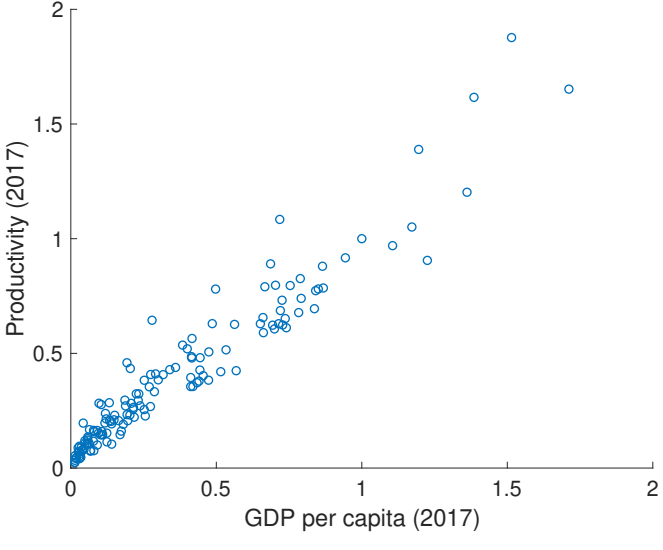
Development Accounting
vs.
Development Regression

Productivity and Income



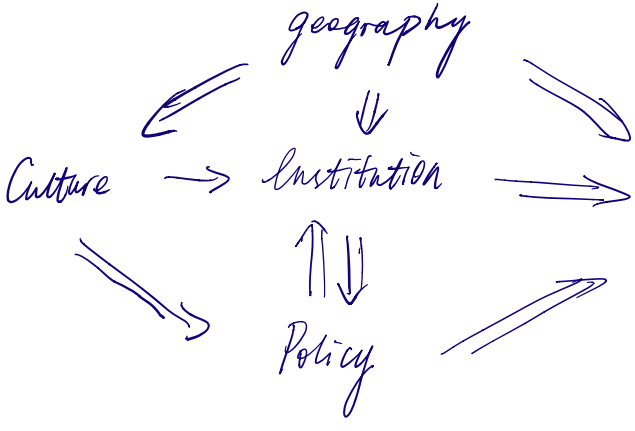
What's the Causal Relationship Between Income and Productivity?

1. Does high productivity *cause* high incomes? (Solow Model)
2. Do high incomes *cause* high productivity?
3. Does something else *cause* high productivity and/or high incomes?

Empirically, this is a challenging question since we do not actually observe productivity!

In this respect, we're in good company! In astrophysics, *dark matter* plays a similar role. Dark matter is invisible in the entire electromagnetic spectrum, but generally accepted theories of gravity can only be supported by the existence of additional matter and energy in the universe.

Income, Productivity, and ...



Productivity ⇒ capital ⇒ income.

Development Accounting.

Policy Question: what determine incomes through the productivity channel.

Candidates for "Dark Matter" in Economics

1. Geography:
   - Climate
   - Natural disasters (luck)
   - Natural resources
   - Access to waterways (cheap transportation)
2. Institutions:
   - "Rules of the Game" for human (political, social, economic) interactions
   - Property rights
   - Accountability (political, criminal, civil)
3. Culture

Institutions and Development: Causality

- Culture is too "malleable" or vague a concept to be empirically testable.
- Let's abstract from geography for now. (Don't worry, I'll bring it back shortly!)
- Do good institutions cause high incomes or do high incomes give rise to good institutions?

Institutions and Development: OLS and Reverse Causality

$$\log(y_i) = \mu_y + \alpha_y R_i + (+ \gamma_i' \delta_y) + \varepsilon_{y_i}$$

R_i: institution. ε_{y_i}: noise. ← want to check relationship.

$$R_i = \mu_R + \alpha_R \log y_i + (+ X_i \gamma_R) + \varepsilon_{R_i}$$

if not zero → y affect institution → effect of institution on income is biased.

$$R_i = \mu_R + \alpha_R (\mu_y + \alpha_y R_i + \varepsilon_{y_i}) + \varepsilon_{R_i}.$$

Rearrange $R_i(1 - \alpha_R \alpha_y) = \mu_R + \alpha_R \mu_y + \alpha_R \varepsilon_{y_i} + \varepsilon_{R_i}$.

$$R_i = \frac{\mu_R + \alpha_R \mu_y}{1 - \alpha_R \alpha_y} + \frac{\alpha_R}{1 - \alpha_R \alpha_y} \varepsilon_{y_i} + \frac{\varepsilon_{R_i}}{1 - \alpha_R \alpha_y}$$

↑ intercept.

Institutions and Development: OLS and Reverse Causality

OLS is B L U. E only if certain conditions are satisfied.

Best · linear unbiased estimator.

most precise estimator.

lowest variance

least noisy.

key condition: $Cov(R_i, \varepsilon_{yi}) = 0$.

$$Cov(R_i, \varepsilon_{yi}) = E(R_i \cdot \varepsilon_{yi}) - E(R_i) E(\varepsilon_{yi})$$

need to check if $E(R_i \cdot \varepsilon_{yi}) = 0$ ($E(\varepsilon_{yi}) = 0$)

$$E(R_i \cdot \varepsilon_{yi}) = E\left(\frac{\mu_R + \alpha_R \mu_y}{1 - \alpha_R \alpha_y} \cdot \varepsilon_{yi} + \frac{\alpha_R}{1 - \alpha_R \alpha_y} \cdot \varepsilon_{yi} \cdot \varepsilon_{yi} + \frac{1}{1 - \alpha_R \alpha_y} \cdot \varepsilon_{Ri} \cdot \varepsilon_{yi} \right)$$

Institutions and Development: OLS and Reverse Causality

$$= \underbrace{\frac{\mu_R + \alpha_R \mu_y}{1 - \alpha_R \alpha_y} E(\varepsilon_{yi})}_{=0.} + \frac{\alpha_R}{1 - \alpha_R \alpha_y} E(\varepsilon_{yi}^2) + \frac{1}{1 - \alpha_R \alpha_y} E(\varepsilon_{Ri} \cdot \varepsilon_{yi})$$

independent $\Rightarrow$ $E(\varepsilon_{Ri}) \cdot E(\varepsilon_{yi}) = 0.$

Note: $Var(\varepsilon_{yi}) = E(\varepsilon_{yi}^2) - E(\varepsilon_{yi})^2 = E(\varepsilon_{yi}^2) > 0.$ ($E(\varepsilon_{yi}) = 0.$)

$cov(R_i, \varepsilon_{yi}) = 0$ iff $\alpha_R = 0$ (income has no effect on institution).

If $\alpha_R \neq 0$, then the estimate is baised.

Institutions and Development: 2SLS / Instruments

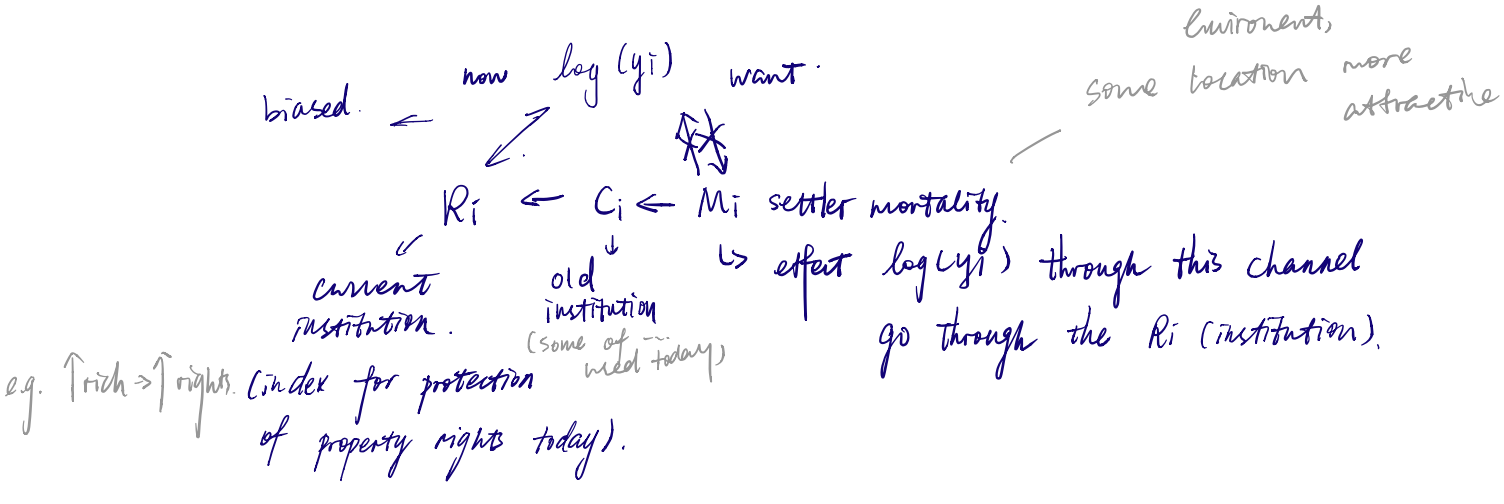
Basic idea:

- Find "instrument" for institutions:
  1. instrument not correlated with error term (i.e. no reverse causality with income)
  2. correlated with institutions
- Regress "instrumented" institutions on income

Challenge: find the instrument!

Institutions and Development: 2SLS / Instruments

Basic Idea - Graphic Illustration



Acemoglu et al. (2001), *Colonial Origins of Development*

want to know.
how much R_i
influenced by m_i

TABLE 2—OLS REGRESSIONS

	Whole world (1)	Base sample (2)	Whole world (3)	Whole world (4)	Base sample (5)	Base sample (6)	Whole world (7)	Base sample (8)
	Dependent variable is log GDP per capita in 1995						Dependent variable is log output per worker in 1988	
Average protection against expropriation risk, 1985–1995	0.54 (0.04)	0.52 (0.06)	0.47 (0.06)	0.43 (0.05)	0.47 (0.06)	0.41 (0.06)	0.45 (0.04)	0.46 (0.06)
Latitude			0.89 (0.49)	0.37 (0.51)	1.60 (0.70)	0.92 (0.63)		
Asia dummy				−0.62 (0.19)		−0.60 (0.23)		
Africa dummy				−1.00 (0.15)		−0.90 (0.17)		
"Other" continent dummy				−0.25 (0.20)		−0.04 (0.32)		
R^2	0.62	0.54	0.63	0.73	0.56	0.69	0.55	0.49
Number of observations	110	64	110	110	64	64	108	61

institutions matter
but geography somewhat matter

Notes: Dependent variable: columns (1)–(6), log GDP per capita (PPP basis) in 1995, current prices (from the World Bank's World Development Indicators 1999); columns (7)–(8), log output per worker in 1988 from Hall and Jones (1999). Average protection against expropriation risk is measured on a scale from 0 to 10, where a higher score means more protection against expropriation, averaged over 1985 to 1995, from Political Risk Services. Standard errors are in parentheses. In regressions with continent dummies, the dummy for America is omitted. See Appendix Table A1 for more detailed variable definitions and sources. Of the countries in our base sample, Hall and Jones do not report output per worker in the Bahamas, Ethiopia, and Vietnam.

Acemoglu et al. (2001), *Colonial Origins of Development*

Panel B: First Stage for Average Protection Against Expropriation Risk in 1985–1995

Log European settler mortality	−0.61	−0.51	−0.39	−0.39	−1.20	−1.10	−0.43	−0.34	−0.63
	(0.13)	(0.14)	(0.13)	(0.14)	(0.22)	(0.24)	(0.17)	(0.18)	(0.13)
Latitude		2.00		−0.11		0.99		2.00	
		(1.34)		(1.50)		(1.43)		(1.40)	
Asia dummy							0.33	0.47	
							(0.49)	(0.50)	
Africa dummy							−0.27	−0.26	
							(0.41)	(0.41)	
"Other" continent dummy							1.24	1.1	
							(0.84)	(0.84)	
R^2	0.27	0.30	0.13	0.13	0.47	0.47	0.30	0.33	0.28

Panel C: Ordinary Least Squares

Average protection against expropriation risk 1985–1995	0.52	0.47	0.49	0.47	0.48	0.47	0.42	0.40	0.46
	(0.06)	(0.06)	(0.08)	(0.07)	(0.07)	(0.07)	(0.06)	(0.06)	(0.06)
Number of observations	64	64	60	60	37	37	64	64	61

Notes: The dependent variable in columns (1)–(8) is log GDP per capita in 1995, PPP basis. The dependent variable in column (9) is log output per worker, from Hall and Jones (1999). "Average protection against expropriation risk 1985–1995" is measured on a scale from 0 to 10, where a higher score means more protection against risk of expropriation of investment by the government, from Political Risk Services. Panel A reports the two-stage least-squares estimates, instrumenting for protection against expropriation risk using log settler mortality; Panel B reports the corresponding first stage. Panel C reports the coefficient from an OLS regression of the dependent variable against average protection against expropriation risk. Standard errors are in parentheses. In regressions with continent dummies, the dummy for America is omitted. See Appendix Table A1 for more detailed variable descriptions and sources.

$R_i = \alpha + \beta M_i + X_i'\gamma + \varepsilon$ — $X_i'\gamma$: other effects.

estimated: $\hat{R}_i = \hat{\alpha} + \hat{\beta} M_i + X_i'\hat{\gamma}$

M_i: measure of institution.

coefficient is negative.

index low where M_i ↑.

change institution, 2 sd difference in index

$\exp 1.04 - 1 = 2.1$ → gdp ≥ 2.

reality: ½.

not accurate. regression

Acemoglu et al. (2001), *Colonial Origins of Development*

TABLE 4—IV REGRESSIONS OF LOG GDP PER CAPITA

	Base sample (1)	Base sample (2)	Base sample without Neo-Europes (3)	Base sample without Neo-Europes (4)	Base sample without Africa (5)	Base sample without Africa (6)	Base sample with continent dummies (7)	Base sample with continent dummies (8)	Base sample, dependent variable is log output per worker (9)
Panel A: Two-Stage Least Squares									
Average protection against expropriation risk 1985–1995	0.94 (0.16)	1.00 (0.22)	1.28 (0.36)	1.21 (0.35)	0.58 (0.10)	0.58 (0.12)	0.98 (0.30)	1.10 (0.46)	0.98 (0.17)
Latitude		−0.65 (1.34)		0.94 (1.46)		0.04 (0.84)		−1.20 (1.8)	
Asia dummy							−0.92 (0.40)	−1.10 (0.52)	
Africa dummy							−0.46 (0.36)	−0.44 (0.42)	
"Other" continent dummy							−0.94 (0.85)	−0.99 (1.0)	

exp 2×0.94 − 1 = 7.

✓ institutions → ↓ geography