Institutions, Education, and Economic Performance

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**Development Prospects Group
The World Bank

The Human Capital Puzzle

Microeconometric evidence on labor markets find that educational levels is one of the strongest predictors of lifetime income

- Earnings increase linearly with schooling completion in Mincer-style regressions
- Verified with U.S. (Heckman, Lochner & Todd 2006) and international data (Peracchi 2006)

Macroeconometric studies on growth find insignificant contribution of human capital to GDP

- Educational attainment generally unrelated to income in cross-country growth regressions
- Holds for both levels (Pritchett 2001) as well as differences (Benhabib & Spiegel 1994)
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Some Stabs at the Problem

1. Human capital is either poorly measured or mismeasured
   - Existing education stock data may fail to capture important quality dimensions (Behrman & Birdsall 1983, Hanushek & Kimko 2000)
   - Data may suffer from systematic deficiencies (Cohen & Soto 2007; Domenech & de la Fuente 2006)

2. Human capital suffers from educational governance failures
   - Governance problems erode productivity of educational sector (Reinikka & Svensson 2005) and reduce incentives for human capital accumulation (Gupta, Davoodi, Tiongson 2001)
   - Institutional failures spill over into growth outcomes (Acemoglu, Johnson & Robinson 2001, 2005)
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A Possible Resolution?

“The incentives that are built into the institutional framework play the decisive role in shaping the kinds of skills and knowledge that pay off.”

North (2004), p. 78

- Adopt 2-stage instrumental variables approach
  1. Estimate national-level educational production functions with governance and school inputs as exogenous variables
  2. Use estimates from the first stage as instruments for human capital in cross-country growth regressions
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Decomposing the Effects of Institutions

- IV accounts for the severe endogeneity problem
- Use of IV allows us to reconcile two competing approaches
  - Including governance directly accounts for institutional environment
  - IV accounts for measurement errors in human capital
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A Simple Motivating Model

- **Goods production**
  \[ Y_t = K_t^\alpha H_t^\beta (A_t L_t)^{1-\alpha-\beta}, \quad 0 < \alpha, \beta < 1 \]

- **Education production**
  \[ H_t = \int_{1}^{A_t L_t} h(\eta_i, F_{it}, S_{it}; G_t) \, di \]
  \[ = F_t \gamma S_t^\epsilon (A_t L_t)^{1-\gamma-\epsilon} \cdot G_t^\phi, \quad 0 < \gamma \]

- **Equations of motion for capital**
  \[ \dot{k}_t = s_k y_t - (n + g + \delta) k_t \]
  \[ \dot{h}_t = s_h y_t - (n + g + \delta) h_t \]
Testable Empirical Specifications

- **Income equation**

\[
\ln \left( \frac{Y}{L} \right) = \ln A_0 + gt + \frac{\alpha}{1 - \alpha} \ln s_k + \frac{\beta}{1 - \alpha} \ln h^* - \frac{\alpha}{1 - \alpha} \ln (n + g + \delta)
\]

\[
\Rightarrow \ln \left( \frac{Y_{it}}{L_{it}} \right) = \pi_0 + \rho_i + \pi_1 \ln s_{k,it} + \pi_2 \ln \left( \frac{H_{it}}{L_{it}} \right) - \pi_3 \ln (n + g + \delta) + Z_{it} \Pi_4 + \nu_{it}
\]

- **Human capital equation**

\[
\ln \left( \frac{H_t}{L_t} \right) = \ln A_0 + gt + \gamma \ln f + \epsilon \ln s + \phi G
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\[
\Rightarrow \ln \left( \frac{H_{it}}{L_{it}} \right) = \theta_0 + \mu_i + \theta_1 G_{it} + \ln \left( \frac{F_{it}}{L_{it}} \right) \Theta_2 + \ln \left( \frac{S_{it}}{L_{it}} \right) \Theta_3 + \epsilon_{it}
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Identification Strategy and Estimation Issues

- Instrument for institutional governance: Lagged government effectiveness
  - Economic policy (especially macro policy) ⇒ But does macro policy affect growth?
  - Financial management (public expenditure) ⇒ But do government expenditures affect growth?
  - Service delivery (especially education) ⇒ Primary channel for effective government

- Proxy for family inputs: Consumption/investment ratio
- Proxy for school inputs: Pupil-teacher ratio
- Other econometric issues: (a) Simultaneity bias (b) Omitted variable bias (c) Exploiting internal instruments
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Human Capital and Government Effectiveness, 2000

Source: Authors’ calculations, using Barro & Lee (2001) and Kaufmann, Kraay & Mastruzzi (2007)
GDP per Worker and Human Capital, 1980–2000

Relationship Between Income and Human Capital

Source: Authors’ calculations, using Barro & Lee (2001) and World Bank (2007)
### Table 1: Benchmark regressions of GDP per capita †

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<thead>
<tr>
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<th>(B1)</th>
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<tr>
<td>Investment share</td>
<td>0.432</td>
<td>0.836</td>
<td>1.097</td>
<td>-0.002</td>
<td>0.689</td>
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</tr>
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<td>(0.34)</td>
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Notes: Huber-White (robust) standard errors reported in parentheses. First stage regressions included second stage controls as instruments, but are not reported. Hansen statistics for exactly identified models are replaced with a dash. ∗ indicates significance at 10 percent level, ∗∗ indicates significance at 5 percent level, and ∗∗∗ indicates significance at 1 percent level.

Result

Human capital is positive and significant, other coefficients in 1st and 2nd stage theoretically-consistent, instruments satisfy exclusion and relevance conditions.
### Model

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Robustness of Benchmark

Result
Human capital survives inclusion of additional growth determining controls in income equation

Result
Human capital robust to alternative variables for and permutations of instruments in human capital equation
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### More Ugly Regression Stuff

**Table 5: Panel regressions of GDP per capita**

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### Result

Human capital is positive and significant, although magnitude is smaller (while remaining significant).
Robustness of Panel

Result
Human capital maintains importance in panel using internal instruments

Result
Human capital continues to be important in most subsamples sliced by institutional quality, geographic location, and income group
Robustness of Panel

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Human capital continues to be important in most subsamples sliced by institutional quality, geographic location, and income group
Recap of Main Findings

- Understand puzzle of insignificance of human capital in macro growth regressions
- Human capital matters when properly instrumented with inputs and governance
- Results robust to a battery of robustness tests in cross section and panel
Selected References I


Robustness to Expanded Panel

Specifications considered:

1. Naïve income equation
2. IV (Overid: $J \chi^2 = 2.59, p = 0.27$, Underid: Anderson $LR = 31.54, p < 0.01$, Weak: $F = 12.32, F_{crit} = 9.08$)
3. Replace effectiveness with full governance measure
4. Exclude family inputs in 1st stage (all income endogenous)
5. Exclude school inputs in 1st stage (avoid simultaneity)
6. Exclude family and school inputs

Formal test of exclusion restriction: high uncertainty about instrument validity yields distribution of posterior that does not include zero

![Posterior Distribution of Human Capital Coefficient](image-url)
Robustness to Additional Controls in Income

- Human capital coefficient estimates: \([2.646, 4.076]\), all significant at 1% level
- Controls considered:
  1. Trade openness (NX/GDP)
  2. Geography (equatorial distance)
  3. Infrastructure (roads/sq km)
  5. Democracy (Polity IV)
  6. Social capital (World Values Survey)
Robustness to Alternative Controls and Permutations

- Human capital coefficient estimates: $[0.707, 3.556]$, most significant at 1% level, all significant at 10% level

- Specifications considered:
  - Controls in education equation
    1. Share of maternal parental authority (OECD GID DB)
    2. Measure of general intelligence (Lynn & Vanhanen 2002)
    3. Educational attainment scores (Altinok & Murseli 2007)
    4. Educational production (trained teacher %, pub ed exp)
  - Interactions in education equation
    1. Governance $\times$ school inputs
    2. Governance $\times$ family inputs
    3. Family $\times$ school inputs
  - Endogenous governance
    2. Pervasiveness of informal payments (Afrobarometer, AmericasBarometer, TI, WB Diagnostic)
    3. Fraction of population with European descent
Robustness to Expanded Panel

- Human capital coefficient estimates: [0.323, 2.183], almost all significant at 1% level, one insignificant coefficient

Specifications considered:
- Fixed effects
  1. Pooled income equation
  2. Replacing educational completion with enrollment
- Panel instrumental variables
  1. IV with FE (Overid: $J \chi^2 = 3.26, p = 0.20$, Underid: Anderson $LR = 13.01, p < 0.01$, Weak: $F = 4.36, F_{crit} = 9.08$)
  2. Replacing effectiveness with full governance measure
  3. Exclude family inputs in 1st stage (all income endogenous)
  4. Exclude school inputs in 1st stage (avoid simultaneity)
Robustness to Expanded Panel

- Human capital coefficient estimates: \([0.816, 1.674]\), almost all significant at 1% level, one significant at 10%

- Specifications considered:
  - System GMM
    1. 1-period lagged GMM instruments, family and school IV instruments (over, under, AR(1), AR(2) satisfied)
    2. 1-period lagged GMM instruments (governance in GMM vector)
    3. 1-period lagged GMM instruments, family, school, time IV instruments
    4. 2-period lagged GMM instruments, family and school IV instruments
    5. 1-period lagged GMM instruments, family and school IV instruments, broad governance
    6. 1-period lagged GMM instruments (governance, family, school in GMM vector)