others). I look at its shape and patterns as children age. Table 1 reports average z-scores of the PPVT/HAZ for the fourth quartile in the first column, and for the first quartile in the second column. The third column presents the gaps and the fourth the p-value of the difference between the quartiles.

Table 1. HAZ and PPVT at age 5 and 8, gaps between 1st. and 4th quartiles and t-tests

	Ethiopia				India				Peru				Vietnam			
	Q.4	*Q.1*	*(Q4-Q1)*	*p-value*	*Q.4*	*Q.1*	*(Q4-Q1)*	*p-value*	*Q.4*	*Q.1*	*(Q4-Q1)*	*p-value*	*Q.4*	*Q.1*	*(Q4-Q1)*	*p-value*
HAZw2	0.2	-0.37	0.57	0.00	0.37	-0.19	0.57	0.00	0.48	-0.65	1.13	0.00	0.46	-0.25	0.71	0.00
PPVTw2	0.6	-0.59	**1.19**	0.00	0.38	-0.12	0.5	0.00	0.64	-0.65	**1.29**	0.00	0.53	-0.45	0.98	0.00
PPVTw3	0.65	-0.72	**1.37**	0.00	0.38	-0.19	0.57	0.00	0.59	-0.75	**1.34**	0.00	0.48	-0.56	1.04	0.00

When looking at the HAZ distribution, the picture is very different. The biggest gap in HAZ between the rich and the poor -at both age 5 (1.13 SD) and 8 (1.08 SD)- is found again among Peruvian children. Vietnam is the country with the second biggest gap in HAZ (0.71 in Round 2 - about half the gap in Peru - and-0.93SD in Round 3), followed by Ethiopia (0.57 in round 2 and 0.81SD in Round 3, less than half the gap in Peru) and India. [14] In general, the gaps in HAZ tend to increase over time (see Figure 3) with the exception of Peru (probably because it starts at an already very high level of inequality).

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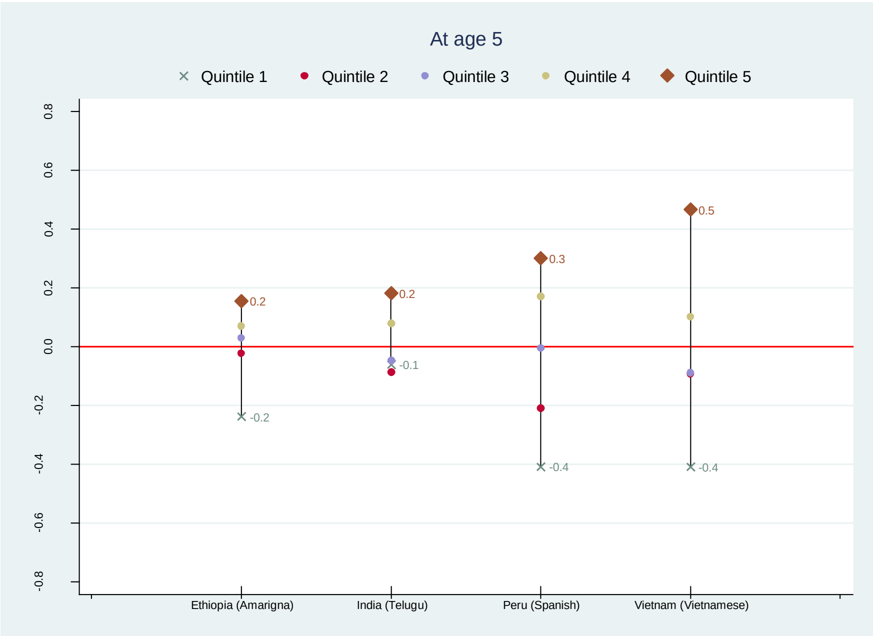
14 Given what is stated in the medical literature (WHO, 2000) in our regressions analysis I will look closely at HAZ at age 5 as it at this stage when nutritional status builds up.

Figure 3 Height-for- Age z scores at age 5, by country and quintile of expenditure

Comment [T3]: Reviser con esta nueva grafica



3. REGRESSION ANALYSIS

I run here a *value-added* specification, taking advantage of the longitudinal data. I control for standard variables at the child level (such as sex, age, attending school, birth-order) and household level (size, urban, wealth, education of caregiver and father) both *measured at age 8* which have all the expected sign. I also include (lagged) HAZ. Standard errors are clustered at the sentinel site level. Given our interest in the pattern of the PPVT over time and SES, the coefficient of interest is that of the lagged PPVT, and the fourth wealth quartile (with the first quartile as the omitted category). I also analyse the effects of past HAZ and instrument it with mother's height and HAZ at age 1.

Column (1) then is a regression of the PPVT at age 8 on the PPVT at age 5 with child and household controls. Here I see that the coefficients of interest are positive as expected. The coefficient on lagged PPVT is largest for Peru (0.42) and Vietnam (0.24). This means, that an increase of the PPVT at age 5 of one standard deviation will be associated with an increase in PPVT at age 8 of 0.42 SD in Peru and of 0.24 SD en Vietnam, 0.18 SD in India and 0.17SD in Ethiopia. These coefficients are interpreted in the education literature as "persistence" or depreciation rates of human capital. In this sense Peru has the highest persistence, and policies aimed at increasing vocabulary tests should be more effective (on average) in Peru than elsewhere. In terms of the wealth quartiles dummies, the coefficient of the fourth wealth quartile dummy says that ceteris paribus children in the fourth wealth quartile in Peru will have 0.24 standard deviations higher PPVT score from their age specific mean. This figure is 0.29 in Ethiopia, not significant at all in India no Vietnam. However, the coefficient on the wealth dummy in Ethiopia is significant and similar in magnitude (=0.28) when taking out the lagged PPVT score.

In column (2), I take out the fourth quartile dummy and these coefficients stay pretty much the same, implying that wealth has indeed an independent and significant effect on PPVT at age 8, above and beyond the effect of lagged PPVT.

In order to further investigate the relationship between wealth and lagged PPVT, in column 3, I do the opposite exercise of column 2, and take out lagged PPVT from the specification. Results show that the fourth wealth quartile dummy does not capture the effect of the lagged PPVT in India (insignificant coefficients) nor Ethiopia (coefficients on wealth dummy are not significantly different) but only in Peru (as the coefficient doubles) and Vietnam (as the coefficient becomes significant). [15] This seems another indication of signification interactions between SES and PPVT in Peru and Vietnam, but not in the other two countries.

Unobserved child, parents or household-specific factors may affect both nutrition and cognitive outcomes, which may lead to a correlation even though no causation exists. Since one important indicator of child malnutrition (low HAZ at age 1) and one of its major determinants (mother's height) are established well before the age at which the tests were given (age 5 and age 8), the identification problem is ameliorated (although not completely solved). That is why the specification in column (4) instruments past HAZ with mother's height and HAZ at age 1, but this does not change the coefficient on past PPVT nor those on wealth at all. [16] In this context, a Peruvian child who finds himself below the mean (z-score between -2 and 0) will improve less than children in the other countries, while a child above the mean will see his z-score decrease in relative terms but not as much as in the other 3 countries. [17] In other words, convergence between groups is going to be (ceteris paribus) around twice slower in Peru than in the other three countries.

The analysis of the IV results for the effect of HAZ at age 5 on the PPVT at age 8 suggests that by increasing HAZ by 1 SD at age 5, PPVT at age 8 could be improved by 0.15 SD in Peru and by 0.12 SD in India, but there is no effect on the other countries. An interpretation of this is that probably lagged PPVT is already capturing nutritional status (up until age 5) effects in Vietnam and Ethiopia and lagged PPVT are a sufficient statistic for all past inputs. However, it seems that in both Peru and India, there are *additional* effects of nutritional status *at* age 5

However, the coefficient of lagged PPVT should be interpreted with caution and not in a way reflecting a causal relationship because, by construction, it is correlated with fixed unobserved

[15] We have added the interaction of wealth with HAZ to see if that pattern would give us some hints on the channel nutrition-cognition, however although these interactions are all significant in column (3),they are all very close to zero.

[16] F-statistic from the first stage are: 87.42 for Vietnam, 69.37 for Peru, 30 for India and 136 for Ethiopia. R-squared of the first stage are 0.65, 0.48; 0.35; and 0.35, respectively. Over identification tests are available upon request

[17] Here is a numeric example a child with a z-score PPVT at age 5 of -1 , will end up of with a z-score PPVT of -0.43 in the next period and a child with +1, will end up with 0.43 (and a gap of 0.86). With a coefficient of 0.29 like Vietnam, the gap is smaller at 0.58.

child characteristics. This suggests that the estimated coefficient will conflate the effect of unobserved innate abilities of the child.

Last, but not least, I reject the assumption of lagged PPVT being a sufficient statistic for all historical inputs as if it were true, one would not expect that factors such as lagged HAZ is going to have a significant association with PPVT at age 8.

Table 2. OLS Regressions 4 YL countries.

Comment [T4]: comentar

	PERU	ETHIOPIA	INDIA	VIETNAM
	OLS	OLS	OLS	OLS
Female	-0.07	0.03	-0.26***	-0.04
	(0.044)	(0.075)	(0.056)	(0.055)
Region 1	-0.12	-0.08	0.21**	0.00
	(0.097)	(0.180)	(0.075)	(0.152)
Region 2	-0.07	-0.38*	0.65***	0.52***
	(0.081)	(0.186)	(0.118)	(0.141)
Urban	0.37***	0.91***	0.43***	0.37*
	(0.091)	(0.141)	(0.072)	(0.206)
Expq4	0.50***	0.42***	0.27***	0.31***
	(0.102)	(0.086)	(0.087)	(0.100)
Caregiver's edu	0.05***	0.01*	0.02***	0.02
	(0.008)	(0.003)	(0.004)	(0.011)
Father's edu	0.05***	0.00	0.01**	0.00
	(0.008)	(0.002)	(0.005)	(0.003)
HAz age 5 (z score)	-0.00***	-0.00**	-0.00	-0.00
	(0.000)	(0.001)	(0.000)	(0.000)
Mother's height	-0.00	0.00	-0.00	0.01**
	(0.000)	(0.002)	(0.004)	(0.006)
In school	0.53**	0.34***	0.24*	0.96***
	(0.247)	(0.082)	(0.134)	(0.181)
Constant	-2.57***	0.93	-0.26	-0.53
	(0.721)	(1.411)	(0.870)	(1.143)
Observations	1,612	626	1,467	1,155
R-squared	0.358	0.511	0.200	0.145
Child and HH controls	Yes	Yes	Yes	Yes
Expenditure	Yes	Yes	Yes	Yes

Table ~~2~~3. Value Added regressions 4 YL countries.

	PERU				ETHIOPIA			
	OLS	OLS	OLS	IV	OLS	OLS	OLS	IV
PPVT age 5 (z-score)	0.42***	0.43***		0.41***	0.17***	0.17***		0.16***
	(0.040)	(0.038)		(0.037)	(0.048)	(0.048)		(0.053)
Female	-0.05	-0.05	-0.06	-0.05	0.03	0.03	0.02	0.03
	(0.037)	(0.037)	(0.044)	(0.035)	(0.089)	(0.089)	(0.094)	(0.078)
Region 1	-0.06	-0.06	-0.13	-0.08	-0.33**	-0.28**	-0.29	-0.32**
	(0.089)	(0.090)	(0.110)	(0.088)	(0.148)	(0.121)	(0.166)	(0.141)
Region 2	-0.05	-0.04	-0.06	-0.05	-0.30	-0.33	-0.36*	-0.29
	(0.080)	(0.078)	(0.093)	(0.078)	(0.196)	(0.187)	(0.196)	(0.186)
Urban	0.22**	0.30***	0.32**	0.20**	0.86***	0.92***	0.91***	0.86***
	(0.085)	(0.071)	(0.112)	(0.083)	(0.207)	(0.185)	(0.191)	(0.193)
Wq4	0.24***		0.51***	0.21***	0.29*		0.31*	0.29**
	(0.084)		(0.094)	(0.078)	(0.154)		(0.162)	(0.139)
Caregiver's edu	0.03***	0.03***	0.04***	0.02***	-0.00	0.00	0.01	-0.00
	(0.006)	(0.007)	(0.008)	(0.007)	(0.012)	(0.012)	(0.013)	(0.011)
Father's edu	0.03***	0.04***	0.05***	0.03***	0.02	0.02	0.02	0.01
	(0.009)	(0.009)	(0.009)	(0.009)	(0.014)	(0.014)	(0.015)	(0.014)
HAZ age 5 (z-score)	0.08***	0.08***	0.12***	0.15***	0.00	0.01	0.03	0.02
	(0.023)	(0.023)	(0.028)	(0.032)	(0.032)	(0.035)	(0.039)	(0.077)
Mother's height	-0.00	-0.00	-0.00		0.00	-0.00	0.00	
	(0.000)	(0.000)	(0.000)		(0.006)	(0.006)	(0.007)	
In school	0.34	0.30	0.58**	0.32	0.36***	0.37***	0.33***	0.35***
	(0.202)	(0.216)	(0.235)	(0.209)	(0.083)	(0.089)	(0.092)	(0.088)
Constant	-4.28***	-4.27***	-2.29***	-4.05***	-0.54	-0.16	-0.49	-0.44
	(0.607)	(0.612)	(0.685)	(0.633)	(1.487)	(1.393)	(1.454)	(0.818)
Observations	1,610	1,610	1,610	1,610	399	399	399	399
R-squared	0.481	0.474	0.371	0.475	0.532	0.526	0.512	0.532
Child and HH controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wealth	Yes	No	Yes	Yes	Yes	No	Yes	Yes

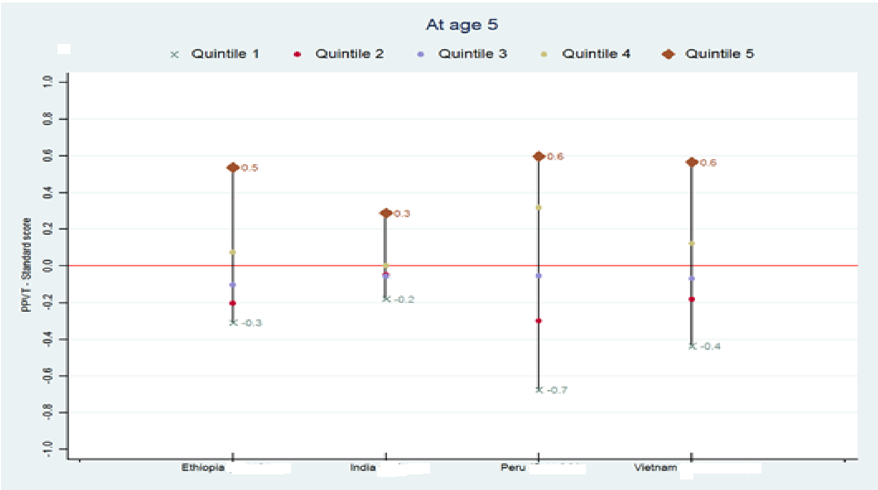
	INDIA				VIETNAM			
	OLS	OLS	OLS	IV	OLS	OLS	OLS	IV
PPVT age 5 (z-score)	0.18***	0.18***		0.17***	0.23***	0.24***		0.23***
	(0.028)	(0.028)		(0.029)	(0.029)	(0.028)		(0.030)
Female	-0.24***	-0.23***	-0.24***	-0.25***	-0.03	-0.04	-0.04	-0.03
	(0.061)	(0.060)	(0.061)	(0.060)	(0.048)	(0.052)	(0.050)	(0.048)
Region 1	-0.01	0.01	0.06	-0.03	0.01	-0.01	0.09	0.00
	(0.062)	(0.063)	(0.073)	(0.057)	(0.135)	(0.132)	(0.128)	(0.134)
Region 2	0.58***	0.57***	0.59***	0.56***	0.26***	0.31***	0.31**	0.25***
	(0.093)	(0.099)	(0.088)	(0.087)	(0.086)	(0.100)	(0.126)	(0.086)
Urban	0.23***	0.30***	0.25***	0.22***	0.17	0.17	0.30	0.17
	(0.076)	(0.087)	(0.085)	(0.069)	(0.206)	(0.218)	(0.216)	(0.198)
Wq4	0.19		0.17	0.17	0.18		0.28*	0.18
	(0.124)		(0.127)	(0.116)	(0.129)		(0.150)	(0.125)
Caregiver's edu	0.02**	0.03***	0.03***	0.03**	0.04***	0.05***	0.05***	0.04***
	(0.010)	(0.010)	(0.009)	(0.010)	(0.012)	(0.012)	(0.013)	(0.012)
Father's edu	0.02**	0.02***	0.02***	0.02**	0.03**	0.03***	0.03***	0.03***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)
HAZ age 5 (z-score)	0.10***	0.10***	0.12***	0.17***	0.04	0.04	0.07**	0.03
	(0.027)	(0.027)	(0.026)	(0.045)	(0.031)	(0.032)	(0.033)	(0.042)
Mother's height	-0.00	-0.00	-0.00		0.00	0.00	0.00	
	(0.004)	(0.004)	(0.004)		(0.005)	(0.005)	(0.005)	
In school	0.10	0.13	0.14	0.06	0.81***	0.82***	0.92***	0.81***
	(0.103)	(0.099)	(0.123)	(0.106)	(0.146)	(0.152)	(0.148)	(0.145)
Constant	0.17	0.20	0.26	-0.16	0.39	0.35	0.65	0.73
	(0.938)	(0.969)	(0.991)	(0.750)	(1.258)	(1.261)	(1.218)	(0.960)
Observations	1,188	1,188	1,188	1,188	1,112	1,112	1,112	1,112
R-squared	0.259	0.255	0.230	0.253	0.278	0.276	0.236	0.278
Child and HH controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wealth	Yes	No	Yes	Yes	Yes	No	Yes	Yes

4. ROBUSTENESS CHECKS

It is likely that the poorest children in all countries are being dropped from the sample above as a consequence of the strategy of only considering those children that speak the main language of the country. Because of this I present here below Figure 4, which replicates Figure 2 but for all children in each country sample, and Table 4 that replicates Table 2, but now including the variable "language used by child during administration".

Figure 4. Peabody Picture Vocabulary Test z-scores at age 5 and 8 by country and quintile of expenditure, all languages

Comment [T5]: Comentar estosnuevos graficos



At age 8
Quintile 1
Quintile 2
Quintile 3
Quintile 4
Quintile 5
PPVT - Standard score
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0.5
-0.3
0.3
-0.2
0.6
-0.8
0.4
-0.3
Ethiopia
India
Peru
Vietnam

	PERU	ETHIOPIA	INDIA	VIETNAM
	OLS	OLS	OLS	OLS
Female	-0.05	0.00	-0.24***	-0.05
	(0.036)	(0.048)	(0.053)	(0.053)
Age (in months)	0.01	-0.02***	-0.00	-0.03***
	(0.006)	(0.008)	(0.006)	(0.007)
Region 1	-0.12	0.36	0.30***	0.01
	(0.095)	(0.371)	(0.080)	(0.147)
Region 2	-0.10	-0.29	0.77***	0.49***
	(0.075)	(0.296)	(0.118)	(0.135)
Urban	0.35***	0.59***	0.29***	0.35*
	(0.090)	(0.180)	(0.077)	(0.195)
HHSIZE	-0.02**	-0.03***	-0.03***	-0.01
	(0.011)	(0.011)	(0.010)	(0.018)
Expq4	0.49***	0.46***	0.31***	0.30***
	(0.100)	(0.093)	(0.088)	(0.098)
Caregiver's edu	0.05***	-0.00	0.01***	0.02
	(0.007)	(0.003)	(0.003)	(0.011)
Father's edu	0.06***	0.00	0.01**	0.00
	(0.008)	(0.002)	(0.005)	(0.003)
HAz age 5 (z score)	-0.00***	-0.00	-0.00	0.00
	(0.000)	(0.001)	(0.000)	(0.000)
Mother's height	0.00	0.00	0.00	0.01**
	(0.000)	(0.002)	(0.004)	(0.005)
In school	0.44*	0.40***	0.23	0.99***
	(0.217)	(0.117)	(0.140)	(0.160)
firstborn	0.60***	0.18	-0.14	0.11
	(0.133)	(0.530)	(1.052)	(0.142)
lastborn	-0.01	0.08	-0.16***	-0.11*
	(0.039)	(0.057)	(0.046)	(0.062)
Language child admin.	-0.03	-0.03	0.03	-0.19***
	(0.022)	(0.029)	(0.037)	(0.055)
Constant	-1.03	1.73*	-0.43	-0.10
	(1.103)	(0.876)	(0.869)	(1.048)
Observations	1,732	1,585	1,766	1,173
R-squared	0.402	0.347	0.196	0.175
Child and HH controls	Yes	Yes	Yes	Yes
Expenditure	Yes	Yes	Yes	Yes

5. (PRELIMINARY) DISCUSSION OF RESULTS

In this paper I used data from the four YL countries to show that there are important differences in early language development between children in wealthier and poorer households. Latin America is one of the most unequal region in the world and our analysis suggests that the differences in income levels and in other measures of wellbeing that are apparent in adulthood arise early in children's lives. Although these differences arise in all countries, they do arise more starkly in Peru, our Latin-American country, vis a vis the rest of the countries.

The contribution of our study is that it is the first multi-continent comparison of wealth gradients in cognitive development for young children in the developing world over critical periods of their life courses. PPVT and HAZ inequalities are larger in Peru and in Ethiopia. The regression analysis shows that Peru has the highest persistence in terms of past-current PPVT in a value-added specification, which may be preventing a faster catch up between disadvantaged and better-off children. This persistence does not differentiate between boys and girls (results available upon request), but it does show differences between urban and rural households and between regions in Peru (see Tables 3 and 4).

Table 3. Value Added regressions: urban vs. rural households

	PERU		ETHIOPIA		INDIA		VIETNAM	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
PPVT age 5 (z-score)	0.49***	0.32***	0.17**	0.18*	0.19**	0.19***	0.14**	0.25***
	(0.046)	(0.044)	(0.054)	(0.088)	(0.087)	(0.025)	(0.056)	(0.033)
Female	-0.00	-0.11	0.11	-0.02	-0.45***	-0.18**	-0.01	-0.04
	(0.048)	(0.080)	(0.121)	(0.121)	(0.105)	(0.063)	(0.081)	(0.057)
Region 1	0.12**	0.05	-0.40**		-0.18	0.03	0.22	0.00
	(0.046)	(0.166)	(0.142)		(0.198)	(0.059)	(0.385)	(0.141)
Region 2	0.23**	-0.20***	-0.42*	0.01	0.50**	0.61***	0.06	0.23**
	(0.092)	(0.059)	(0.215)	(0.293)	(0.224)	(0.099)	(0.420)	(0.084)
Wq4	0.09	0.04	0.48**	-0.35*	-0.07	0.19	-0.19	0.15
	(0.090)	(0.161)	(0.186)	(0.177)	(0.166)	(0.147)	(0.806)	(0.134)
Caregiver's edu	0.01	0.03***	-0.01	-0.01	0.02	0.02**	0.05	0.04**
	(0.010)	(0.010)	(0.018)	(0.029)	(0.022)	(0.011)	(0.029)	(0.013)
Father's edu	0.01	0.05***	0.01	0.04***	0.04**	0.01	-0.01	0.03***
	(0.010)	(0.010)	(0.020)	(0.011)	(0.017)	(0.009)	(0.019)	(0.011)
HAZ age 5 (z-score)	0.05	0.11**	-0.03	0.02	0.09	0.10***	0.10	0.02
	(0.029)	(0.041)	(0.058)	(0.031)	(0.072)	(0.031)	(0.081)	(0.034)
Mother's height	-0.00	-0.00	0.01	-0.01***	0.02	-0.01	-0.00	0.00
	(0.000)	(0.001)	(0.011)	(0.002)	(0.015)	(0.004)	(0.005)	(0.006)
In school	0.83***	0.00	0.31	0.34***	0.38*	0.02		0.76***
	(0.260)	(0.153)	(0.229)	(0.097)	(0.209)	(0.086)		(0.130)
Constant	-4.29***	-4.15***	-2.43	2.38***	3.12	-0.25	5.36*	-0.10
	(0.740)	(0.617)	(1.997)	(0.587)	(2.810)	(1.057)	(2.586)	(1.500)
Observations	988	622	226	173	202	986	244	868
R-squared	0.439	0.310	0.145	0.263	0.259	0.227	0.172	0.298

Table 4. Value Added regressions: Peru, by region

	Costa	Sierra	Selva
PPVT age 5 (z-score)	0.48***	0.43***	0.23***
	(0.042)	(0.049)	(0.048)
Female	0.06	-0.16**	-0.01
	(0.037)	(0.063)	(0.103)
Urban	0.09	0.28**	0.07
	(0.100)	(0.105)	(0.055)
Wq4	0.12	0.22*	0.38*
	(0.084)	(0.120)	(0.181)
Caregiver's edu	0.00	0.04***	0.01
	(0.012)	(0.008)	(0.024)
Father's edu	0.01	0.04***	0.03
	(0.010)	(0.013)	(0.019)
HAZ age 5 (z-score)	0.07*	0.09**	0.10*
	(0.035)	(0.037)	(0.048)
Mother's height	-0.00**	-0.00	0.00*
	(0.000)	(0.001)	(0.000)
In school	1.04***	0.59	0.14
	(0.079)	(0.440)	(0.108)
Constant	-3.80***	-5.78***	-2.77*
	(0.671)	(0.904)	(1.234)
Observations	658	698	254
R-squared	0.440	0.508	0.367

Robust standard errors in parentheses
$***p < 0.01$, $**p < 0.05$, $*p < 0.1$

The analysis of the effect of HAZ at age 5 on the PPVT at age 8 suggests that lagged PPVT is a sufficient statistic for all past inputs in Vietnam and Ethiopia, but that is not the case for Peru and India, where is shown that by increasing HAZ by 1 SD at age 5, PPVT at age 8 could be improved by 0.15 SD in Peru and by 0.12 SD in India. Other determinants of HAZ and PPVT such as parental investments at birth, age 5 and age 8 are presented in the Appendix as background.

One possible venue that could be investigated (although I am not aware that the data exists) is how much of the higher persistence in Peru is explained by the correlation between SES of the child and school quality attended by this child. In a cross-country study (Heynemann and Loxley, 1983) it was found that this correlation was 0.25 for Peru, and 0.06 for India (with no data for neither Vietnam nor Ethiopia). [18] If new data of this kind became available this seems a promising venue to investigate the patterns found in this paper further.

Moreover, the analysis for Peru in relation to other countries (and continents) is particularly timely, as the Humala government has announced that Early Childhood Development (ECD) is a priority in his social policy agenda, and has already created a new program of integrated ECD

[18] In our data, 98% of Vietnamese children, 83% of Peruvian, 73% of Indian and 68% of Ethiopian children attend public schools.

services for poor households. These results would directly inform the debate in Peru and, more generally, in many countries in Latin America considering similar policy reforms. They reinforce with much more direct evidence the importance of programs directed towards poor children in developing countries emphasized in a prominent recent survey (Engle et al, 2011). A number of interventions have been shown to affect the cognitive development of young children in Latin America and the Caribbean, including preschool in Argentina (Berlinski et al, 2009) parenting interventions in Jamaica (Walker et al, 2011) nutritional supplements in Guatemala (Pollit et al, 1993) and cash transfers in Nicaragua (Macours et al, 2011). Extending the coverage of these and other programs is likely to be an important policy priority in Latin-American countries.

APPENDIX A ADDITIONAL TABLES.

Figure A.1a DISTRIBUTION OF EXPENDITURES IN 4 YL COUNTRIES.

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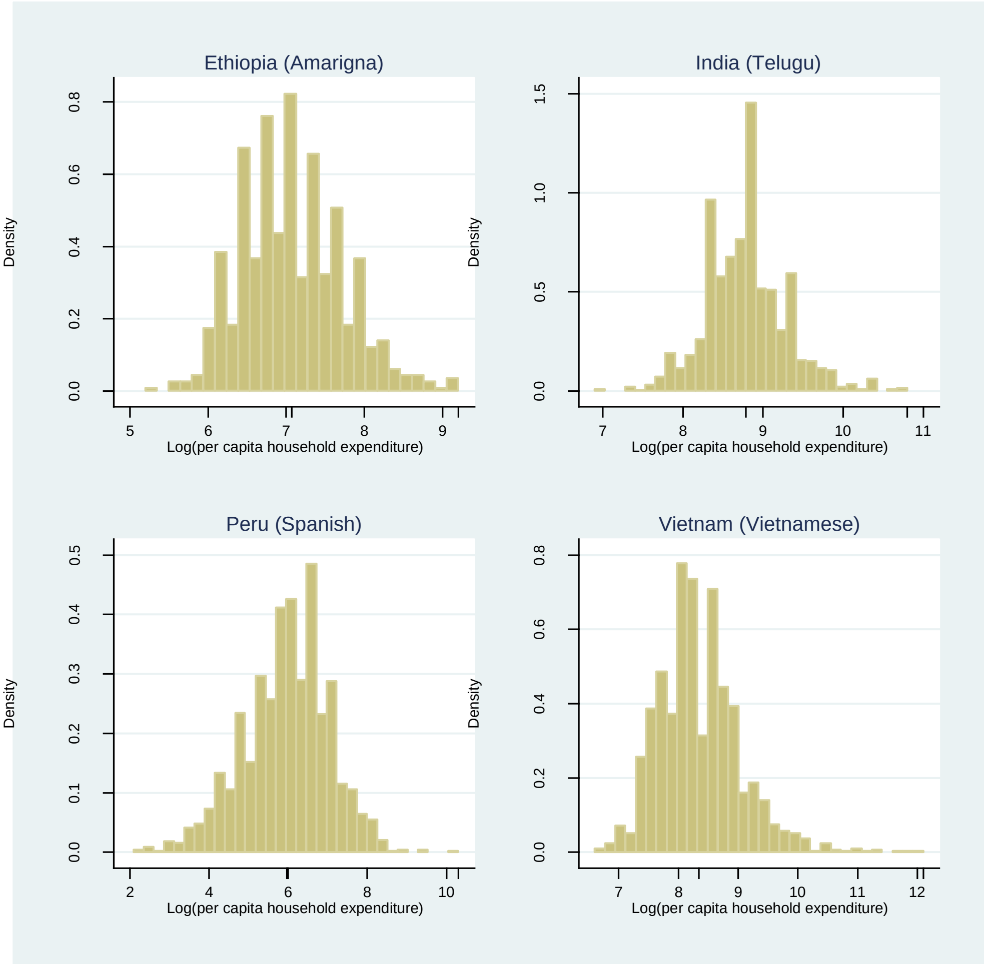

Figure A.1a DISTRIBUTION OF WEALTH IN 4 YL COUNTRIES.

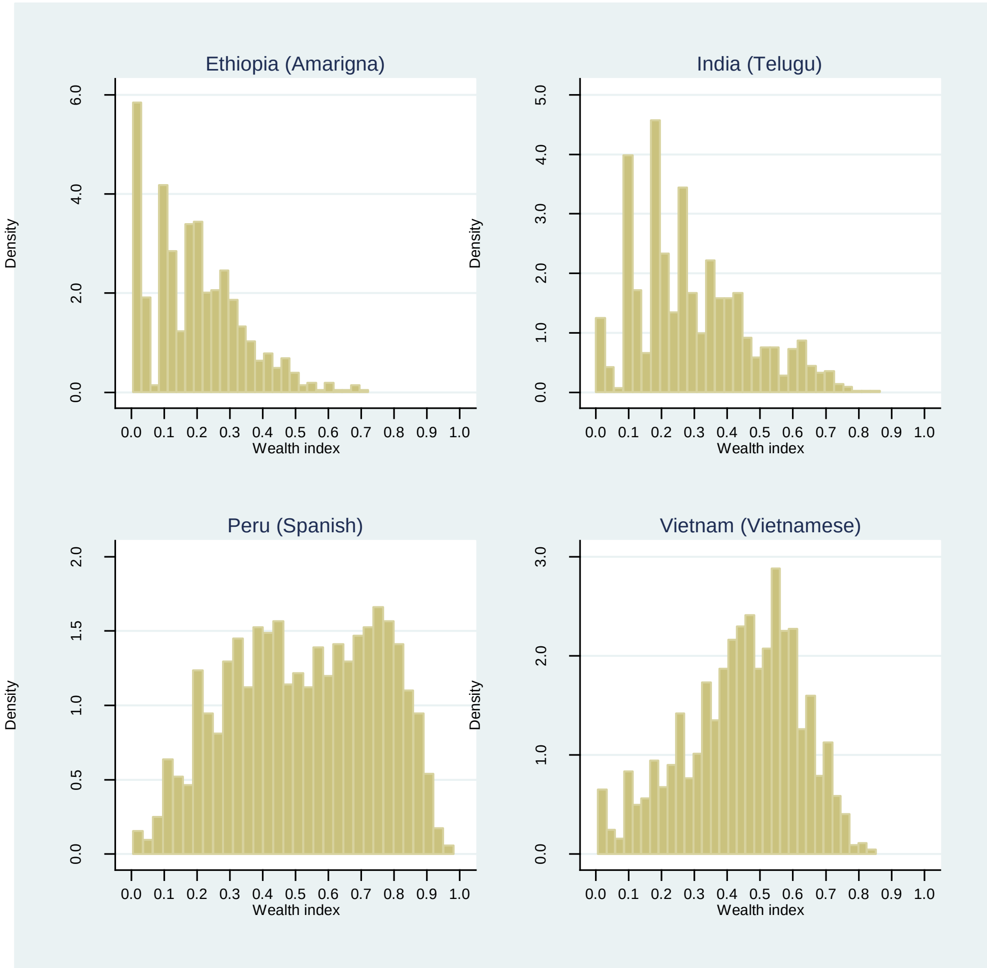

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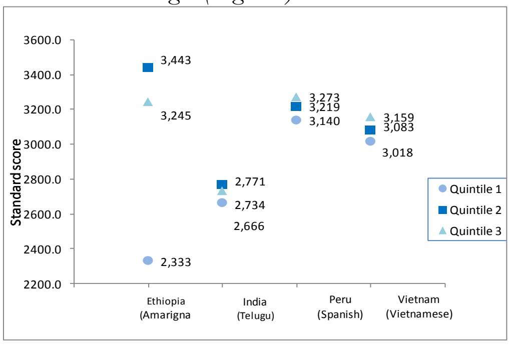
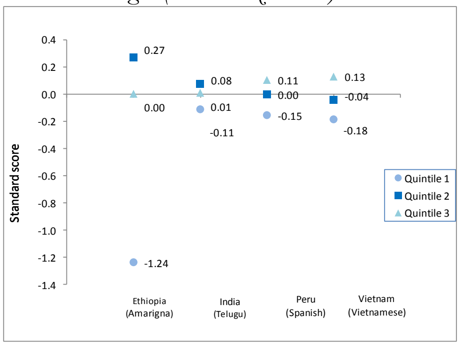
Figure A.1b Relationship between SES (wealth) and birth weight

Panel A: Birth weight (in grams)



Panel B: Birth weight (standardized score)



Note: Data for children speaking the majority language of the region or country .

Table A1. Parental Inputs at Birth

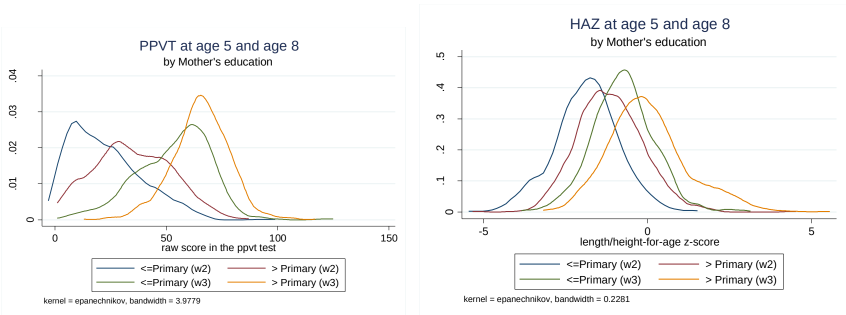
		Parental Inputs															
		See Dad Daily/Weekly		A Doctor or at least a Nurse Present at Birth		Medium/High Level of Antenatal care		BCG against tubercolosis		Polio		Measles		All Vaccines (BCG, Polio, Measles)		Mother takes Iron Folate Tablets	
	Wealth Index tertiles	%	Std score	%	Std score	%	Std score	%	Std score	%	Std score	%	Std score	%	Std score	%	Std score
Ethiopia	1	0.88	0.16	0.02	-0.54	0.07	-0.62	0.74	-0.22	.	.	0.40	-0.33	0.40	-0.29	.	.
	2	0.78	-0.09	0.09	-0.37	0.26	-0.22	0.74	-0.23	.	.	0.49	-0.14	0.44	-0.20	.	.
	3	0.80	-0.06	0.42	0.40	0.58	0.45	0.90	0.19	.	.	0.67	0.21	0.64	0.21	.	.
Obs.		750		779		691		773		.	.	766		768		.	.
India	1	0.98	0.00	0.38	-0.29	0.54	-0.20	0.92	-0.04	0.96	0.02	0.69	-0.09	0.68	-0.08	0.91	-0.09
	2	0.97	-0.04	0.50	-0.04	0.60	-0.09	0.93	0.00	0.96	0.01	0.77	0.08	0.75	0.07	0.94	0.02
	3	0.99	0.05	0.78	0.52	0.85	0.44	0.94	0.05	0.95	-0.05	0.74	0.02	0.73	0.02	0.95	0.09
Obs.		1585		1604		1560		1604		1603		1604		1603		1334	
Peru	1	0.83	-0.09	0.54	-0.43	0.64	-0.17	0.97	-0.07	.	.	0.34	-0.02	0.33	-0.02	.	.
	2	0.88	0.03	0.73	0.00	0.70	-0.03	0.97	-0.07	.	.	0.35	0.00	0.34	0.00	.	.
	3	0.88	0.05	0.89	0.37	0.79	0.17	1.00	0.12	.	.	0.35	0.01	0.35	0.02	.	.
Obs.		1768		1782		1708		1767		.	.	1753		1753		.	.
Vietnam	1	0.93	0.05	0.55	-0.41	0.33	-0.36	0.87	-0.09	.	.	0.63	-0.13	0.58	-0.10	.	.
	2	0.94	0.06	0.77	0.09	0.47	-0.09	0.89	-0.03	.	.	0.68	-0.02	0.61	-0.04	.	.
	3	0.93	0.03	0.81	0.19	0.70	0.38	0.96	0.22	.	.	0.75	0.14	0.72	0.20	.	.
Obs.		1921		1925		1881		1723		.	.	1757		1720		.	.

Appendix 2 A further look at Peru's inequalities

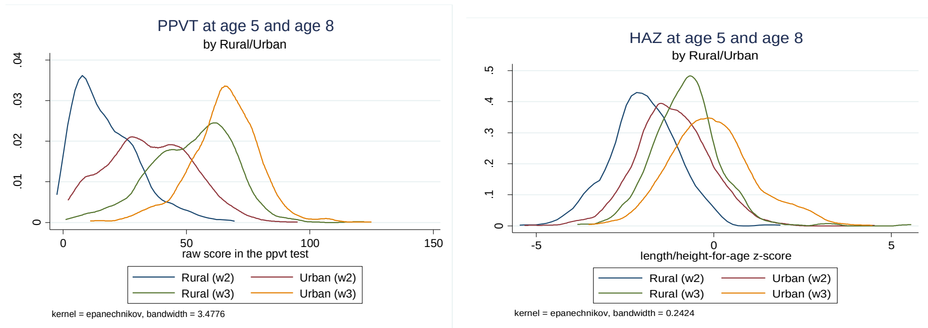
Having noticed that PPVT and HAZ inequalities are larger in Peru, in the following figures I show both distributions for children at age 5 and 8 evaluated at different proxies for household's SES to see if our previous result still hold. These proxies are: maternal education and rural versus urban status (Figure B1). I also look at these distributions by preschool enrolment status and birthweight (Figure B2), and by shocks *in utero* (B2), which have been shown to influence both variables of interest.[19]

Figure B1. PPVT and HAZ at Age 5 and 8: by mother's education and rural-urban area

<u>Panel A</u>



<u>Panel B</u>



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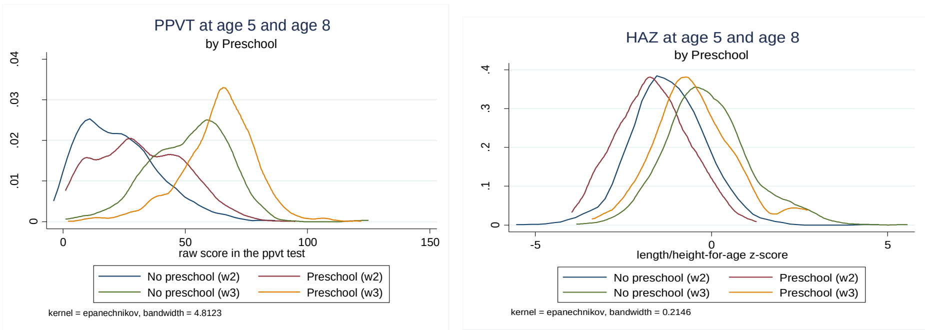
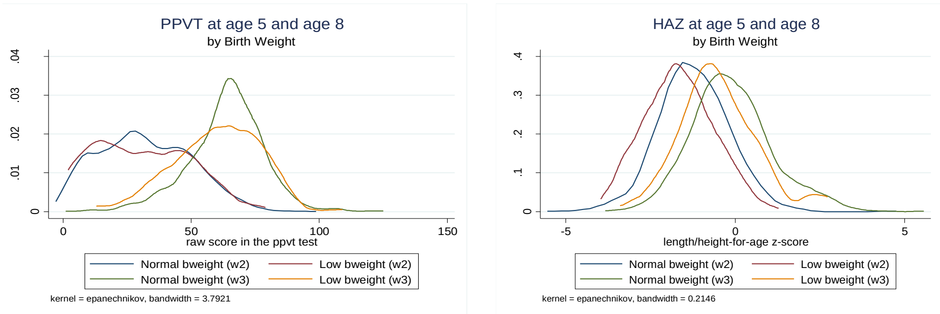
[19] We are aware that as McGovern (2011) argues that "finding that birth weight matters for later outcomes could simply reflect the fact that it is correlated with some other component of family background which is the true causal factor in determining later outcomes. For example, "bad" parents may have children of lower birth weight, and this may be the factor which actually influences the future status of children with poor early life health. Similarly, children of low birth weight may be more likely to attend lower quality schools or live in poorer neighbourhoods." If I do not take in account of the potential biases due to selection on unobservables the OLS estimates for either PPVT score or HAZ would be bias and the direction of the potential bias is not clear.

Figure B2. PPVT and HAZ at Age 5 and 8: by Preschool enrolment and birth-weight

<u>PANEL A</u>



<u>PANEL B</u>



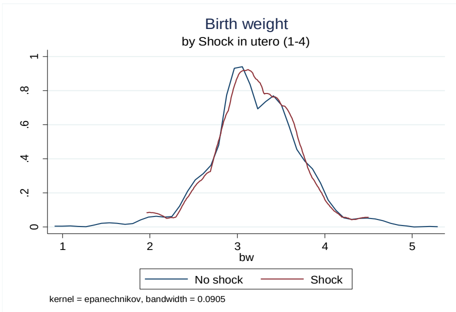
In Figure B1 I compare children whose mothers have no education or primary and those with higher education (Panel A) and children living in rural or urban area (Panel B). There are clear socio-economic gradient in cognitive skills and nutritional status, using both maternal education and urban/rural as proxies of SES.

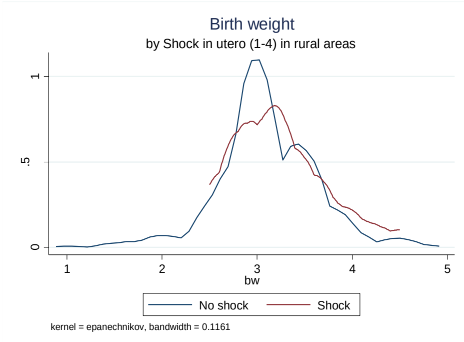
In Figure B2, I look at children enrolled in pre-school programs since age 3 and those who are not (Panel A) and finally I compare children with poor initial health endowment measured by low birth weight versus those children with a birth weight higher than 2.500 grams (Panel B). Early investment in education, such as preeschool plays a role and is positively associated on PPVT score; while low-birth-weight children have lower HAZ at both age 5 and 8 and slightly lower PPVT scores.

Our definition of shock *in utero* is such as to identify those children that suffer an <u>exogenous</u> shock while in the womb. These are: children whose mothers: suffered a natural disaster (only 12 children), suffered a decrease or change in food availability (52 children), livestock died (20 observations), or crops failed (38 observations). I have 104 children (about 5% of the sample) with such exogenous changes.

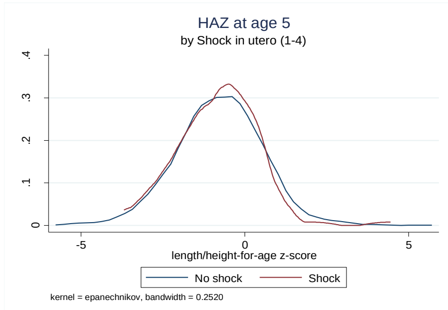
Figure B3. Shock in utero and birth weight and HAZ at Age 5 and 8

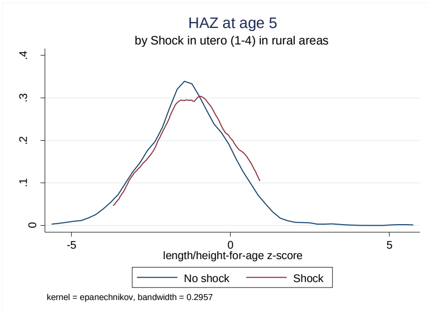
<u>*Birth weight*</u>



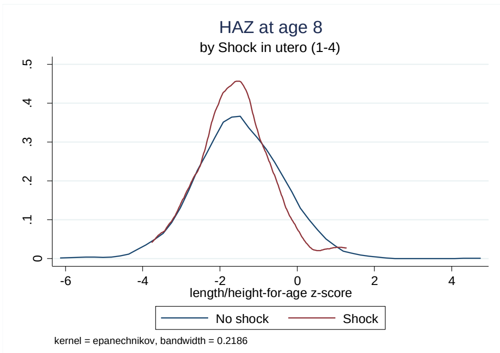


<u>*On HAZ at age 5*</u>





<u>*On HAZ at age 8*</u>



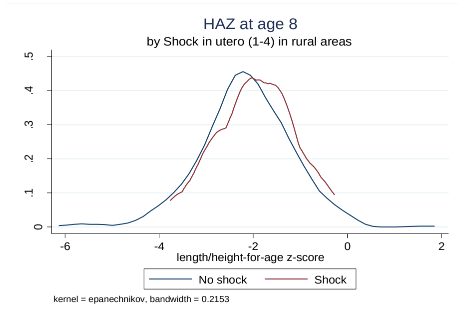


Figure B3 shows that these relationships are not significant. A negative shock *in utero* seems negatively correlated to birth weight and HAZ at age 5 just for those children living in rural/poorer areas: maybe because their mothers are more vulnerable (nutrition, health condition) and they have less resources to compensate for these shocks. Negative shocks *in utero* completely disappear and does not seem to affect AZ at age 8, especially in rural areas. This might be due to compensatory investments.

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