Maternal Mental Health and Child Development

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Presentation at the BMGF/HICHD/GCC research symposium
30th June 2015
What We Do

- Examine the relationship between maternal mental health and two dimensions of child development - health and cognitive in a developing country context.
- Examine multiple stages in childhood (not just post-natal)
- Utilise wealth and longitudinal design of YL data to examine the sensitivity of the estimates to key identifying assumptions
- Draw conclusions on the assumptions that we need to make in order to claim causal identification with these observational data
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Outline

- Motivation & existing evidence
  - Measuring maternal mental health
  - Analytical Framework
  - Results
  - Extensions
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Motivation

- Evidence that maternal mental health can have significant effects on children’s development (cognitive, nutritional, health, socio-emotional).
  - HIC’s: psychosocial, behavioural and emotional domains
  - LMIC’s: associations with physical growth and illness also found
- But:
  - Existing evidence based on developed country samples (highly selected samples in developing countries)
  - Most evidence based on cross-sectional studies of correlations
  - Focus on PND
- Big identification challenges
  - Hard to think of an RCT (other than interventions treating maternal depression)
  - Hard to think of instruments
- How well can we do with one of the best observational data-sets available to answer this question in developing countries?
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Measuring Maternal Mental Health

Use the Self-Reporting Questionnaire (SRQ-20) = list of 20 statements to which women answer yes/no

- Developed by Harding et al (1980) for WHO as screening tool for developing countries based originally on large samples in Colombia, India, Senegal, and Sudan (70’s-80’s)
- Items selected based on existing screening instruments
- Validated in 21 languages incl. Spanish and contexts incl. Latin America
- Standard way of using these data = score is number of “yes’s”. Score above 8 = clinically significant levels of symptoms
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Strengths & Weaknesses of the Measure

► Harpham et al 2003 “Measuring Mental Health”; Health Policy and Planning:
  ▶ Pluses: correlates with other measures, good specificity (healthy also healthy according to diagnostic instruments); 10 min and can be administered by lay interviewers; available in many languages and cut-offs determined for many contexts; respondents like
  ▶ Minuses: Measures symptoms and respondent’s inclination to report symptoms; 30 day recall can lead to more bias with some respondents; differential misclassification (false positives found to be more likely among women and less educated)
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YL Data - SRQ 20 Summary Stats

- Measured in Round 1 in all countries and all rounds in Peru

<table>
<thead>
<tr>
<th>Mean SRQ20 Score</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>sd</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
</tr>
<tr>
<td>Mean SRQ20 Score</td>
<td></td>
</tr>
<tr>
<td>Round 1</td>
<td>5.640</td>
</tr>
<tr>
<td>Round 2</td>
<td>3.645</td>
</tr>
<tr>
<td>Round 3</td>
<td>3.296</td>
</tr>
</tbody>
</table>

Elevated score (SRQ20 ≥ 8)

<table>
<thead>
<tr>
<th>Mean SRQ20 Score</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td></td>
</tr>
<tr>
<td>Mean SRQ20 Score</td>
<td></td>
</tr>
<tr>
<td>Round 1</td>
<td>0.298</td>
</tr>
<tr>
<td>Round 2</td>
<td>0.134</td>
</tr>
<tr>
<td>Round 3</td>
<td>0.115</td>
</tr>
</tbody>
</table>

Elevated score (SRQ20 ≥ 10)

<table>
<thead>
<tr>
<th>Mean SRQ20 Score</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td></td>
</tr>
<tr>
<td>Mean SRQ20 Score</td>
<td></td>
</tr>
<tr>
<td>Round 1</td>
<td>0.188</td>
</tr>
<tr>
<td>Round 2</td>
<td>0.071</td>
</tr>
<tr>
<td>Round 3</td>
<td>0.064</td>
</tr>
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</table>
## YL Data - SRQ-20 Items

<table>
<thead>
<tr>
<th></th>
<th>Round 1</th>
<th>Round 2</th>
<th>Round 3</th>
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<tbody>
<tr>
<td><strong>Highest in all 3 rounds</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did you often have headaches?</td>
<td>43.5</td>
<td>46.3</td>
<td>37.6</td>
</tr>
<tr>
<td>Do you feel nervous, tense or worried?</td>
<td>64.4</td>
<td>62.7</td>
<td>59.3</td>
</tr>
<tr>
<td>Do you feel unhappy?</td>
<td>50.1</td>
<td>40.1</td>
<td>37.7</td>
</tr>
<tr>
<td>Are you easily frightened?</td>
<td>44.8</td>
<td>26.6</td>
<td>21.3</td>
</tr>
<tr>
<td><strong>Lowest in all 3 rounds</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has the thought of ending your life been on your mind?</td>
<td>4.6</td>
<td>4.0</td>
<td>3.5</td>
</tr>
<tr>
<td>Have you lost interest in things?</td>
<td>14.5</td>
<td>5.4</td>
<td>5.0</td>
</tr>
<tr>
<td>Are you unable to play a useful part in life?</td>
<td>16.5</td>
<td>5.3</td>
<td>4.8</td>
</tr>
<tr>
<td>Do you find it difficult to enjoy your daily activities?</td>
<td>27.0</td>
<td>9.3</td>
<td>7.8</td>
</tr>
</tbody>
</table>
## YL Data - Factor Analysis

### Round 1 | Round 2 | Round 3
---|---|---
Did you often have headaches | 0.4980299 | 0.3756009 | 0.4032587
Was your appetite poor | 0.4214907 | 0.4273576 | 0.5227025
Did you sleep badly | 0.4249748 | 0.4311664 | 0.4616438
Were you easily frightened | 0.4363372 | 0.4440142 | 0.4101455
Did your hands shake | 0.4226731 | 0.4240796 | 0.3303908
Did you feel nervous, tense and worried | 0.5357928 | 0.3995726 | 0.4588188
Was your digestion poor | 0.4285753 | 0.3911444 | 0.3353664
Did you have trouble thinking clearly | 0.345021 | 0.4785902 | 0.4033839
Did you feel unhappy | 0.6147466 | 0.4585044 | 0.5380994
Did you cry more than usual | 0.5187635 | 0.4917386 | 0.5253355
Did you find it difficult to enjoy your daily activities | 0.5017172 | 0.5896607 | 0.460697
Did you find it difficult to make decisions | 0.490869 | 0.4831448 | 0.4861538
Did your daily work suffer | 0.417044 | 0.5370951 | 0.4174711
Were you unable to play a useful part in life | 0.4053799 | 0.5123652 | 0.3720731
Did you lose interest in things | 0.4432083 | 0.5402109 | 0.4182716
Did you feel you were a worthless person | 0.4329623 | 0.4334857 | 0.4280044
Were things so bad that you felt that you just couldn't go on | 0.3541617 | 0.4324416 | 0.3921413
Did you feel tired all the time | 0.5570952 | 0.5807227 | 0.5405439
Were you easily tired | 0.4963387 | 0.501255 | 0.5204935
Eigenvalues | 4.03551 | 4.26770 | 3.81388
Conceptualisation

- Use continuous measure for core analysis
- Think of this more as a measure of stress? (more on that in the next presentation)
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Analytical Framework

Adopt the production function framework within which: the accumulated stock of human capital (health, cognitive skills) is a function of child, parental and pre-school/school inputs (esp. cognitive production function). Allow production functions for health and cognitive skills to differ:

$$Y_{ija} = Y_a(P_{ij}(a), I_{ij}(a), S_{ij}(a), \mu_{ij0}, \mu_{j0}, \varepsilon_{ija})$$  \hspace{1cm} (1)

$Y_{ija} =$ Outcome of child $i$ from household $j$ at age $a$

$P_{ij}(a) =$ Parental input history as of age $a$

$I_{ij}(a) =$ Individual input history as of age $a$

$S_{ij}(a) =$ School input history as of age $a$

$\mu_{ij0} =$ child specific endowments at birth

$\mu_{j0} =$ mother specific genetic endowment at birth

$\varepsilon_{ija} = \mu_{ija} + \nu_{ja}$ household and individual level shocks/measurement error
Estimation

Start with linear approximation

\[ Y_{ija} = F_{ija} \beta_1 + F_{ija-1} \beta_2 + \ldots + F_{ij1} \beta_a + \alpha \mu_{ij0} + \gamma \mu_{j0} + \varepsilon_{ija} \]  \hspace{1cm} (2)

Challenges:

- Missing data on inputs \((P_{ij}(a), I_{ij}(a), S_{ij}(a))\)
- Endowments \(\mu_{ij0}, \mu_{j0}\) are hard to observe but are not orthogonal to inputs
- Shocks to child development \(\varepsilon_{ija}\) are not orthogonal to inputs
- Measurement error
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I believe serious attention to two words would sweeten the atmosphere of econometric discourse. These are whimsy and fragility. In order to draw inferences from data as described by econometric tests, it is necessary to make whimsical assumptions. The professional audience consequently and properly withholds belief until an inference is shown to be adequately insensitive to the choice of assumptions...If we are to make effective use of our scarce data resources, it is therefore important that we study fragility in a much more systematic way.”
Taking a Leaf Out of Leamer’s Book

- Utilise the wealth of Young Lives data & longitudinal dimension to estimate a number of different models
  - Keep track of the assumptions for each of these
  - Determine which assumptions estimates are sensitive to...
  - And which assumptions none of these models allow to test

  → Take careful stock of just how whimsy and fragile our estimates are and the assumptions under which we could claim causality with these data
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The Models We Estimate

- Contemporaneous: Only current inputs matter / inputs are unchanging over time; observed inputs are orthogonal to endowments/shocks.

\[ Y_{ija} = \kappa_0 + F_{ija}\kappa_1 + \epsilon_{ija} \quad (3) \]

- Cumulative: Observables fully capture the past history of inputs; observed inputs are not correlated with endowments/shocks:

\[ Y_{ija} = \theta_0 + F_{ija}\theta_1 + F_{ija-1}\theta_2 + \ldots + F_{ij1}\theta_a + \epsilon_{ija} \quad (4) \]

- Cumulative + VA: Effect of unobserved inputs and endowments declines geometrically with age at constant rate \( \psi_2 \) & contemporaneous unobserved inputs are uncorrelated with observed ones or lagged outcome.

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- Studies finding similar results using experimental design vs VAM (DOLS):
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  - Deming et al (2014): school effects comparing VAM to school choice lottery effects
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A Quick VAM Interlude

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Growing evidence to suggest that this specification of VAM models (Dynamic OLS) yields reliable estimates:

- Studies finding similar results using experimental design vs VAM (DOLS):
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And Some More Models

- Within Child
  - Within Family
  - Help as long as we can assume that endowment and shock effects do not vary with age or time elapsed
  - Within Child assumptions about persistence of lagged outcome effects especially problematic for skills
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Assumptions We Can Test

- Only current inputs matter = A1
- Observed history of inputs captures full history = A2
- Inputs are uncorrelated with individual endowments and shocks = A3a
- Inputs are uncorrelated with parental endowments and shocks = A3b

<table>
<thead>
<tr>
<th>Test</th>
<th>A1</th>
<th>A2</th>
<th>A3a</th>
<th>A3b</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\kappa_{aOLS,ha} = \theta_{aOLS,ha}$</td>
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<tr>
<td>$\theta_{aOLS,ha} = \vartheta_{aOLS,ha}$</td>
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<tr>
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</tr>
<tr>
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</tr>
<tr>
<td>$\theta_{aOLS,ha} = \theta_{aIFE,ha}$</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\theta_{aOLS,ha} = \theta_{aSFE,ha}$</td>
<td></td>
<td></td>
<td>?</td>
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</tr>
</tbody>
</table>

$\kappa$, $\theta_{aOLS,ha}$, $\vartheta$, $\theta_{aIFE,ha}$, $\theta_{aSFE,ha}$
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<td>?</td>
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<tr>
<td>( \theta_{\text{OLS},ha} = \vartheta_{\text{OLS},ha} )</td>
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<td>?</td>
<td></td>
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<tr>
<td>( \theta_{\text{OLS},ha} = \theta_{\text{IFE},ha} )</td>
<td>?</td>
<td>?</td>
<td></td>
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</tr>
<tr>
<td>( \theta_{\text{OLS},ha} = \theta_{\text{SFE},ha} )</td>
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<td></td>
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# Health and Cognitive Skill Production Functions

<table>
<thead>
<tr>
<th>Level</th>
<th>Cognitive skill production function</th>
<th>Health production function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child endowments at birth</td>
<td>birth size, pre-natal care, conditions at birth, birth-spacing (age gap between index child and next oldest child), mother’s age</td>
<td>birth size, pre-natal care, conditions at birth, birth-spacing (age gap between index child and next oldest child), mother’s age</td>
</tr>
<tr>
<td>Child characteristics</td>
<td>Age, sex, ethnicity, birthorder, health, nutrition</td>
<td>Age, sex, ethnicity, birthorder, health</td>
</tr>
<tr>
<td>Shocks</td>
<td>At least one negative shock in the last x years</td>
<td>At least one negative shock in the last x years</td>
</tr>
<tr>
<td>Parental inputs - time</td>
<td>Parents live in the household, child-care in infancy</td>
<td>Parents live in the household, child-care in infancy</td>
</tr>
<tr>
<td>Parental inputs - quality of time</td>
<td>parental education, parenting style (age 1), maternal self-esteem and self-efficacy, household size</td>
<td>parental education, household size</td>
</tr>
<tr>
<td>Parental inputs - materials</td>
<td>wealth index, vaccinations, educational materials at home</td>
<td>wealth index, vaccinations, dietary diversity</td>
</tr>
<tr>
<td>Child time-use</td>
<td>time-allocation (ages 5 &amp; 8), pre-school/school</td>
<td></td>
</tr>
</tbody>
</table>
### Descriptive Stats: Endowments

<table>
<thead>
<tr>
<th>“Endowments” at birth</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulties during pregnancy</td>
<td>0.75</td>
<td>0.43</td>
</tr>
<tr>
<td>Difficult labour</td>
<td>0.33</td>
<td>0.47</td>
</tr>
<tr>
<td>Number of ante-natal visits ≤ 5</td>
<td>0.27</td>
<td>0.44</td>
</tr>
<tr>
<td>Four weeks plus premature</td>
<td>0.05</td>
<td>0.22</td>
</tr>
<tr>
<td>Two or more tetanus injections (antenatal)</td>
<td>0.57</td>
<td>0.50</td>
</tr>
<tr>
<td>Gave birth at home</td>
<td>0.31</td>
<td>0.46</td>
</tr>
<tr>
<td>Child hospitalised at birth</td>
<td>0.10</td>
<td>0.30</td>
</tr>
<tr>
<td>Birth size (maternal report: 1-5)</td>
<td>2.88</td>
<td>0.99</td>
</tr>
<tr>
<td>Child received measles vaccine</td>
<td>0.35</td>
<td>0.48</td>
</tr>
</tbody>
</table>
## Maternal Mental Health Estimates: Health

<table>
<thead>
<tr>
<th></th>
<th>ZHFA (age 1)</th>
<th>ZHFA (age 5)</th>
<th>ZHFA (age 5)</th>
<th>ZHFA (age 5)</th>
<th>ZHFA (age 8)</th>
<th>ZHFA (age 8)</th>
<th>ZHFA (age 8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>maternal mental health</td>
<td>-0.036*</td>
<td>-0.025</td>
<td>-0.030</td>
<td>-0.019</td>
<td>-0.002</td>
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<tr>
<td>score (age 1)</td>
<td>(0.021)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>maternal mental health</td>
<td>0.032</td>
<td>0.037</td>
<td>-0.022</td>
<td>0.047*</td>
<td>0.020</td>
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<tr>
<td>score (age 5)</td>
<td></td>
<td>(0.022)</td>
<td></td>
<td></td>
<td>(0.026)</td>
<td></td>
<td></td>
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<tr>
<td>maternal mental health</td>
<td></td>
<td></td>
<td>(0.017)</td>
<td></td>
<td>(0.027)</td>
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<tr>
<td>score (age 8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.007)</td>
<td>-0.019</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.001</td>
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<td></td>
<td></td>
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<tr>
<td>contemporaneous controls</td>
<td>x*</td>
<td>x</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>cumulative controls</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cumulative controls +</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>lagged outcome</td>
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<tr>
<td>sentinel site fixed</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>effects</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>R-squared</td>
<td>0.35</td>
<td>0.36</td>
<td>0.36</td>
<td>0.53</td>
<td>0.35</td>
<td>0.36</td>
<td>0.67</td>
</tr>
</tbody>
</table>
Other Inputs (cumulative specification)

- Health (haz): Less than 4 antenatal visits; born at home, birth size, mother age $>25$ (ages 5-8), parental education, relative health, wealth index
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Maternal Mental Health Estimates: Cognitive Skills - Verbal

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<tr>
<th></th>
<th>PPVT (age 5)</th>
<th>PPVT (age 5)</th>
<th>PPVT (age 8)</th>
<th>PPVT (age 8)</th>
<th>PPVT (age 8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>maternal mental health score</td>
<td></td>
<td>-0.006</td>
<td></td>
<td>0.03</td>
<td>0.044*</td>
</tr>
<tr>
<td>(age 1)</td>
<td></td>
<td>(0.017)</td>
<td></td>
<td>(0.025)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>maternal mental health score</td>
<td>-0.042*</td>
<td>-0.047**</td>
<td>0.008</td>
<td>0.024</td>
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</tr>
<tr>
<td>(age 5)</td>
<td>(0.021)</td>
<td>(0.022)</td>
<td></td>
<td>(0.020)</td>
<td>(0.021)</td>
</tr>
<tr>
<td>maternal mental health score</td>
<td></td>
<td></td>
<td>-0.050***</td>
<td>-0.060**</td>
<td>-0.060***</td>
</tr>
<tr>
<td>(age 8)</td>
<td></td>
<td></td>
<td>(0.019)</td>
<td>(0.024)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>contemporaneous controls</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(with endowments)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cumulative controls (with</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>endowments)</td>
<td></td>
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</tr>
<tr>
<td>cumulative controls + lagged</td>
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<td></td>
<td>x</td>
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<tr>
<td>outcome</td>
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<tr>
<td>sentinel site fixed effects</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>R-squared</td>
<td>0.60</td>
<td>0.60</td>
<td>0.49</td>
<td>0.49</td>
<td>0.56</td>
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## Estimates: Cognitive Skills - Quantitative

<table>
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<tr>
<th></th>
<th>CDA (age 5)</th>
<th>CDA (age 5)</th>
<th>Maths (age 8)</th>
<th>Maths (age 8)</th>
<th>Maths (age 8)</th>
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<tbody>
<tr>
<td>maternal mental health score (age 1)</td>
<td>0.043</td>
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<td>-0.013</td>
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<td></td>
<td>(0.27)</td>
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<td>(0.025)</td>
<td>(0.024)</td>
<td></td>
</tr>
<tr>
<td>maternal mental health score (age 5)</td>
<td>-0.04</td>
<td>-0.063**</td>
<td>0.028</td>
<td></td>
<td>-0.016</td>
</tr>
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<td></td>
<td>(0.028)</td>
<td>(0.030)</td>
<td>(0.022)</td>
<td>(0.022)</td>
<td></td>
</tr>
<tr>
<td>maternal mental health score (age 8)</td>
<td></td>
<td></td>
<td>-0.021</td>
<td>-0.011</td>
<td>-0.011</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.018)</td>
<td>(0.021)</td>
<td>(0.020)</td>
</tr>
</tbody>
</table>

- **contemporaneous controls (with endowments)**: x, x
- **cumulative controls (with endowments)**: x
- **cumulative controls + lagged outcome (cda)**: x
- **sentinel site fixed effects**: x, x, x, x, x
Other Inputs (cumulative specification)

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Extensions

- **Psychosocial dimension**
  - Within child and family fixed effects
  - Linearity of effects - elevated levels measure
  - Linearity of production function - implies that inputs are perfect substitutes for each other. Strongly rejected in a number of contexts incl YL India (Attanasio et al, 2015) and Colombia (Attanasio et al, 2015b). Accounting for complementarities between inputs is highly important CES production function.
  - Measurement - is there a more efficient way to control for different groups of inputs?
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