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Based on work with:

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- Marcos Vera-Hernandes (UCL & IFS)
- Lina Cardona, Carlos Medina (Banco de la Republica, Medellin)
- Darwin Cortés (Universidad del Rosario)
- Flavio Cunha (Rice)
- Sally Grantham McGregor and Pamela Jervis (IFS & UCL)
- Costas Meghir, Emily Nix (Yale)
- Marta Rubio (IADB)
Human Development... or Human Capital

Definitions and concepts

- Economists have tended to use the term of 'Human Capital'
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- In the past, it was seen as a uni-dimensional object that would provide yields in the labour market.
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Definitions and concepts

- Economists have tended to use the term of 'Human Capital'
- In the past, it was seen as a uni-dimensional object that would provide yields in the labour market.
- In recent decades, the treatment of Human Capital has changed substantially:
  - It is recognised as a multimensual object.
  - There is much heterogeneity in the process of human development and it starts early.
  - The dynamics is complex.
  - Early years are important and malleable.
Different dimensions and domains

- Different domains:
  - Cognition, Language, Executive functions.
  - Socio-emotional, Self-control, Grit.
  - Health, Nutritional status.

- They get remunerated differently in the labour market.
Different dimensions and domains

- Different domains:
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  - Socio-emotional, Self-control, Grit.
  - Health, Nutritional status.

- They get remunerated differently in the labour market.
- They interact dynamically in potentially complex ways in the process of development.
- The importance of different factors changes over time.
The Process of Human Development
Many domains

CAF - RED publication 2016

CAF Survey 2015

Cognitive and socioemotional skills requirements, 10 large cities in Latin America
Inequality in HK starts early

- We observe much variability and inequality in child development.
- Socio economic status seems to matter considerably.
Inequality in HK starts early

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- Children from poor families start school with severe developmental gaps relative to children from wealthier families.
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Inequality in HK starts early

- We observe much variability and inequality in child development.
- Socio economic status seems to matter considerably.
- Children from poor families start school with severe developmental gaps relative to children from wealthier families.
- ... and gaps appear very early.
- It can be debated whether that gap can be filled or remedied but it is a problem.
Inequality in HK starts early: Ecuador

- The delay accumulated by age 6 by the poorest children is 3 s.d. of standardized scores.
- This is equivalent to a 2.5 years delay.
  - (Paxson and Schady, Journal of Human Resources, 2007.)
Inequality in HK starts early: Bogotá.

- Socioeconomic gradient significant at 12 months in Bogotá.
- Delays evident in several domains.
  - (Attanasio et al., *Journal of Human Resources, 2013*).
Inequality in HK starts early: Chile

- Inequality by SES is large by the time children reach school age
- Delays evident in several domains.
- Some indexes are more sensitive than others.
Bangladesh: Human capital at 18 months: z-score of MDI

<table>
<thead>
<tr>
<th></th>
<th>5th quintile of</th>
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<th></th>
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<tr>
<td></td>
<td>ses index</td>
<td>0.681</td>
<td>0.424</td>
<td>0.345</td>
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<td></td>
<td>(0.079)</td>
<td>(0.094)</td>
<td>(0.092)</td>
<td>(0.096)</td>
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<tr>
<td>Child dev. at 7 months</td>
<td></td>
<td>0.153</td>
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<tr>
<td></td>
<td>(0.024)</td>
<td>(0.024)</td>
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<td>length growth 1</td>
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<td>0.137</td>
<td>0.121</td>
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<tr>
<td></td>
<td>(0.031)</td>
<td>(0.031)</td>
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<td>length growth 2</td>
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<tr>
<td></td>
<td>(0.027)</td>
<td>(0.028)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HOME at 18 months</td>
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<td></td>
<td></td>
<td>0.023</td>
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<tr>
<td></td>
<td></td>
<td></td>
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<td>(0.004)</td>
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<tr>
<td>parental background</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Nb obs</td>
<td>1579</td>
<td></td>
<td></td>
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</table>
Inequality in HK starts early

- Poor children start school with a considerable delay in their development.
Inequality in HK starts early

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- They then often receive very poor quality education in schools.
Inequality in HK starts early

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- They then often receive very poor quality education in schools.
- Schools (and not only) are often programmed to teach to a curriculum rather than to children.
The dynamics of the process are complex.

Early years are important.
The dynamics of the process

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- Early years are important.
- The process of human development is still not completely understood.
- Initial conditions and environmental factors play important roles.
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- Early years are important.
- The process of human development is still not completely understood.
- Initial conditions and environmental factors play important roles.
- Trajectories per se can be relevant to the final outcomes.
- Simple ‘Markov’ models might be inadequate.
Complex dynamics: an example from Bangladesh

- Data from a large cohort from poor rural villages in rural Bangladesh
- Children observed at birth, 7 months, 18 months and 60 months

**Table: child dev. at 60 months**

<table>
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<th>(1)</th>
<th>(2)</th>
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<tbody>
<tr>
<td>child dev. 18 months</td>
<td>0.2110***</td>
<td>0.2020***</td>
<td>0.1743***</td>
</tr>
<tr>
<td></td>
<td>(.0215)</td>
<td>(.0216)</td>
<td>(.0212)</td>
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<tr>
<td>child dev. at 7 months</td>
<td>0.0663***</td>
<td>0.0654***</td>
<td>0.0626***</td>
</tr>
<tr>
<td></td>
<td>(.0210)</td>
<td>(.0206)</td>
<td>(.0202)</td>
</tr>
<tr>
<td>health at birth</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>health at 7 and 18 months</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
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<td>parental investment</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
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<td>$R^2$</td>
<td>0.3319</td>
<td>0.3717</td>
<td>0.4003</td>
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<tr>
<td>Obs.</td>
<td>1,576</td>
<td>1,576</td>
<td>1,576</td>
</tr>
</tbody>
</table>

**Notes.** All regressions control for tester fixed effects, age at test, socio-economic status, parental background.
• Long run follow up of children are very rare, especially in developing countries.
The process of HK formation: an example

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- A recent amazing piece of research is coming out of the Kangaroo study in Bogotá
The process of HK formation: an example

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- A recent amazing piece of research is coming out of the Kangaroo study in Bogotá
- 20 year follow up of a sample of children part of an RCT to evaluate the impact of KMC
### Kangaroo Mother Care example

#### Table: IQ at 18 - WASI Composite Score

<table>
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<th>(3)</th>
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<tbody>
<tr>
<td>cog dev at 12 months</td>
<td>0.3721***</td>
<td>0.3294***</td>
<td>0.3850***</td>
</tr>
<tr>
<td></td>
<td>(0.0817)</td>
<td>(0.0978)</td>
<td>(0.0994)</td>
</tr>
<tr>
<td>HOME score at 12 months</td>
<td>0.4321***</td>
<td>0.2682*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.1322)</td>
<td>(0.1386)</td>
<td></td>
</tr>
<tr>
<td>HOME score at 18 years</td>
<td></td>
<td></td>
<td>0.4456***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.1274)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.0456</td>
<td>0.0691</td>
<td>0.1162</td>
</tr>
<tr>
<td>Obs.</td>
<td>436</td>
<td>290</td>
<td></td>
</tr>
</tbody>
</table>
The process of HK formation

- To understand human development and the variety of outcomes observed in adulthood it is necessary to understand what happens in the early years.
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- To understand human development and the variety of outcomes observed in adulthood it is necessary to understand what happens in the early years.
- There is very strong evidence of extreme forms of persistence that could have a biological and neurological basis.
- Modeling the process in a flexible and complex fashion is key to understand many observed outcomes.
  - Fade out of interventions.
The process of HK formation

- This does not mean that nothing can be done after age 3!
The process of HK formation

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- Or that the early years are the only important ‘window’.
  - Sarah-Jayne Blakemore work on the adolescent brain is illuminating.
  - Different dimensions, and in particular, the social brain could be key in those years.
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The production function of human capital

- We study human capital as the outcome of a ‘production function’
  - HK is assumed to be a function of different inputs.
  - Different dimensions and domains
The production function of human capital

- We study human capital as the outcome of a ‘production function’
  - HK is assumed to be a function of different inputs.
  - Different dimensions and domains
  - Dynamically, the outcomes at a given age, become the inputs in the process at that age.
  - We consider other inputs, including environmental factors.
  - Role of parental inputs and parental behaviour.

- We want to use a reasonably flexible specification to allow for different phenomena and the interaction of different inputs.
- We want to model explicitly measurement problems.
The Production Function of Human Capital

\[ H_{t+1} = g_t(H_t, X_t, Z_t, e_{t+1}) \]

- \( H_t \) is Human Capital (including cognition \( c \), socio-emotional dev. \( s \) and health \( h \) capital).
- \( Z_t \) are background variables (either fixed or time varying) (including mother \( m \), father \( f \) and other \( r \)).
- \( X_t \) are Investments in HK (including materials \( M \) and time \( T \)).
- \( e_{t+1} \) are shocks.

All variables are multidimensional:

\[ H_t = \{ \theta_t^c, \theta_t^s, \theta_t^h \} \]
\[ Z_t = \{ \theta_t^m, \theta_t^f, \theta_t^r \} \]
\[ X_t = \{ \theta_t^M, \theta_t^T \} \]
The Investment Problem

- Parents choose investment to maximise an objective function that depends on Children Human Capital and Consumption
  - subject to a budget constraint
  - subject to (their perception of) the production function

- Identification issues: establishing causal links.
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\[
\text{Max}_{\{C_t, X_t\}} \ U(C_t, H_{t+1}) \\
\text{s.t.} \quad C_t + P_t^X X_t = Y_t \\
\quad H_{t+1} = g_t(H_t, X_t, Z_t, e_{t+1})
\]

- Investment could be in commodities or time.
Production function estimates

- We have estimated version of this model with different data sets and in different contexts.
  - Colombia (Attanasio, Cattan, Fitzsimmons, Meghir and Rubio-Codina)
    - Interpreting the outcome of a stimulation intervention.
  - India, Ethiopia and Peru. (Attanasio, Nix and Meghir, 2017; and Attanasio, Nix, Meghir and Salvati, 2017)
    - Using data from the Young Lives cohorts.
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    - Using data from the Young Lives cohorts.
- We do not assume parents ’know’ the true production function.
Summary of the results (from Colombia’s study)

- The production function is well approximated by a Cobb Douglas.
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- The production function is well approximated by a Cobb Douglas.
- Initial conditions matter.
  - $\theta^c_t$ is important for $\theta^c_{t+1}$ and $\theta^s_t$ for $\theta^s_{t+1}$;
  - $\theta^c_t$ is important for $\theta^s_{t+1}$;
  - $\theta^c_t$ is not important for $\theta^s_{t+1}$;

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Summary of the results

• Investment:
  • Material investment matters for cognitive development.
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  - Time investment matters for socio-emotional development.

• The intervention shifts significantly the distribution of the two investment factors.

• The parameters of the production function are not affected by the intervention.
Parental investment: what do parents do?

- Parents are obviously key.
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- Parents are obviously key.
- ... but what are the constraints they face?
  - Resources
  - Information and beliefs
  - Credit constraints
Parental investment: what do parents do?

- Parents are obviously key.
- ... but what are the constraints they face?
  - Resources
  - Information and beliefs
  - Credit constraints
- How are resources allocated within the household?
  - who controls resources
  - how are resources allocated among several siblings
  - fertility choices
Do parents know the production function?

- Poor parents seem to be making the ‘wrong’ investment choices
  - Poor stimulation environment

- Could they have the wrong beliefs about the production function?
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- Could they have the wrong beliefs about the production function?
- Recent papers investigating the issue
  - Cunha et al (2013)
  - Aizer and Cunha (2014)
  - Attanasio, Cunha and Jervis (2016)
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- Elicitation of parental beliefs.
Eliciting parental beliefs

- Mothers are presented with different scenarios about initial conditions and parental investment.
Eliciting parental beliefs

- Mothers are presented with different scenarios about initial conditions and parental investment.
- Mothers are then asked to relate these scenarios to child development in certain dimensions (language).
  - Particular care is given to the choice of scenarios using available data.
  - The idea is that mothers relate certain investments and development status to future development.
  - ... and that their idea of development is linked to certain variables in the same way as observable data.
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- We can then infer 'returns' to specific investments.
- We can also assume that mothers have 'ideas' about the production function of HK but possibly the 'wrong' parameters.
- Under some assumptions we can estimate the 'true' production function and the one perceived by each mother.
Perceived production functions
Attanasio, Cunha and Jervis (2016)

- Perceived production function:
  
  \[ \ln(h_1) = \mu_{0,i} + \mu_{1,i} \ln(h_0) + \mu_{2,i} \ln(X) + \mu_{3,i} \ln(h_0) \ln(X) ] \]

- "True" production function:
  
  \[ \ln h_{i,1} = \delta_0 + \delta_1 \ln h_{i,0} + \delta_2 \ln X_i + \delta_3 \ln h_{i,0} \ln X_i] + \epsilon_i \]

**Table:** Production Function Estimates: Perceived Median and "True"

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<tr>
<th></th>
<th>Perceived</th>
<th>&quot;True&quot;</th>
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<td>( \mu_0 )</td>
<td>2.433</td>
<td>( \delta_0 )</td>
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<tr>
<td>( \mu_1 )</td>
<td>0.454</td>
<td>( \delta_1 )</td>
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<td>( \mu_2 )</td>
<td>0.197</td>
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</tr>
<tr>
<td>( \mu_3 )</td>
<td>-0.065</td>
<td>( \delta_3 )</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Standard errors (in parentheses) are clustered at municipality level.
Conclusions

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