

# Institutions, Education, and Economic Performance

Jonathon Adams-Kane\*    Jamus Jerome Lim\*\*

\*Department of Economics  
*University of California, Santa Cruz*

\*\*Development Prospects Group  
*The World Bank*

**Silvaplana Workshop on Political Economy, Jul 25–29, 2009**



# The Human Capital Puzzle

- Microeconomic 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)
- Macroeconomic 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)

# The Human Capital Puzzle

- Microeconomic 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)
- Macroeconomic 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)

# 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)

# 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)

# 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

# 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

# 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



# 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

# 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

$$\begin{aligned} H_t &= \int_1^{A_t L_t} h(\eta_i, F_{it}, S_{it}; G_t) di \\ &= F_t^\gamma S_t^\epsilon (A_t L_t)^{1-\gamma-\epsilon} \cdot G_t^\phi, \quad 0 < \gamma \end{aligned}$$

- Equations of motion for capital

$$\begin{aligned} \dot{k}_t &= s_k y_t - (n + g + \delta) k_t \\ \dot{h}_t &= s_h y_t - (n + g + \delta) h_t \end{aligned}$$

# Testable Empirical Specifications

- Income equation

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

$$\Rightarrow \ln \left[ \frac{Y_{it}}{L_{it}} \right] =$$

$$\pi_0 + \rho_i + \pi_1 \ln s_{k,it} + \pi_2 \ln \left[ \frac{H_{it}}{L_{it}} \right] - \pi_3 \ln (n + g + \delta) + \mathbf{Z}_{it} \mathbf{\Pi}_4 + \nu_{it}$$

- Human capital equation

$$\ln \left[ \frac{H_t}{L_t} \right] = \ln A_0 + gt + \gamma \ln f + \epsilon \ln s + \phi G$$

$$\Rightarrow \ln \left[ \frac{H_{it}}{L_{it}} \right] = \theta_0 + \mu_i + \theta_1 G_{it} + \ln \left[ \frac{\mathbf{F}_{it}}{L_{it}} \right] \Theta_2 + \ln \left[ \frac{\mathbf{S}_{it}}{L_{it}} \right] \Theta_3 + \varepsilon_{it}$$

# Testable Empirical Specifications

- Income equation

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

$$\Rightarrow \ln \left[ \frac{Y_{it}}{L_{it}} \right] =$$

$$\pi_0 + \rho_i + \pi_1 \ln s_{k,it} + \pi_2 \ln \left[ \frac{H_{it}}{L_{it}} \right] - \pi_3 \ln (n + g + \delta) + \mathbf{Z}_{it} \mathbf{\Pi}_4 + \nu_{it}$$

- Human capital equation

$$\ln \left[ \frac{H_t}{L_t} \right] = \ln A_0 + gt + \gamma \ln f + \epsilon \ln s + \phi G$$

$$\Rightarrow \ln \left[ \frac{H_{it}}{L_{it}} \right] = \theta_0 + \mu_i + \theta_1 G_{it} + \ln \left[ \frac{\mathbf{F}_{it}}{L_{it}} \right] \Theta_2 + \ln \left[ \frac{\mathbf{S}_{it}}{L_{it}} \right] \Theta_3 + \varepsilon_{it}$$

# 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

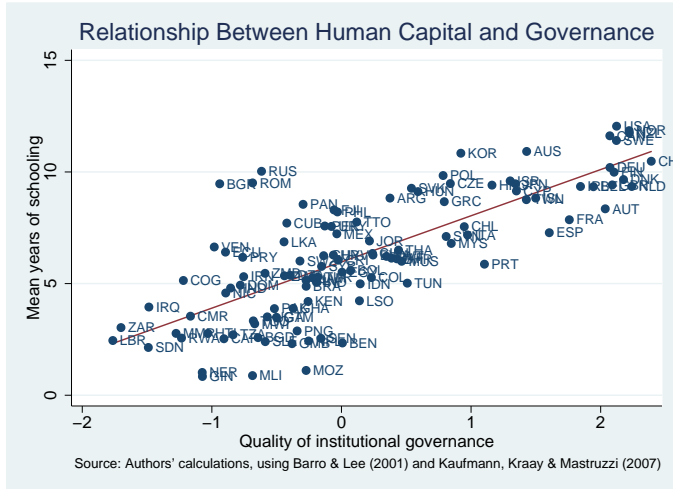
# Identification Strategy and Estimation Issues

- 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

# Identification Strategy and Estimation Issues

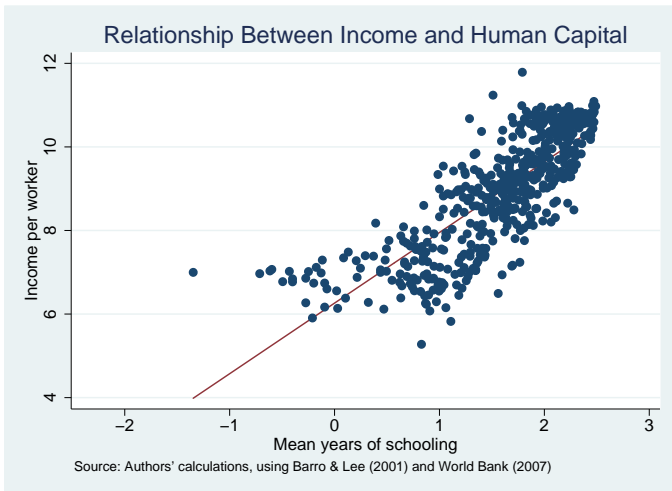
- Instrument for institutional governance: Lagged government effectiveness
  - Economic policy (especially macro policy) ⇒ But does macro policy affect growth?
  - Financial management (public expenditure) ⇒ But do government expenditures affect growth?
  - Service delivery (especially education) ⇒ Primary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

# Human Capital and Government Effectiveness, 2000





# GDP per Worker and Human Capital, 1980–2000



# Ugly Regression Stuff

	(B1)	(B2)	(B3)	(B4)	(B5)	(B6)
	<i>Second stage income equation</i>					
Investment share	0.432 (0.34)	0.836 (0.47)*	1.097 (0.48)**	-0.002 (0.42)	0.689 (0.27)**	0.255 (0.32)
Net rate of depreciation	-0.900 (0.63)	0.815 (0.99)	0.801 (1.02)	1.889 (0.74)**	0.744 (0.98)	1.695 (0.69)**
Human capital	1.840 (0.23)***	3.125 (0.48)***	3.142 (0.44)***	3.329 (0.39)***	3.024 (0.41)***	3.250 (0.32)***
Constant	4.111 (1.58)**	7.231 (2.35)***	7.547 (2.56)***	8.616 (1.84)***	6.954 (2.33)***	8.545 (1.79)***

## Result

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

▶ Details

# Ugly Regression Stuff

	(B1)	(B2)	(B3)	(B4)	(B5)	(B6)
	<i>Second stage income equation</i>					
Investment share	0.432 (0.34)	0.836 (0.47)*	1.097 (0.48)**	-0.002 (0.42)	0.689 (0.27)**	0.255 (0.32)
Net rate of depreciation	-0.900 (0.63)	0.815 (0.99)	0.801 (1.02)	1.889 (0.74)**	0.744 (0.98)	1.695 (0.69)**
Human capital	1.840 (0.23)***	3.125 (0.48)***	3.142 (0.44)***	3.329 (0.39)***	3.024 (0.41)***	3.250 (0.32)***
Constant	4.111 (1.58)**	7.231 (2.35)***	7.547 (2.56)***	8.616 (1.84)***	6.954 (2.33)***	8.545 (1.79)***

## Result

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

► Details

# Robustness of Benchmark

## Result

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

[▶ Details](#)

## Result

Human capital robust to alternative variables for and permutations of instruments in human capital equation

[▶ Details](#)

# Robustness of Benchmark

## Result

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

▶ Details

## Result

Human capital robust to alternative variables for and permutations of instruments in human capital equation

▶ Details

# More Ugly Regression Stuff

	(P1)	(P2)	(P3)	(P4)	(P5)	(P6)
	<i>Second stage income equation</i>					
Investment share	0.162 (0.05)***	0.152 (0.04)***	0.111 (0.08)	0.126 (0.08)	0.031 (0.11)	0.139 (0.10)
Net rate of depreciation	-0.098 (0.13)	0.043 (0.13)	0.337 (0.18)*	0.349 (0.19)*	0.733 (0.28)***	-0.612 (0.46)
Human capital	0.409 (0.11)***					
Alternative human capital		0.323 (0.05)***	1.503 (0.44)***	1.546 (0.47)***	2.183 (0.72)***	-0.937 (1.12)
Constant	8.263 (0.39)***	8.101 (0.37)***				

## Result

Human capital is positive and significant, although magnitude is smaller (while remaining significant)

▶ Details

# More Ugly Regression Stuff

	(P1)	(P2)	(P3)	(P4)	(P5)	(P6)
	<i>Second stage income equation</i>					
Investment share	0.162 (0.05)***	0.152 (0.04)***	0.111 (0.08)	0.126 (0.08)	0.031 (0.11)	0.139 (0.10)
Net rate of depreciation	-0.098 (0.13)	0.043 (0.13)	0.337 (0.18)*	0.349 (0.19)*	0.733 (0.28)***	-0.612 (0.46)
Human capital	0.409 (0.11)***					
Alternative human capital		0.323 (0.05)***	1.503 (0.44)***	1.546 (0.47)***	2.183 (0.72)***	-0.937 (1.12)
Constant	8.263 (0.39)***	8.101 (0.37)***				

## Result

Human capital is positive and significant, although magnitude is smaller (while remaining significant)

► Details

# Robustness of Panel

## Result

Human capital maintains importance in panel using internal instruments

▶ Details

## Result

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



# Robustness of Panel

## Result

Human capital maintains importance in panel using internal instruments

▶ Details

## Result

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

## Recap of Main Findings

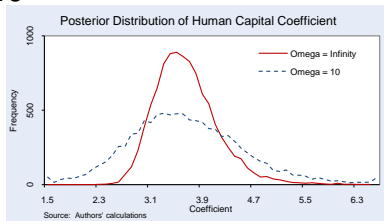
- Understand puzzle of insignificance of human capital in macro growth regressions
- Human capital matters when properly instrumented with inputs and governance
- Results robust to a battery of robustness tests in cross section and panel

# Selected References I

-  Mincer, Jacob (1974). *Schooling, Experience, and Earnings*. New York, NY: Columbia University Press
-  Cohen, Daniel & Marcelo Soto (2007). "Growth and Human Capital: Good Data, Good Results". *Journal of Economic Growth* 12(1) (March): 51–76
-  Hanushek, Eric A. & Dennis D. Kimko (2000). "Schooling, Labor-Force Quality, and the Growth of Nations". *American Economic Review* 90(5) (December): 1184–1208
-  Mankiw, N. Gregory, David Romer & David N. Weil (1992). "A Contribution to the Empirics of Economic Growth". *Quarterly Journal of Economics* 107(2) (May): 407–437
-  Pritchett, Lant H. (2001). "Where Has All the Education Gone?" *World Bank Economic Review* 15(3) (September): 367–391
-  Reinikka, Ritva & Jakob Svensson (2005). "Fighting Corruption to Improve Schooling: Evidence from a Newspaper Campaign in Uganda". *Journal of the European Economic Association* 3(2–3) (April/May): 259–267

# 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

[Return](#)

# 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)
  - 4 Ethnolinguistic fractionalization (Alesina *et al* 2003)
  - 5 Democracy (Polity IV)
  - 6 Social capital (World Values Survey)

[← Return](#)

# 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
    - 1 Lagged (1996) for contemporaneous (2000) governance
    - 2 Pervasiveness of informal payments (Afrobarometer, AmericasBarometer, TI, WB Diagnostic)
    - 3 Fraction of population with European descent

[Return](#)

# 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)

◀ Return

# 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)

[Return](#)