Maternal Mental Health and Child Development

Sonya Krutikova
Jere Behrman
Ian Bennett
Whitney Schott

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

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

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

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

Outline

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

Outline

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

Outline

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

Outline

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

Outline

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

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:
- Big identification challenges
- *How well can we do with one of the best observational data-sets available to answer this question in developing countries?*

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:
- Big identification challenges
- *How well can we do with one of the best observational data-sets available to answer this question in developing countries?*

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)
- Big identification challenges
- *How well can we do with one of the best observational data-sets available to answer this question in developing countries?*

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
- *How well can we do with one of the best observational data-sets available to answer this question in developing countries?*

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
- *How well can we do with one of the best observational data-sets available to answer this question in developing countries?*

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
- *How well can we do with one of the best observational data-sets available to answer this question in developing countries?*

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)
  - Need to think creatively
- *How well can we do with one of the best observational data-sets available to answer this question in developing countries?*

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?*

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?*

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?*

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?*

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

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

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

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

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)

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)

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)

YL Data - SRQ 20 Summary Stats

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

	Mean SRQ20 Score		N
	Mean	sd	
Mean SRQ20 Score			
Round 1	5.640	4.219	2,011
Round 2	3.645	3.468	1,958
Round 3	3.296	3.303	1,901
Elevated score (SRQ20>=8)			
Round 1	0.298	0.458	2,011
Round 2	0.134	0.341	1,958
Round 3	0.115	0.319	1,901
Elevated score (SRQ20>=10)			
Round 1	0.188	0.391	2,011
Round 2	0.071	0.257	1,958
Round 3	0.064	0.244	1,901

YL Data - SRQ-20 Items

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

YL Data - Factor Analysis

	Round 1	Round 2	Round3
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	0.4090869	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)

Conceptualisation

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

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:

$$Y_{ija} = Y_a(\mathbf{P}_{ij}(a), \mathbf{I}_{ij}(a), \mathbf{S}_{ij}(a), \mu_{ij0}, \mu_{j0}, \varepsilon_{ija}) \tag{1}$$

Y_{ija}= Outcome of child i from household j at age a
$\mathbf{P}_{ij}(a)$ = Parental input history as of age a
$\mathbf{I}_{ij}(a)$ = Individual input history as of age a
$\mathbf{S_{ij}}(a)$ =School input history as of age a
μ_{ij0}= child specific endowments at birth
μ_{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

$$Y_{ija} = \mathbf{F}_{ija}\beta_1 + \mathbf{F}_{ija-1}\beta_2 + ... + \mathbf{F}_{ij1}\beta_a + \alpha\mu_{ij0} + \gamma\mu_{j0} + \varepsilon_{ija} \quad (2)$$

Challenges:

- Missing data on inputs $(\mathbf{P}_{ij}(a), \mathbf{I}_{ij}(a), \mathbf{S}_{ij}(a))$
- Endowments μ_{ij0}, μ_{j0} are hard to observe but are not orthgonal to inputs
- Shocks to child development ε_{ija} are not orthogonal to inputs
- Measurement error

Estimation

Start with linear approximation

$$Y_{ija} = \mathbf{F}_{ija}\beta_1 + \mathbf{F}_{ija-1}\beta_2 + ... + \mathbf{F}_{ij1}\beta_a + \alpha\mu_{ij0} + \gamma\mu_{j0} + \varepsilon_{ija} \quad (2)$$

Challenges:

- Missing data on inputs $(\mathbf{P}_{ij}(a), \mathbf{I}_{ij}(a), \mathbf{S}_{ij}(a))$
- Endowments μ_{ij0}, μ_{j0} are hard to observe but are not orthgonal to inputs
- Shocks to child development ε_{ija} are not orthogonal to inputs
- Measurement error

Estimation

Start with linear approximation

$$Y_{ija} = \mathbf{F}_{ija}\beta_1 + \mathbf{F}_{ija-1}\beta_2 + ... + \mathbf{F}_{ij1}\beta_a + \alpha\mu_{ij0} + \gamma\mu_{j0} + \varepsilon_{ija} \quad (2)$$

Challenges:

- Missing data on inputs $(\mathbf{P}_{ij}(a), \mathbf{I}_{ij}(a), \mathbf{S}_{ij}(a))$
- Endowments μ_{ij0}, μ_{j0} are hard to observe but are not orthgonal to inputs
- Shocks to child development ε_{ija} are not orthogonal to inputs
- Measurement error

Estimation

Start with linear approximation

$$Y_{ija} = \mathbf{F}_{ija}\beta_1 + \mathbf{F}_{ija-1}\beta_2 + ... + \mathbf{F}_{ij1}\beta_a + \alpha\mu_{ij0} + \gamma\mu_{j0} + \varepsilon_{ija} \quad (2)$$

Challenges:

- Missing data on inputs $(\mathbf{P}_{ij}(a), \mathbf{I}_{ij}(a), \mathbf{S}_{ij}(a))$
- Endowments μ_{ij0}, μ_{j0} are hard to observe but are not orthgonal to inputs
- Shocks to child development ε_{ija} are not orthogonal to inputs
- Measurement error

Our Approach

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."

Edward Leamer, 1983, American Economic Review*: Take the Con Out of Econometrics.*

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

$\rightarrow$Take careful stock of just how whimsy and fragile our estimates are and the assumptions under which we could claim causality with these data

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

$\rightarrow$Take careful stock of just how whimsy and fragile our estimates are and the assumptions under which we could claim causality with these data

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

$\rightarrow$Take careful stock of just how whimsy and fragile our estimates are and the assumptions under which we could claim causality with these data

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

$\rightarrow$Take careful stock of just how whimsy and fragile our estimates are and the assumptions under which we could claim causality with these data

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

$\rightarrow$Take careful stock of just how whimsy and fragile our estimates are and the assumptions under which we could claim causality with these data

The Models We Estimate

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

$$Y_{ija} = \kappa_{\mathbf{0}} + \mathbf{F}_{ija}\kappa_1 + \epsilon_{ija} \tag{3}$$

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

$$Y_{ija} = \theta_{\mathbf{0}} + \mathbf{F}_{ija}\theta_1 + \mathbf{F}_{ija-1}\theta_2 + ... + \mathbf{F}_{ij1}\theta_a + \epsilon_{ija} \tag{4}$$

- Cumulative + VA: Effect of unobserved inputs and endowments declines geometrically with age at constant rate ψ_2& contemporaneous unobserved inputs are uncorrelated with observed ones or lagged outcome.

$$Y_{ija} = \vartheta_0 + \mathbf{F}_{ija}\vartheta_1 + \mathbf{F}_{ija-1}\vartheta_2 + ... + \mathbf{F}_{ij1}\vartheta_a + \psi_2 Y_{ija-1} + \epsilon_{ija} \tag{5}$$

The Models We Estimate

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

$$Y_{ija} = \kappa_{\mathbf{0}} + \mathbf{F}_{ija}\kappa_1 + \epsilon_{ija} \tag{3}$$

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

$$Y_{ija} = \theta_{\mathbf{0}} + \mathbf{F}_{ija}\theta_1 + \mathbf{F}_{ija-1}\theta_2 + ... + \mathbf{F}_{ij1}\theta_a + \epsilon_{ija} \tag{4}$$

- Cumulative + VA: Effect of unobserved inputs and endowments declines geometrically with age at constant rate ψ_2& contemporaneous unobserved inputs are uncorrelated with observed ones or lagged outcome.

$$Y_{ija} = \vartheta_0 + \mathbf{F}_{ija}\vartheta_1 + \mathbf{F}_{ija-1}\vartheta_2 + ... + \mathbf{F}_{ij1}\vartheta_a + \psi_2 Y_{ija-1} + \epsilon_{ija} \tag{5}$$

The Models We Estimate

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

$$Y_{ija} = \kappa_{\mathbf{0}} + \mathbf{F}_{ija}\kappa_1 + \epsilon_{ija} \tag{3}$$

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

$$Y_{ija} = \theta_{\mathbf{0}} + \mathbf{F}_{ija}\theta_1 + \mathbf{F}_{ija-1}\theta_2 + ... + \mathbf{F}_{ij1}\theta_a + \epsilon_{ija} \tag{4}$$

- Cumulative + VA: Effect of unobserved inputs and endowments declines geometrically with age at constant rate ψ_2& contemporaneous unobserved inputs are uncorrelated with observed ones or lagged outcome.

$$Y_{ija} = \vartheta_0 + \mathbf{F}_{ija}\vartheta_1 + \mathbf{F}_{ija-1}\vartheta_2 + ... + \mathbf{F}_{ij1}\vartheta_a + \psi_2 Y_{ija-1} + \epsilon_{ija} \tag{5}$$

A Quick VAM Interlude

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

- Guarino et al (2014): simulations
- Studies finding similar results using experimental design vs VAM (DOLS):
  - Andrabi et al (2011): effectiveness of private schools in Pakistan

A Quick VAM Interlude

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

- Guarino et al (2014): simulations
- Studies finding similar results using experimental design vs VAM (DOLS):
  - Andrabi et al (2011): effectiveness of private schools in Pakistan
  - Muralidharan & Sundararaman (2013): effectiveness of contract teachers
  - Deming et al (2014): school effects comparing VAm to school choice lottery effects

A Quick VAM Interlude

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

- Guarino et al (2014): simulations
- Studies finding similar results using experimental design vs VAM (DOLS):
  - Andrabi et al (2011): effectiveness of private schools in Pakistan
  - Muralidharan & Sundararaman (2013): effectiveness of contract teachers
  - Deming et al (2014): school effects comparing VAm to school choice lottery effects

A Quick VAM Interlude

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

- Guarino et al (2014): simulations
- Studies finding similar results using experimental design vs VAM (DOLS):
  - Andrabi et al (2011): effectiveness of private schools in Pakistan
  - Muralidharan & Sundararaman (2013): effectiveness of contract teachers
  - Deming et al (2014): school effects comparing VAm to school choice lottery effects

A Quick VAM Interlude

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

- Guarino et al (2014): simulations
- Studies finding similar results using experimental design vs VAM (DOLS):
  - Andrabi et al (2011): effectiveness of private schools in Pakistan
  - Muralidharan & Sundararaman (2013): effectiveness of contract teachers
  - Deming et al (2014): school effects comparing VAm to school choice lottery effects

And Some More Models

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

And Some More Models

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

And Some More Models

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

And Some More Models

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

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

Test	A1	A2	A3a	A3b
$\kappa_{aOLS,ha} = \theta_{aOLS,ha}$	?			
$\theta_{aOLS,ha} = \vartheta_{aOLS,ha}$		?		
$\theta_{aOLS,ha} = \theta_{aIFE,ha}$			?	
$\theta_{aOLS,ha} = \theta_{aSFE,ha}$				?

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

Test	A1	A2	A3a	A3b
$\kappa_{aOLS,ha} = \theta_{aOLS,ha}$	?			
$\theta_{aOLS,ha} = \vartheta_{aOLS,ha}$		?		
$\theta_{aOLS,ha} = \theta_{aIFE,ha}$			?	
$\theta_{aOLS,ha} = \theta_{aSFE,ha}$				?

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

Test	A1	A2	A3a	A3b
$\kappa_{aOLS,ha} = \theta_{aOLS,ha}$	?			
$\theta_{aOLS,ha} = \vartheta_{aOLS,ha}$		?		
$\theta_{aOLS,ha} = \theta_{aIFE,ha}$			?	
$\theta_{aOLS,ha} = \theta_{aSFE,ha}$				?

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

Test	A1	A2	A3a	A3b
$\kappa_{aOLS,ha} = \theta_{aOLS,ha}$	?			
$\theta_{aOLS,ha} = \vartheta_{aOLS,ha}$		?		
$\theta_{aOLS,ha} = \theta_{aIFE,ha}$			?	
$\theta_{aOLS,ha} = \theta_{aSFE,ha}$				?

Health and Cognitive Skill Production Functions

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

Descriptive Stats: Endowments

	Mean	Std Dev
"Endowments" at birth		
Difficulties during pregnancy	0.75	0.43
Difficult labour	0.33	0.47
Number of ante-natal visits<5	0.27	0.44
Four weeks plus premature	0.05	0.22
Two or more tetanus injections (antenatal)	0.57	0.50
Gave birth at home	0.31	0.46
Child hospitalised at birth	0.10	0.30
Birth size (maternal report: 1-5)	2.88	0.99
Child received measles vaccine	0.35	0.48

Maternal Mental Health Estimates:Health

	ZHFA (age 1)	ZHFA (age 5)	ZHFA (age 5)	ZHFA (age 5)	ZHFA (age 8)	ZHFA (age 8)	ZHFA (age 8)
maternal mental health score (age 1)	-0.036*		-0.025	-0.030		-0.019	-0.002
	(0.021)		(0.022)	(0.023)		(0.026)	(0.024)
maternal mental health score (age 5)		0.032	0.037	-0.022		0.047*	0.020
		(0.022)	(0.024)	(0.017)		(0.027)	(0.014)
maternal mental health score (age 8)					0.007	-0.019	-0.001
					(0.025)	(0.024)	(0.016)
contemporaneous controls	x*	x			x		
cumulative controls			x			x	
cumulative controls + lagged outcome				x			x
sentinel site fixed effects	x	x	x	x	x	x	x
R-squared	0.35	0.36	0.36	0.53	0.35	0.36	0.67

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
- Cognitive (PPVT): born at home, received measles vaccine, parental education, haz, wealth, chores instead of play time - (age 8), pre-school/school +

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
- Cognitive (PPVT): born at home, received measles vaccine, parental education, haz, wealth, chores instead of play time - (age 8), pre-school/school +

Maternal Mental Health Estimates: Cognitive Skills - Verbal

	PPVT (age 5)	PPVT (age 5)	PPVT (age 8)	PPVT (age 8)	PPVT (age 8)
maternal mental health score (age 1)		-0.006		0.03	0.044*
		(0.017)		(0.025)	(0.023)
maternal mental health score (age 5)	-0.042*	-0.047**		0.008	0.024
	(0.021)	(0.022)		(0.020)	(0.021)
maternal mental health score (age 8)			-0.050***	-0.060**	-0.060***
			(0.019)	(0.024)	(0.023)
contemporaneous controls (with endowments)	x		x		
cumulative controls (with endowments)		x		x	
cumulative controls + lagged outcome					x
sentinel site fixed effects	x	x	x	x	x
R-squared	0.60	0.60	0.49	0.49	0.56

Estimates: Cognitive Skills - Quantitative

	CDA (age 5)	CDA (age 5)	Maths (age 8)	Maths (age 8)	Maths (age 8)
maternal mental health score (age 1)		0.043		-0.013	-0.017
		(0.27)		(0.025)	(0.024)
maternal mental health score (age 5)	-0.04	-0.063**		0.028	-0.016
	(0.028)	(0.030)		(0.022)	(0.022)
maternal mental health score (age 8)			-0.021	-0.011	-0.011
			(0.018)	(0.021)	(0.020)
contemporaneous controls (with endowments)	x		x		
cumulative controls (with endowments)		x		x	
cumulative controls + lagged outcome (cda)					x
sentinel site fixed effects	x	x	x	x	x

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
- Cognitive (PPVT): born at home, received measles vaccine, parental education, haz, wealth, chores instead of play time - (age 8), pre-school/school +

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
- Cognitive (PPVT): born at home, received measles vaccine, parental education, haz, wealth, chores instead of play time - (age 8), pre-school/school +

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 eachother. 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?

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 eachother. 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?

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 eachother. 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?

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 eachother. 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?

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 eachother. 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?