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

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IDB

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Motivation

- Early childhood investments can have large returns for human capital development
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- Positive impacts of programs aimed at providing nutrition, psychosocial and educational inputs during early childhood (Nores and Barnett, 2010; Engle et al, 2011)
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  - Evidence from developmental psychology suggests that measures of cognitive skills are set early on in life (Sameroff et al, 1993)

However, uncertainties prevail regarding disparities in cognitive development by SES; when they arise, whom they affect and how they evolve as children age, particularly so for developing countries.
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2. Much of LAC's inequality is associated with inequality of opportunities, not just outcomes. That is, a substantial fraction of the observed inequality in incomes is determined by SES.
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  - Much of LAC's inequality is associated with inequality of opportunities, not just outcomes. That is, a substantial fraction of the observed inequality in incomes is determined by SES.
- Peru, one of the countries of interest in this work, is the 21st most unequal country in the world with a Gini of 0.48, with none of the other 3 countries/continents under study anywhere close to that position in the ranking.
What this paper does

Goal:

*Study disparities in cognitive development, and their persistence, between children from high and low-SES households in four developing countries over two phases of childhood: pre-school and school ages.*
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- Use rich measures of cognitive outcomes, parental characteristics and inputs, and anthropometrics provided by the Young Lives longitudinal data.
- Assess whether there are socioeconomic differences that emerge in early cognition and how these differ by country and by age.
- Estimate a value added production function identifying the relation between cognition in the pre-school years and cognition at age 8; and between nutrition and cognition.
Data

- Data from the Young Lives (YL) Project
- Two cohorts of children over three rounds: Round 1 (2002), Round 2 (2006) & Round 3 (2010), with very low attrition rate (0.9%)
- Younger Cohort: N =2000 (in each country); Round 1 (age 1), Round 2 (age 5) & Round 3 (age 8)
- Concentrate on balanced panel of children present in waves 2 and 3 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)
Key Variables

- Use wealth as a proxy of SES
- Major strength of the study is the use of a common measure of child cognitive development: performance on the widely-used Peabody Picture Vocabulary Test (PPVT) at ages 5 and 8
- Use WHO standardized score of height-for-age (HAZ), 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)
PPVT z-scores by country and quartile of wealth
PPVT z-scores by country and quartile of wealth

At age 5

At age 8
HAZ z scores by country and quartile of wealth

At age 5

Ethiopia (Amarigna)  India (Telugu)  Peru (Spanish)  Vietnam (Vietnamese)

Standard score

-1  - .6  -.4  -.2  0  .2  .4  .6  .8  1

Quintile 1  Quintile 4
HAZ z scores by country and quartile of wealth

At age 5

At age 8
Panel data analysis of PPVT age patterns: 4 Young Lives countries
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Figure: Panel data analysis of PPVT age patterns: 4 Young Lives countries
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The goal is to identify the relation between past and current cognition; and
cognition and nutrition

\[ \theta_t = f(\text{nutrition}, \text{controls}) \]  

Assumptions:
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.
Methodology

- The goal is to identify the relation between past and current cognition; and cognition and nutrition

\[ \theta_t = f(nutrition, controls) \]  \hspace{2cm} (1)

\[ \theta_{it} = \alpha i_{it} + \gamma H_{it} + \delta X_{it} + \beta \mu_{it} + \varepsilon_{it}. \]  \hspace{2cm} (2)

Assumptions:
- 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.
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Assumptions:

- Only contemporaneous inputs matter for the production of current cognitive skills
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$$\theta_t = f(nutrition, controls)$$  \hspace{1cm} (1)

$$\theta_{it} = \alpha i_{it} + \gamma H_{it} + \delta X_{it} + \beta \mu_{it} + \varepsilon_{it}. \hspace{1cm} (2)$$

Assumptions:
- Only contemporaneous inputs matter for the production of current cognitive skills
- or inputs are unchanging over time
The goal is to identify the relation between past and current cognition; and cognition and nutrition

\[ \theta_t = f(\text{nutrition, controls}) \]  

\[ \theta_{it} = \alpha i_{it} + \gamma H_{it} + \delta X_{it} + \beta \mu_{it} + \varepsilon_{it}. \]

Assumptions:
- 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 maximize utility derived from consumption, leisure and their child’s achievement (our measure of the child’s human capital):

$$\max_{h, i, ih} U(c, l, \theta)$$  \hspace{1cm} (3)

subject to:

- a production function of cognitive skills ($\theta_t$)
  $$\theta_t = f(\theta_{t-1}, i_t, H_t, X_t, \mu_t),$$

- a production function for next period nutrition status
  $$H_{t+1} = g(H_t, ih_t, X_t, \mu_t),$$

- 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.
  $$wh_t = c_t + p_i i_t + p_h ih_t.$$
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. We assume that investment in nutrition only affect the child’s nutrition status at the end of the period.

One assumption is that the production function has a value-added form, and it can be written as:

$$\theta_{it} = \alpha i_{it} + \gamma H_{it} + \delta X_{it} + \varsigma \theta_{it-1} + \beta \mu_{it} + \epsilon_{it}$$ (4)
### Table: The production function of skills, value added specification for 8 years old (OLS)

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<thead>
<tr>
<th>VARIABLES</th>
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<th>ETHIOPIA</th>
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<th></th>
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<td>(0.037)</td>
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<td>(0.090)</td>
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<td>0.26***</td>
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<td></td>
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<td>0.03***</td>
<td>0.06***</td>
<td>0.06***</td>
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<td>(0.006)</td>
<td>(0.007)</td>
<td>(0.007)</td>
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<td>0.07***</td>
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<td>(0.023)</td>
<td>(0.028)</td>
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<td>0.05*</td>
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<td>(0.003)</td>
<td>(0.003)</td>
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<td>(0.003)</td>
<td>(0.003)</td>
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<td>(0.003)</td>
<td>(0.003)</td>
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<td>1,686</td>
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<tr>
<td>R-squared</td>
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<td>0.486</td>
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<td>Child and HH controls</td>
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<td>Yes</td>
<td>Yes</td>
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<td>HAZ X wealth</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>PPVT X wealth</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
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| VARIABLES | INDIA | | | VIETNAM |
|-----------|-------| | |-------|
| | PPVT age 8 | | | PPVT age 8 |
| PPVT age 5 | 0.28*** | 0.19*** | 0.14** | 0.36*** | 0.28*** | 0.36*** |
| | (0.042) | (0.034) | (0.053) | (0.055) | (0.038) | (0.072) |
| Urban | 0.27* | 0.27* | 0.31** | 0.31** | -0.09 | -0.08 | 0.02 | 0.05 |
| | (0.154) | (0.154) | (0.148) | (0.149) | (0.215) | (0.217) | (0.237) | (0.238) |
| wq4 | 0.22 | 0.22 | 0.26* | 0.19 | 0.53*** | 0.51*** | 0.72*** | 0.51** |
| | (0.131) | (0.125) | (0.138) | (0.152) | (0.149) | (0.142) | (0.202) | (0.200) |
| z tvipR2 wq2 | 0.10 | | | 0.10 | | | -0.06 | |
| | | | | | | | (0.072) | (0.095) |
| z tvipR2 wq3 | -0.00 | | | -0.00 | | | -0.15 | |
| | | | | | | | (0.078) | (0.117) |
| z tvipR2 wq4 | 0.08 | | | 0.08 | | | -0.08 | |
| | | | | | | | (0.077) | (0.094) |
| Mom Edu | 0.02*** | 0.02*** | 0.02*** | 0.02*** | 0.01 | 0.01 | 0.02 | 0.02 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.009) | (0.009) | (0.011) | (0.011) |
| HAZ age 5 | 0.11*** | 0.10*** | 0.12*** | 0.15*** | 0.08** | 0.08** | 0.12*** | 0.21*** |
| | (0.032) | (0.031) | (0.028) | (0.029) | (0.032) | (0.031) | (0.041) | (0.067) |

| | Observations | R-squared | | | | | | |
| | 1,524 | 1,239 | 1,239 | 1,239 | 1,239 | 1,679 | 1,164 | 1,164 | 1,164 | 1,167 | 1,167 |
| | 0.076 | 0.181 | 0.182 | 0.148 | 0.148 | 0.131 | 0.240 | 0.240 | 0.172 | 0.178 |

<table>
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<tr>
<th>Child and HH controls</th>
<th>No</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>No</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
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<tbody>
<tr>
<td>HAZ X wealth</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<td>Yes</td>
</tr>
<tr>
<td>PPVT X wealth</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
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</table>
### Table: The production function of skills, 5 year-olds (OLS)

<table>
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<tr>
<th>VARIABLES</th>
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<th>INDIA</th>
<th>VIETNAM</th>
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<tr>
<td></td>
<td>PPVT age 5</td>
<td>PPVT age 5</td>
<td>PPVT age 5</td>
<td>PPVT age 5</td>
</tr>
<tr>
<td>Urban</td>
<td>0.24**</td>
<td>0.26***</td>
<td>0.70***</td>
<td>0.21</td>
</tr>
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<td>(0.085)</td>
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<td>0.63***</td>
<td>0.62***</td>
<td>0.51**</td>
<td>0.21</td>
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<td></td>
<td>(0.110)</td>
<td>(0.108)</td>
<td>(0.177)</td>
<td>(0.138)</td>
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<td></td>
<td>0.06***</td>
<td>0.06***</td>
<td>0.00</td>
<td>0.02***</td>
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<td>(0.010)</td>
<td>(0.009)</td>
<td>(0.005)</td>
<td>(0.005)</td>
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<tr>
<td>wq4</td>
<td>0.63***</td>
<td>0.62***</td>
<td>0.51**</td>
<td>0.21</td>
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<td></td>
<td>(0.110)</td>
<td>(0.108)</td>
<td>(0.177)</td>
<td>(0.138)</td>
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<td>0.06***</td>
<td>0.06***</td>
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<td>0.02***</td>
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<td>(0.010)</td>
<td>(0.009)</td>
<td>(0.005)</td>
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<tr>
<td>HAZ age 1</td>
<td>0.11***</td>
<td>0.11***</td>
<td>0.15**</td>
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<td>(0.024)</td>
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<td>0.15**</td>
<td>0.15**</td>
<td>0.08</td>
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<td>(0.067)</td>
<td>(0.067)</td>
<td>(0.045)</td>
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<td>R-squared</td>
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<td>Other HH and child controls</td>
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<td>Yes</td>
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<td>Yes</td>
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<tr>
<td>HAZ X wealth</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Main Findings

- Differences in income levels found in adulthood seem to arise already early in childhood; and disparities found at age 5 persist into the early school years across all four countries.
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- Nutrition has a very important role in the production of cognition. One standard deviation increase in height-for-age at age 5 leads to a cognitive test score that are, on average, 10% of a standard deviation higher at age 8 (endogeneity is a concern).
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- Differences in income levels found in adulthood seem to arise already early in childhood; and disparities found at age 5 persist into the early school years across all four countries.

- Nutrition has a very important role in the production of cognition. One standard deviation increase in height-for-age at age 5 leads to a cognitive test score that are, on average, 10% of a standard deviation higher at age 8 (endogeneity is a concern).

- 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), but also as the country with the highest persistence in cognitive achievement.
Estimates: Robustness

- Use subsample of data with siblings birthweight.
Estimates: Robustness

- Use subsample of data with siblings birthweight.
- Fixed effects would control for parental preferences and other unobserved fixed family characteristics that are correlated with children nutritional status.
Use subsample of data with siblings birthweight.

Fixed effects would control for parental preferences and other unobserved fixed family characteristics that are correlated with children nutritional status.

If unobserved family characteristics associated with children health are sibling invariant, variation within family can be used to identify children’s health influence in children’s performance on cognitive test.
## Estimates: Robustness

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<thead>
<tr>
<th>Variables</th>
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<th>IV (2)</th>
<th>OLS (3)</th>
<th>IV (4)</th>
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<td>HAZ age 5</td>
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<td>R-squared</td>
<td>0.337</td>
<td>0.334</td>
<td>0.341</td>
<td>0.340</td>
</tr>
</tbody>
</table>
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- Estimate a production function of cognition using panel data from four YL countries

Findings:

- Strong evidence that the largest disparity in cognitive achievement between rich and poor is found in Peru.
- Past test scores are important determinants of current test scores in four countries, but not perfect persistence.
- Peru shows the highest persistence in cognitive achievement, suggesting lower opportunities for convergence in cognitive achievement between rich and poor over time; and therefore room for early interventions.
- Better cognitive outcomes are related to a better nutritional status in early childhood.
- Results are robust to various specifications.
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