WPS6779

Policy Research Working Paper 6779

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Norbert Schady
Jere Behrman
Maria Caridad Araujo
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Florencia Lopez-Boo
Karen Macours
Daniela Marshall
Christina Paxson
Renos Vakis

The World Bank
Development Research Group
Poverty and Inequality Team
February 2014

Policy Research Working Paper 6779

Abstract

Research from the United States shows that gaps in early cognitive and noncognitive abilities appear early in the life cycle. Little is known about this important question for developing countries. This paper provides new evidence of sharp differences in cognitive development by socioeconomic status in early childhood for five Latin American countries. To help with comparability, the paper uses the same measure of receptive language ability for all five countries. It finds important differences in development in early childhood across countries, and steep socioeconomic gradients within every country. For the three countries where panel data to follow children over time exists, there are few substantive changes in scores once children enter school. These results are robust to different ways of defining socioeconomic status, to different ways of standardizing outcomes, and to selective non-response on the measure of cognitive development.

This paper is a product of the Poverty and Inequality Team, Development Research Group. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at rvakis@worldbank.org.

Wealth Gradients in Early Childhood Cognitive Development in Five Latin American Countries[1]

Norbert Schady,[1] Jere Behrman,[2] Maria Caridad Araujo,[3] Rodrigo Azuero,[4] Raquel Bernal,[5] David Bravo,[6] Florencia Lopez-Boo,[7] Karen Macours,[8] Daniela Marshall,[9] Christina Paxson,[10] and Renos Vakis[11]

Keywords: early childhood education, child development, social status, testing, Latin America

JEL codes: I24, I25
Sector Board: POV, EDU

[1] Inter-American Development Bank, Washington, DC, US, norberts@iadb.org
[2] University of Pennsylvania, Philadelphia, PA, US, jbehrman@econ.upenn.edu
[3] Inter-American Development Bank, Washington, DC, US, mcaraujo@iadb.org
[4] University of Pennsylvania, Philadelphia, PA, US, rodazuero@gmail.com
[5] Universidad de Los Andes, Bogotá, Colombia, rbernal@uniandes.edu.co
[6] Universidad de Chile, Santiago, Chile, microdatos@gmail.com
[7] Inter-American Development Bank, Washington, DC, US, florencial@iadb.org
[8] Paris School of Economics, Paris, France, karen.macours@parisschoolofeconomics.eu
[9] University of Pennsylvania, Philadelphia, PA, US, daniela.marshall@gmail.com
[10] Brown University, Providence, RI, US, christina.paxson@gmail.com
[11] World Bank Washington, DC, US, rvakis@worldbank.org

[1] Acknowledgments: This research was supported by the Inter-American Development Bank, the World Bank, the Eunice Shriver Kennedy National Institute of Child Health and Development (Grant R01-HD065436) and Grand Challenges Canada (Grant 10036540). The paper also benefited from two anonymous referees.

1. Introduction

Development in early childhood is an important predictor of success in adulthood in a number of domains. Research from multiple disciplines makes clear that outcomes in early childhood are malleable, although the window of opportunity may be short, especially for cognitive outcomes and nutritional status. There is also evidence from developed and developing countries that investments in early childhood can positively affect long-term trajectories (Almond and Currie 2011, and Cunha et al. 2006 are reviews for the United States; Engle et al. 2007, 2011 and Behrman et al. 2013 are reviews for developing countries that focus primarily on the medical literature).

This paper provides new evidence of sharp differences in cognitive development by socioeconomic status in early childhood for five Latin American countries. It complements research from the United States that shows that gaps in early cognitive and non-cognitive ability appear early in the life cycle. At age 3, the difference in cognitive scores between children of college graduates and high school dropouts in the United States is almost 1.5 standard deviations, and this difference is stable until (at least) 18 years of age (Heckman 2008). At age 5, children in the lowest income quartile have scores that are approximately 0.8 standard deviations lower than those in the highest income quartile on a math test (Cunha and Heckman 2007). Duncan and Magnuson (2013) report that average achievement gaps in math and reading between children in the top and bottom income quintiles are more than a full standard deviation at the beginning of kindergarten.

By and large, comparable evidence does not exist for developing countries. We are aware of only a handful of earlier studies that seek to measure socioeconomic differences in early childhood in developing countries. A study of poor children in rural Ecuador uses panel data to show that there are substantial differences in cognitive development at young ages, including in vocabulary, memory and visual integration, between children of higher and lower socioeconomic status. The socioeconomic gradients in vocabulary (but not in other measures of cognitive development) appear to increase between 3 and 5 years of age (Schady 2011, which builds on Paxson and Schady 2007). Two other studies use single cross-sections of data from low-income countries, specifically Madagascar (Fernald et al. 2011) and Cambodia and Mozambique (Naudeau et al. 2011). These studies also find substantial differences in cognitive development at young ages, with increasing gaps in the cross sections between 3 and 5/6 years of age for some, but not all, indicators of cognitive development.

Our paper substantially extends earlier work on the subject. We highlight three important contributions. First, we present results that are comparable for five countries, based on a common outcome measure, child performance on the *Test de Vocabulario en Imágenes Peabody* (TVIP). In all five countries, we observe socioeconomic gradients in cognitive development (albeit of different magnitudes), which suggests that this pattern is not idiosyncratic, country-specific, or a result of data mining. Moreover, in the rural areas of all five countries, and in the urban areas of Chile and Colombia the distribution of socioeconomic status in the surveys we use is broadly similar to the distribution of socioeconomic status in nationally-representative household surveys, further suggesting that the results we report have external validity, at least in rural areas.[2] Second, we show that our findings are robust to different ways of defining socioeconomic status, to different ways of standardizing outcomes, and to selective non-response on our measure of cognitive development. Finally, in three countries (Ecuador, Nicaragua, and Peru) we exploit the longitudinal structure of the data to analyze how deficits in receptive language ability observed at young ages evolve as children enter the early school years.

2. Data and setting

We begin by describing the surveys that we use for our analysis in Table 1. The table shows that the surveys we use vary in sample sizes and coverage. The largest samples are found in the survey for Chile (approximately 5,400 children) and the smallest in Nicaragua and Peru (between 1,800 and 1,900 children each). The Nicaraguan survey only sampled children in rural areas, while the data for Chile, Colombia, Ecuador and Peru covered both urban and rural areas. The age range of children in the surveys also varies. The test of child cognitive development we use, discussed in more detail below, is designed to be applied to children 30 months and older, and in most of our analysis we limit the sample to children ages 36-71 months of age. In practice, however, the oldest children in Chile are 57 months of age, while the youngest children in Peru are 53 months of age.

Table 1 also shows that in three of the countries we analyze, Ecuador, Nicaragua, and Peru, there is a panel component in the data. In Peru, there are two waves of this panel, separated by approximately three years; in Nicaragua, there are three rounds of data collected over a four-year period; in Ecuador, finally, there are four rounds of data collected over a seven-year period.

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[2] To make this comparison, we use nationally-representative household surveys in each of the five countries, restrict the list of assets and dwelling characteristics to those that are common to both the nationally-representative survey and the survey that was the basis for our analysis of the TVIP scores, and calculate wealth indices in the nationally-representative surveys, separately for urban and rural areas. We then re-calculate a wealth index in the surveys that we use to analyze the TVIP scores, giving each of the assets and dwelling characteristics the same weight that they receive in the calculation of the first principal component in the nationally-representative survey. Finally, we graph kernel densities of the distribution of wealth in both surveys (See Appendix Figure 1).

A major strength of our study is the use of a common measure of child cognitive development: performance on the widely-used *Test de Vocabulario en Imágenes Peabody* (TVIP), the Spanish version of the Peabody Picture Vocabulary Test (PPVT) (Dunn et al. 1986). Children are shown slides, each of which has four pictures, and are asked to identify the picture that corresponds to the object (for example, "boat") or action (for example, "to measure") named by the test administrator. The test continues until the child has made six mistakes in the last eight slides. The test is a measure of receptive vocabulary because children do not have to name the objects themselves and because children need not be able to read or write. Performance on the PPVT and TVIP at early ages has been shown to be predictive of important outcomes in a variety of settings.[3]

To analyze socioeconomic gradients in TVIP scores, we construct country-specific, 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, separately by country and by urban-rural place of residence (as in Cunha and Heckman 2007 and many others).[4] As a robustness test, we also report results that use the tables given by the test developers to standardize the test (as done by Paxson and Schady 2007).

A fraction of children in every survey, ranging from 2 percent in Colombia to 18 percent in Nicaragua, did not take the TVIP. Although we do not have data that are comparable across all 5 countries on the reasons why these children did not take the test, it appears that most of them had difficulty understanding the instructions and making it past the practice items that are applied at the outset. Consistent with this, there are more children with missing test data at younger ages, and more in the poorest country, Nicaragua. Earlier work on Ecuador has shown that children who miss a given test do worse on other tests, or on the same test in different survey waves, than other children with comparable wealth and parental schooling levels (Paxson and Schady 2010; Schady 2011). Because children who miss tests are likely to be "low performers", we assign these children a test score of zero. We test the robustness of our results to this approach to handling missing data.

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[3] Some examples include Schady (2011), who shows that children with low levels of TVIP scores before they enter school are more likely to repeat school grades and have lower scores on tests of math and reading in primary school in Ecuador; Case and Paxson (2008), who show that low performance on the PPVT at early ages predicts wages in adulthood in the United States; and Cunha and Heckman (2007) who use the National Longitudinal Survey of Youth (NLSY) to show that, by age 3 years, there is a difference of approximately 1.2 standard deviations in PPVT scores between children in the top and bottom quartiles of the distribution of permanent income in the United States, and that this difference is largely unchanged until at least 14 years of age. More generally, there is a large literature that shows that vocabulary size in kindergarten and earlier predicts reading comprehension throughout school and into early adulthood (see the discussion in Powell and Diamond 2012, and the references therein).

[4] These calculations give equal weight to each month of age, thereby standardizing for possible differences across samples in the age distributions of children. The t-statistics adjust for the possible correlation of errors at the level of communities or census tract in Colombia, Ecuador, Nicaragua, and Peru, and at the state level in Chile.

We construct a measure of household wealth by aggregating a number of household assets and dwelling characteristics using the first principal component. Similar wealth indices have been used extensively in the medical, demographic, nutritional, and economics literatures. The exact variables included in the wealth measures vary by country because of differences in the assets and dwelling characteristics that were collected in the surveys (see Appendix Table 1). As a robustness check, we test whether our results are sensitive to using consumption or education as an alternative measure of socioeconomic status, or to using only a common set of assets to construct the wealth index in all countries.

There are substantial differences across the countries we study in their level of development. Four of them, Chile, Colombia, Ecuador and Peru, are classified by the World Bank as upper-middle-income countries, while Nicaragua is classified as a lower-middle-income country. Chile is the richest of the five countries, with GDP per capita in 2010 above US $ 15,000, and Nicaragua is the poorest, with GDP per capita below US $ 3,000. The other three countries, Colombia, Ecuador, and Peru, all have per capita GDP levels between US $ 8,000 and US $ 9,500. The average grades of completed schooling of adults in each country follows the same pattern as GDP per capita, with approximately four more grades of schooling in Chile than in Nicaragua. Like other countries in Latin America, the countries we analyze are highly unequal. The Gini coefficient of household per capita income ranges from 0.48 for Peru to 0.56 for Colombia. In comparison, the Gini coefficient for Sweden is 0.25, and that for the United States is 0.41. The average Gini for OECD countries (excluding the two Latin American countries, Chile and Mexico) is 0.31.

3. Results

The aim of this paper is descriptive. In our main results we simply compare the TVIP scores for children in the top and bottom quartiles of the distribution of wealth. Because associations between TVIP scores and wealth could differ between urban and rural areas, we calculate separate wealth indices and conduct separate analyses for urban and rural areas.

Table 2 shows that differences in language development between richer and poorer children within countries are statistically significant and large. Differences across quartiles are biggest in urban Colombia (1.23 standard deviations) and rural Ecuador (1.21 standard deviations). Appendix Table 2 shows that, as expected, the differences between children in the richest and poorest deciles (as opposed to quartiles) are substantially larger—in both urban Colombia and rural Ecuador they are 1.64 standard deviations.

We next present the results from nonparametric (Fan) regressions (Fan and Gijbels 1996) of the difference in scores between children in the top and bottom quartiles, and the associated confidence intervals constructed by bootstrapping. Figure 1 suggests that the bulk of the difference between poorer and less poor children is apparent by age 3 years in all countries; Appendix Figure 2 shows that this is also the case in comparisons between the poorest and richest deciles. We note, however, that making comparisons of age gaps in test scores measured in standard deviations is not straightforward when the tests are measured with error. Suppose, as seems likely, that there is more measurement error in the TVIP at younger ages (for example, if younger children are more easily distracted). In this case, a finding of a constant gap in standard deviations of test scores as children age would be consistent with a decline in the *actual* (as opposed to *measured*) gap as children age.[5]

We conduct a number of robustness checks on our main results (Table 3). First, for four countries (Colombia, Ecuador, Nicaragua, and Peru) we present results in which we use a common set of household assets, rather than the largest set of assets available in the surveys for each country, to construct our measure of wealth. (We cannot do this for Chile because there are very few assets that are common to the Chilean and other data sets.) Second, for two countries in which consumption data are available (Colombia and Nicaragua), we sort households into quartiles using household per capita consumption, rather than wealth. Third, we compare outcomes for children of mothers with incomplete primary education or less and those with complete secondary education or more. Fourth, we restrict the sample to children of monolingual parents.[6] Fifth, we report results that use the norms provided by the test-developers (rather than the internal z-scores we construct) to standardize the TVIP.[7]

Table 3 shows that the patterns summarized above are robust. Results are very similar when only assets that are common across countries are used to construct the wealth index, or when we use consumption, rather than wealth, as a measure of wellbeing. There are substantial differences in child TVIP scores by mother schooling levels (incomplete primary or less, compared to complete secondary or more) in all countries. For example, in rural Ecuador the difference in outcomes

[5] We thank an anonymous referee for pointing this out to us.
[6] In Peru, the TVIP was translated into Quechua, an indigenous language spoken primarily in rural areas of the highlands, and children were given the option of taking the test in Spanish or Quechua. Twenty-two percent of children in rural areas, but only 0.1 percent of children in urban areas, chose to take the test in Quechua. Because children in households that speak Quechua or another indigenous language may have more limited vocabularies in any given language, and because the likelihood of being a non-Spanish speaker is correlated with household wealth, we exclude children with mothers who report they speak a language other than Spanish in Peru (56 percent and 17 percent in rural and urban areas, respectively) and Ecuador (2 percent in both urban and rural areas).
[7] The TVIP has been standardized by the test developers on samples of Mexican and Puerto Rican children to have an average score of 100 and a standard deviation of 15 at all ages. The lowest standardized score is 55.

between children of mothers with complete secondary schooling or more and those with incomplete primary schooling or less is 1.16 standard deviations. Excluding children in households where a language other than Spanish is spoken substantially increases the wealth gradient in rural Peru (from 0.77 to 0.95 standard deviations), but has little effect on the results for urban Peru, or urban or rural Ecuador.

Results that use the norms provided by the test developers (fifth row of the table) show similar wealth gradients as those we report in our main specification. Recall that the distribution of wealth in the data we use to calculate the TVIP scores is broadly similar to the distribution of wealth in nationally representative surveys for the rural areas of all five countries, and for the urban areas of Chile and Colombia. We can therefore also use these results to make (cautious) comparisons across rural-urban areas in these two countries and across rural areas in all five countries.

First, limiting the sample to rural areas, mean scores are highest in Chile (90 points), substantially lower in Colombia and Ecuador (78 and 75 points, respectively), and lower still in Peru and Nicaragua (69 and 66 points, respectively). This means that, in Nicaragua and Peru, the average child in the poorest wealth quartile in rural areas has TVIP scores that are more than two standard deviations below the reference population that was used to norm the test. The results for Peru are particularly noteworthy because GDP per capita levels in Peru are roughly comparable to those found in Colombia and Ecuador, and are approximately three times as high as those in Nicaragua. Second, children in urban areas have somewhat higher scores than those in rural areas in Chile (a difference of 6 points for those in the highest quartile), and substantially higher scores in Colombia (a difference of 26 points, more than 1.5 standard deviations, for those in the highest quartile). Of course, in interpreting these urban-rural comparisons, it is important to keep in mind that average income levels tend to be substantially higher in urban than in rural areas in most Latin American countries.

We also test the degree to which our results are sensitive to missing test data by calculating upper and lower bounds on the wealth gradients (last row of Table 3), in the spirit of Manski (1990) and Horowitz and Manski (2000). Specifically, we estimate the upper bound by excluding all children with missing test data in the richest wealth quartile, and assigning a score of zero to all children in the poorest wealth quartile who were missing the TVIP, as before. Conversely, we estimate the lower bound by excluding all children with missing test data in the poorest wealth quartile, and assigning a score of zero to all children in richest wealth quartile who were missing the TVIP, as before. Table 3 shows that the bounds that take account of missing test data are generally quite tight.

For example, in urban Chile, our basic estimate suggests that the difference in outcomes between children in the first and fourth wealth quartiles is 0.78 standard deviations, the lower bound on this difference is 0.74, and the upper bound is 0.83. Only in Nicaragua, the country with the largest number of children with missing test data, are the bounds somewhat wider, with a lower bound for the difference of 0.59 standard deviations and an upper bound of 0.99 standard deviations.

Although the aim of our paper is descriptive, and the data we have do not allow us to establish causality from socioeconomic status (whether measured by wealth, consumption or education) to child cognitive development, we make an attempt to deepen our understanding of the gradients we observe by carrying out some basic Oaxaca-Blinder decompositions. Specifically, we divide each of the samples for a given country and area (urban or rural) into children below and above the median level of wealth (Groups 1 and 2, respectively). We then closely follow Blinder (1973), and calculate the proportion of the total difference in outcomes between the two groups that can be attributed to differences in endowments (in our case, wealth), the difference in the returns to these endowments, and the unexplained portion of the differential (the difference in the intercepts). We carry out this decomposition with and without location fixed effects (states in Chile, communities or census tracts in the other four countries). The results from these decompositions are presented in Table 4.

We begin with a discussion of the results without location fixed effects (which are comparable to other results in the paper). The top panel of the table shows that, in 6 out of 9 cases (rural Chile, Ecuador and Nicaragua; urban Chile, Ecuador, and Peru), between 75 percent and 86 percent of the difference in TVIP scores between richer and poorer households is accounted for by differences in wealth endowments; in another case, urban Colombia, differences in endowments can account for the full difference in TVIP scores. Differences in the returns to wealth between Groups 1 and 2 are generally small.

On the other hand, the returns to wealth appear to be substantially higher among poorer households in the rural areas of Colombia and Peru. The overall difference in TVIP scores masks this difference in the returns. We do not know why the returns to wealth in the rural areas of Colombia and Peru would be different from those found in the rural areas of Chile, Ecuador, and Nicaragua. It is possible that more in-depth qualitative work would be informative. In the absence of such work, we cautiously conclude that, in most of the settings we study, the bulk of the difference in TVIP scores between richer and poorer households can be accounted for by the difference in endowments rather than differences in returns.

We next turn to the results that include location fixed effects, reported in the lower panel of Table 4. Including these fixed effects substantially reduces the difference in TVIP scores between richer and poorer households in Colombia, Ecuador and Nicaragua. This suggests that, in these three countries, a substantial portion of the socioeconomic gradients in cognitive development can be accounted for by residential sorting. Once we limit the comparisons to children who live in the same location, the gap between richer and poorer households is substantially smaller.

Finally, we use longitudinal data from rural Ecuador, rural Nicaragua, and rural and urban Peru to analyze possible changes in the wealth gradients as children age. For this analysis, we limit the sample to children who took the TVIP in all four survey waves in Ecuador (85 percent of children who took the TVIP at baseline), three survey waves in Nicaragua (92 percent), and two survey waves in Peru (96 percent). Figure 2 shows that in all three countries the wealth gradients that are apparent among 4-5 year old children are also apparent as these children age. In Ecuador, where the panel has the longest duration (7 years), differences in TVIP scores between wealthier and less wealthy children at 12-13 years of age, when children are of an age where they would be completing elementary school, are very similar to those found at 5-6 years of age. In all three countries, there is no evidence of catch-up. On the other hand, the poorest children do not appear to fall further behind either.[8]

4. Discussion and conclusions

Early childhood development has long-lasting consequences for adult success. Long-term panels that have followed children from early ages into adulthood show that children with poor levels of nutrition, inadequate cognitive development, and low levels of socio-emotional development tend to do badly in school, have higher levels of unemployment, earn lower wages (even controlling for schooling attainment), have a higher incidence of teenage pregnancy, are more likely to use drugs, are more likely to be involved in criminal activities, and have children with worse nutritional status.

Evidence on the extent to which there are shortfalls and socioeconomic gradients in cognitive development among young children in developing countries is very scarce. In this paper we use data from five countries in Latin America to show that there are important differences in early language development between children in wealthier and poorer households. Latin America is

[8] Of course, in the presence of noisy data, one must be cautious about interpreting these panel results for the same reason one must be cautious about interpreting age-patterns based on a single cross-section.

generally regarded as the most unequal region in the world (World Bank 2005). 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.

Our study has limitations. The lack of nationally-representative data for some countries and the lack of urban data for Nicaragua limit our comparisons. Also, our wealth measure is based on correlations of patterns of asset ownership and dwelling characteristics but does not include a complete list of assets and dwelling characteristics, and does not consider that such characteristics have different values (prices). Finally, we are able to compare only one measure of cognitive development across countries.

Nevertheless, the strengths of our study are considerable. It is the first systematic, multi-country comparison of wealth gradients in cognitive development for young children in the developing world over critical periods of their life courses. The gradients we observe are substantial. There are also large differences across countries in levels of child cognitive development. In the three countries where we can follow children over time, there do not appear to be substantive changes in the gradients once children enter school. This pattern, whereby socioeconomic gradients appear early and are largely unchanged after age 6 years, is similar to findings from the United States (Carneiro and Heckman 2003; Cunha and Heckman 2007; Brooks-Gunn at al. 2006).

Our results have important policy implications. They reinforce with much more direct evidence the importance of programs directed towards poor young children in developing countries emphasized in a prominent recent survey (Engle et al. 2011). Nevertheless, they also lead us to be somewhat pessimistic about closing these gaps because the magnitudes of the differential we find are large relative to the program effects that have been estimated in the literature. Berlinski et al. (2009) estimate that preschool attendance improves cognitive development by 0.23 standard deviations in Argentina; cash transfers to very poor households improve cognitive development by 0.18 standard deviations in Ecuador (Paxson and Schady 2010), and 0.10 standard deviations in Nicaragua (Macours et al. 2012); home visits are estimated to improve cognitive development of young children by approximately 0.25 standard deviations in Colombia (Attanasio et al. 2012). In this paper, we estimate that the difference between children in the poorest and the richest quartile in the countries we study are bigger than one standard deviation in urban Colombia and rural Ecuador, and larger than 0.75 standard deviations in the urban and rural areas of all five countries (with the exception of rural Colombia, where the difference is 0.57 standard deviations). Differences between children in the top and bottom deciles are of course even larger. The results in our paper underline the magnitude of the challenge faced by policy-makers seeking to close the gaps in development in early childhood in Latin America and, we suspect, in many other developing countries.

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Table 1: Surveys used in analysis

Country	Name of Survey	Years when Survey was Applied	Urban	Rural	Population Coverage	Age range for children (in moths)
			Children 36-71 months old in Survey			
Chile	Encuesta Longitudinal de la Primera Infancia	2010	4,800	594	Survey is nationally representative for households with children 5 years of age and younger	36-57
Colombia	Encuesta Longitudinal Colombiana de la Universidad de los Andes (ELCA)	2010	1,208	1,297	Urban sample representative of all but the richest 10 percent of population Rural sample representative for 4 geographic subregions	36-71
Ecuador	Ecuador Longitudinal Survey of Child Health and Development (ELSCHD)	Baseline: 2003-2004 1st follow-up: 2006 2nd follow-up: 2008 3rd follow-up: 2011	1,227	1,692	Families eligible or almost eligible for the *Bono de Desarrollo Humano* cash transfer program	36-71
Nicaragua	"Atención a Crisis" database	Baseline: 2005 1st follow-up: 2006 2nd follow-up: 2008	NA	1,817	Households representative for 6 rural municipalities targeted for the *Atención a Crisis* cash transfer program	36-71
Peru	Young Lives	Baseline: 2006-2007 1st follow-up: 2009	1,038	817	Representative for all but the richest 5% of districts in Peru	53-71

Note: In countries with more than one survey, the sample sizes refer to the baseline survey, as these are the results we use for the bulk of the analysis.

Table 2: Main results

		Chile		Colombia		Ecuador		Nicaragua	Peru	
		Urban	Rural	Urban	Rural	Urban	Rural	Rural	Urban	Rural
Wealth quartile	Richest quartile	0.42	0.47	0.77	0.25	0.46	0.63	0.52	0.50	0.43
	Poorest quartile	-0.36	-0.42	-0.46	-0.32	-0.41	-0.58	-0.25	-0.45	-0.35
	Difference	0.78	0.89	1.23	0.57	0.87	1.21	0.77	0.95	0.77
	t-statistic	12.28	7.64	13.96	7.58	9.41	8.27	6.51	8.12	5.29

Note: Clustering of standard errors is done at community or census tract level (Colombia, Ecuador, Nicaragua, Peru) and state level (Chile). The calculation of the mean scores gives equal weight to each month of age, within a country and by place of residence (urban or rural).

Table 3: Robustness checks and extensions

		Chile		Colombia		Ecuador		Nicaragua	Peru	
		Urban	Rural	Urban	Rural	Urban	Rural	Rural	Urban	Rural
Common set of assets*	Richest quartile			0.79	0.44	0.51	0.62	0.40	0.47	0.43
	Poorest quartile			-0.48	-0.25	-0.39	-0.54	-0.20	-0.56	-0.34
	Difference			1.27	0.69	0.90	1.16	0.60	1.03	0.77
	t-statistic			10.68	6.57	9.22	8.09	5.29	10.74	5.30
Consumption	Richest quartile			0.88	0.49			0.42		
	Poorest quartile			-0.43	-0.23			-0.21		
	Difference			1.31	0.72			0.63		
	t-statistic			13.03	6.55			5.37		
Education	Highest education	0.16	0.27	0.32	0.44	0.46	0.60	1.12	0.33	0.63
	Lowest education	-0.52	-0.33	-0.65	-0.23	-0.42	-0.56	-0.10	-0.80	-0.15
	Difference	0.68	0.60	0.97	0.68	0.88	1.16	1.21	1.13	0.78
	t-statistic	8.97	4.14	10.48	5.04	7.40	9.20	5.58	9.52	6.08
Children with monolingual Spanish-speaking mothers	Richest quartile					0.46	0.63		0.52	0.48
	Poorest quartile					-0.39	-0.57		-0.40	-0.47
	Difference					0.85	1.20		0.91	0.95
	t-statistic					9.05	8.30		7.52	4.44
Using external norms	Richest quartile	112.36	106.70	113.3	86.92	89.29	99.02	73.03	106.82	83.55
	Poorest quartile	96.65	90.32	88.55	78.29	73.62	75.08	65.62	86.99	69.20
	Difference	15.72	16.38	24.75	8.63	15.67	23.94	7.41	19.83	14.35
	t-statistic	-6.63	-6.70	-13.15	-6.86	-9.24	-8.23	-5.98	-8.47	-5.10
Lower and upper bound	Richest quartile	(0.38 , 0.43)	(0.41 , 0.52)	(0.76 , 0.79)	(0.24 , 0.25)	(0.39 , 0.61)	(0.57 , 0.68)	(0.35 , 0.63)	(0.49 , 0.51)	(0.35 , 0.51)
	Poorest quartile	(-0.36 , -0.40)	(-0.39 , -0.46)	(-0.46 , -0.47)	(-0.31 , -0.32)	(-0.33 , -0.46)	(-0.50 , -0.60)	(-0.23 , -0.36)	(-0.37 , -0.47)	(-0.29 , -0.43)
	Difference	(0.74 , 0.83)	(0.80 , 0.98)	(1.22 , 1.27)	(0.55 , 0.57)	(0.72 , 1.07)	(1.07 , 1.28)	(0.59 , 0.99)	(0.85 , 0.98)	(0.64 , 0.93)
	t-statistic	(11.40 , 15.70)	(7.90 , 7.80)	(13.70 , 14.60)	(7.30 , 7.60)	(7.30 , 11.10)	(7.20 , 8.80)	(5.00 , 8.00)	(8.00 , 8.50)	(3.80 , 6.60)

*Assets include: car, type of floor, type of walls, electricity, access to piped water, possession of cooking gas and refrigerator.

Note: Clustering of standard errors is done at the community or census tract level (Colombia, Ecuador, Nicaragua, Peru) and state level (Chile). The calculations of the mean scores give equal weight to each month of age, within a country and by place of residence (urban or rural). The fraction of mothers with incomplete primary or less education is 3.5% for urban Chile, 7.8% for rural Chile, 12.3% for urban Colombia, 38.5% for rural Colombia, 14.3% for urban Ecuador, 20.1% for rural Ecuador, 68.5% for rural Nicaragua, 11.1% for urban Peru and 51.3 for rural Peru. The fraction of mothers with complete secondary education or more is 66.3% for urban Chile, 42.5% for rural Chile, 53.5% for urban Colombia, 14.9% for rural Colombia, 26.5% for urban Ecuador, 23.8% for rural Ecuador, 3.7% for rural Nicaragua, 56.5% for urban Peru and 13% for rural Peru. Children of mothers who speak only Spanish account for 83% of the sample in urban Peru, 44.2% in rural Peru, 98.7% in urban Ecuador 98.8% in rural Ecuador.

Table 4: Oaxaca-Blinder Decomposition of Differences

		Chile		Colombia		Ecuador		Nicaragua	Peru	
		Urban	Rural	Urban	Rural	Urban	Rural	Rural	Urban	Rural
No Fixed Effects	Endowments	-0.39	-0.60	-0.74	-1.04	-0.44	-0.71	-0.32	-0.55	-0.92
	Coefficients	-0.07	0.02	-0.05	0.54	-0.20	-0.06	-0.04	-0.04	0.36
	Unexplained	-0.06	-0.08	0.06	0.02	0.08	-0.05	-0.07	-0.07	-0.02
	Total difference	-0.52	-0.66	-0.74	-0.48	-0.56	-0.82	-0.42	-0.65	-0.58
Fixed Effects	Endowments	-0.38	-0.42	-0.37	-0.52	-0.28	-0.29	-0.03	-0.42	-0.37
	Coefficients	-0.09	-0.06	-0.29	0.27	-0.12	-0.02	-0.13	-0.08	0.13
	Unexplained	-0.05	-0.06	0.40	-0.11	0.06	-0.02	-0.05	-0.05	-0.37
	Total difference	-0.52	-0.55	-0.26	-0.37	-0.34	-0.32	-0.22	-0.55	-0.61

Note: Group 1 = below wealth median, Group 2: above wealth median. Clustering of standard errors is done at community or census tract level (Colombia, Ecuador, Nicaragua, Peru) and state level (Chile). Fixed Effects estimates include community or census tract (Colombia, Ecuador, Nicaragua, Peru) and region (Chile) dummy variables. The calculation of the mean scores gives equal weight to each month of age, within a country and by place of residence (urban or rural).

Figure 1: Age patterns in scores

Notes: Nonparametric regressions of TVIP score on age in months, by wealth quartile. The bandwidth of the regressions is 7.5.

Figure 2: panel data analysis

Notes: Nonparametric regressions of TVIP score on age in months, by baseline wealth quartile. The bandwidth of the regressions is 7.5.

Appendix Table 1: Housing Conditions and Assets used for construction of wealth index

	Chile	Colombia	Ecuador	Nicaragua	Peru
Piped Water		x	x	x	x
Gas		x	x	x	x
Type of Toilet		x	x	x	x
Electricity		x	x	x	
Landline Phone		x			x
Mobile Phone	x				x
Access to Internet	x	x			
Type of Shower			x		
Access to Hot Water	x				
Sewer System		x			
Garbage Elimination System		x			
Exclusive Place for Cooking		x			
Private Place for Cooking		x			
Type of Cooking Fuel					x
Rooms in Dwelling			x		
Owns House				x	
Owns Working Animals				x	
Floor Material	x	x	x	x	x
Walls Material		x	x	x	x
Roof Material			x	x	x
Washing Machine	x	x	x		x
Dryer Machine*					x
Refrigerator	x	x	x	x	
Fridge			x		x
Microwave	x	x			x
Stove			x	x	
Mixer		x	x		
Blender			x		x
Oven		x			
Personal Computer	x		x		x
TV		x			x
Color TV			x		
Cable TV	x	x			
DVD	x				
VHS or DVD			x		
Video Camera	x	x			
Record Player					x
Video Games					x
Stereo		x	x		
Radio				x	x
Car		x	x	x	
Jeep				x	
Motorbike		x			x
Bicycle					x
Iron			x		x
Fan				x	x
Fumigator				x	
Shredder				x	
Floor Polisher					x
Loom**					x
Sewing Machine					x
Water Heater*					x

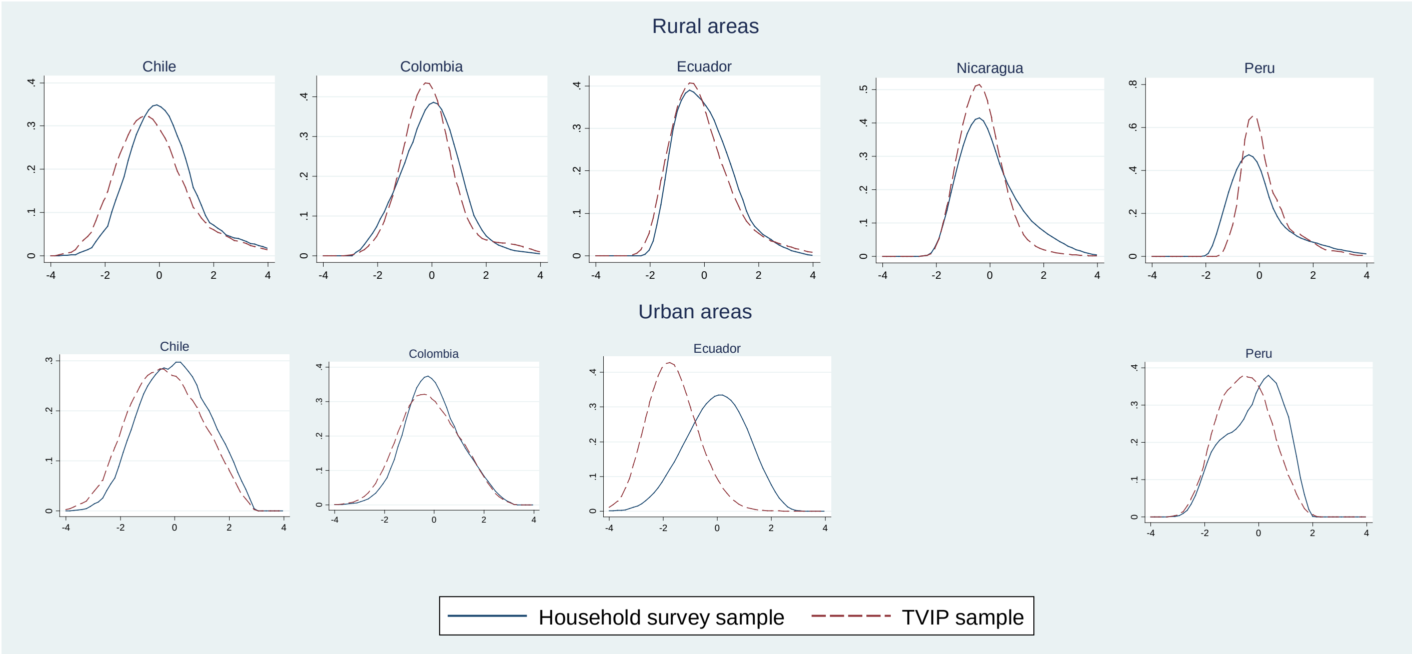
*Only used in urban sample
**Only used in rural sample

Appendix Table 2: Main results

		Chile		Colombia		Ecuador		Nicaragua	Peru	
		Urban	Rural	Urban	Rural	Urban	Rural	Rural	Urban	Rural
Wealth decile	Richest decile	0.52	0.44	0.91	0.26	0.73	0.98	0.76	0.85	0.78
	Poorest decile	-0.48	-0.60	-0.73	-0.47	-0.57	-0.65	-0.29	-0.72	-0.39
	Difference	1.00	1.04	1.64	0.73	1.30	1.64	1.05	1.56	1.17
	t-statistic	-9.83	-6.47	-12.57	-5.72	-8.52	-11.38	-7.27	-13.38	-6.28

Note: Clustering of standard errors is done at community (Colombia, Ecuador, Nicaragua, Peru) and region level (Chile). The calculation of the mean scores gives equal weight to each month of age, within a country and by place of residence (urban or rural).

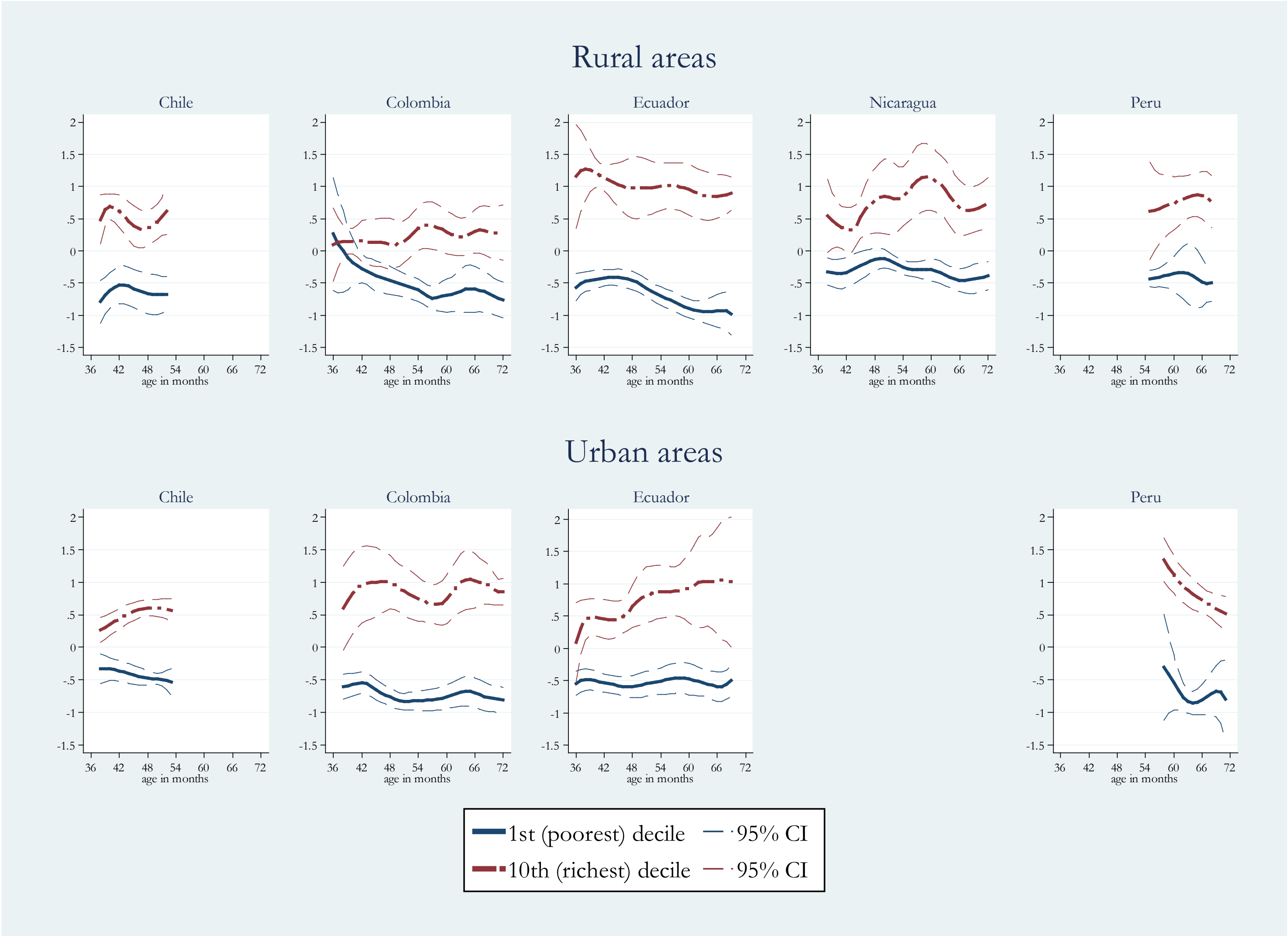
Appendix Figure 1: Distribution of wealth in survey used to calculate TVIP scores and nationally-representative surveys



Notes: Nationally representative surveys used: Chile, CASEN (2009); Colombia, GEIH (2009); Ecuador, ENEMDU, (2007); Nicaragua, EMNV (2005); Peru, ENAHO (2009).

List of common assets used in each country. **Chile**: refrigerator, washing machine, mobile telephone, access to internet, cable TV, type of floor and personal computer. **Colombia**: access to piped water, car, electricity, refrigerator, type of walls, type of floor, landline telephone, TV, personal computer, exclusive place for cooking, stereo, oven, microwave, access to internet, motorbike and cable TV. **Ecuador**: access to piped water, car, electricity, refrigerator, type of floor, blender, TV, personal computer, stereo, VHS or DVD, washing machine, rooms in dwelling and type of shower. **Nicaragua**: access to piped water, car, electricity, refrigerator, type of walls, type of floor, type of roof, type of toilet, radio and fan. **Peru**: access to piped water, type of walls, type of floor, type of roof, blender, TV, personal computer, iron, bicycle, motorbike, radio, washing machine, landline telephone and mobile telephone.

Appendix Figure 2: Age patterns in scores



Notes: Nonparametric regressions of TVIP score on age in months, by wealth quartile. The bandwidth of the regressions is 7.5.