Cross-country Income Differences

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Introduction

We study why there are rich and poor countries.

This borrows heavily from Caselli (2005).

You should also read Acemoglu (2009).

Hsieh and Klenow (2010) is a more recent survey.

A Simple Start

A common view in the literature:

productivity accounts for at least half of cross-country income variation.

We build up this result and then look at recent contributions.

Development Accounting

The basic framework postulates

$$y = Ak^{\alpha}h^{1-\alpha}$$

where

- y: gdp per worker (PPP)
- k: capital per worker
- h: human capital per worker

A key parameter: $\alpha = 1/3$

- observable as the capital share – around 1/3 in the U.S.
- Gollin (2002) argues that the capital share is roughly the same in rich and poor countries
- that motivates the Cobb-Douglas functional form
- but it may not actually be true

The basic question

The ratio of rich to poor incomes is given by

$$\frac{y_{rich}}{y_{poor}} = \frac{A_{rich}}{A_{poor}} \left(\frac{k_{rich}}{k_{poor}}\right)^{\alpha} \left(\frac{h_{rich}}{h_{poor}}\right)^{1-\alpha}$$

How big are the contributions of inputs (k, h) and "productivity" A?

Measurement

GDP:

- we assume that the PWT got this right.

Capital:

- we have data on investment (quantities)
  - meaning: expenditures deflated by the local price of capital
- perpetual inventory method: $K_{t+1} = (1 - \delta) K_t + I_t$
- assumption: $K_0 = I_0 / (g + \delta)$
- I_0: investment up to 1970 (or something like it)
- $\delta = 0.06$: based on studies of depreciation in rich countries

Measurement: Human capital

Here, things get tricky.

The standard approach follows Hall and Jones (1999)

$h = e^{\phi(s)}$

s: average years of schooling of population over age 25 (Barro-Lee)

$\phi(s)$: piecewise linear with slopes

- 0.13 for $s \leq 4$
- 0.10 for $4 < s \leq 8$
- 0.07 for $s > 8$

The rationale for this:

- assume that workers are paid their marginal products
- then variation of wages within countries reveals $\phi(s)$
- cross-country data show that $\phi(s)$ is higher in countries with low schooling (Psacharopoulos)
- that last fact is probably not true

Implicit assumptions:

- $h(0)$ is the same everywhere
- a year of schooling is the same everywhere

Measures of success

Define $y_{KH} = k^{\alpha} h^{1-\alpha}$.

Variation in y_{KH} is explained by inputs.

Fraction of income variation due to factors according to Caselli (2005):

$$success1 = \frac{var\left[\ln y_{KH}\right]}{var\left[\ln y\right]} = 0.39$$

$$success2 = \frac{y_{KH}^{90}/y_{KH}^{10}}{y^{90}/y^{10}} = 0.34$$

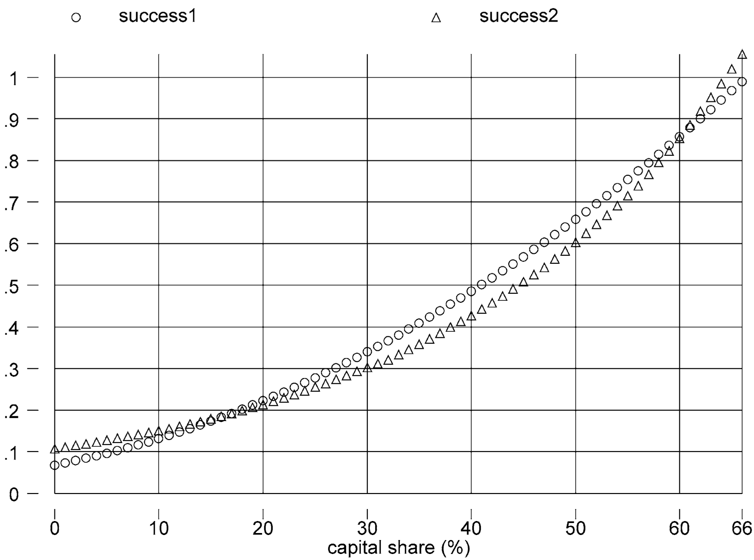
Exercise: Replicate these figures.

Robustness

Quantitatively not important (Caselli, 2005)

- depreciation rate δ
- how K_0 is constructed
- reasonable variation in $\phi(s)$
  - as long as it is consistent with wage data
  - return to schooling could be higher if there a big externalities
- differences in hours worked
  - hours are lower in richer countries

Robustness: Capital share



Higher capital share $\implies$ higher success

Because capital varies more than h.

Robustness: School Quality

Since we observe wages by schooling, school quality cannot affect $\phi(s)$.

So we must assume it affects $h(0)$:

$$h = A_h e^{\phi(s)} \tag{1}$$

The problem: if this is the quality of learning, why does it affect all workers equally?

For this to make sense, we need workers with different s to be imperfect substitutes.

We will return to this later.

A simple specification (Caselli 2005):

$$A_h = p^{\phi_p} m^{\phi_m} k_h^{\phi_k} h_t^{\phi_h} \tag{2}$$

This is freely invented.
The inputs are:

- p: teacher-pupil ratio
- m: teaching materials per student
- k_h: capital in education sector
- h_t: teacher human capital.

Why these inputs?

- because we can observe them

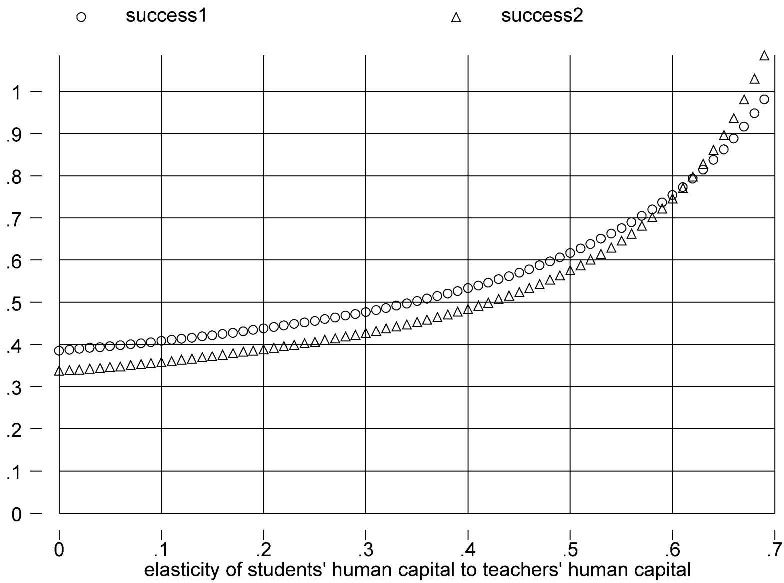
Problem: we don't know anything about the elasticities

- in micro studies using rich country data, the elasticities look like 0
- but there are measurement issues (Hanushek)

A special case

Only include teacher human capital (Bils and Klenow, 2000)

Assume steady state: $h_t = h$.



Source: Caselli (2005)

Clearly, quality could be important.

Problem: how to estimate the h production function?

Later, we look at some sophisticated efforts to do just this.

Promising Ideas

Test scores

Assume that $A_h = e^{\phi_\tau \tau}$

τ is a standardized test score.

Problem:

within a country, a 1 standard deviation increase in test scores increases earnings by at most 20%

See Hanushek and Woessman (2008)

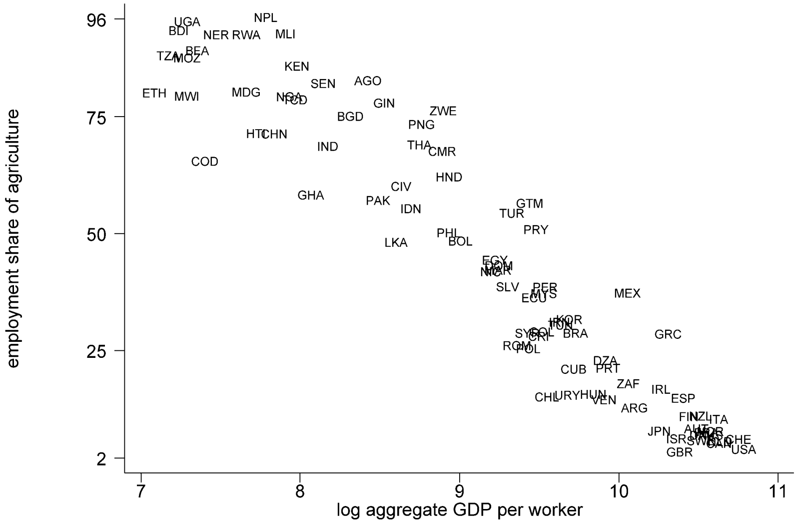
Health

Any measure of health (e.g. mortality) is strongly related to income.

Problem: how to quantify the effect of health on h?

Agriculture

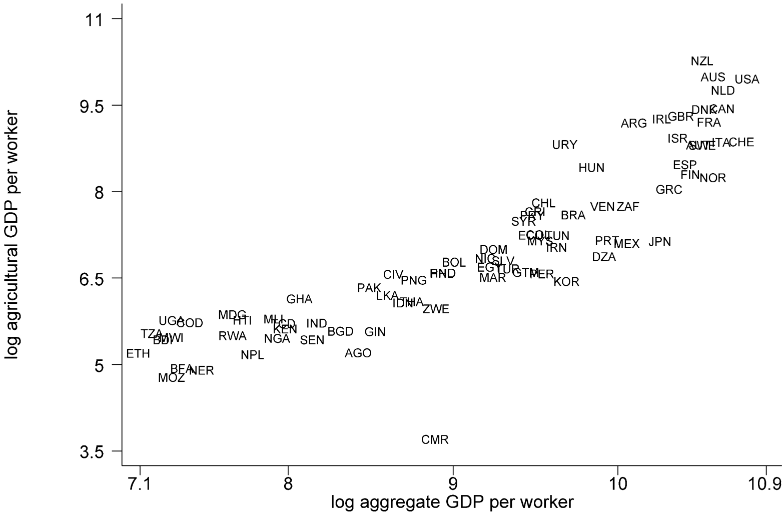
Fact: fraction of workers in agriculture varies from essentially 0 to essentially 1.



Source: Caselli (2005)

Large Variation in Ag Productivity

Variation in Ag productivity is much greater than variation in non-ag productivity



Source: Caselli (2005)

The pattern: low income countries employ large amounts of labor in a sector with particularly low productivity.

How much does this matter?

A counterfactual experiment by Caselli (2005):

moving all labor into industry (holding productivity constant) would cut cross-country income differences by 3/4

This provides the background for papers that ask:

1. Why is so much labor employed in the wrong sector in low income countries?
   (a) subsistence consumption (the “food problem”):Gollin et al. (2002), Gollin et al. (2007)
   (b) intermediate inputs and labor market restrictions: Restuccia et al. (2008)
2. Why is labor productivity so low in agriculture?
   (a) Herrendorf and Schoellman (2011), Gollin et al. (2013): it’s not just an accounting problem
   (b) Lagakos and Waugh (2013): the food problem implies that unproductive farmers work in ag

Non-neutral Productivity Differences

What if we relax the Cobb-Douglas assumption?

For example:

$$Y = \left[\alpha \left(A_k K\right)^{\sigma} + (1-\alpha)\left(A_h h L\right)^{\sigma}\right]^{1/\sigma} \tag{3}$$

with elasticity of substitution $\eta = 1/\left(1-\sigma\right)$.

Parameterizing this: Assume that factors are paid marginal products:

$$r = \alpha \left(y/k\right)^{1-\sigma} A_k^{\sigma} \tag{4}$$

$$w = (1-\alpha)\left(y/h\right)^{1-\sigma} A_h^{\sigma} \tag{5}$$

Given data on y, k, h, r, w, we can back out productivities:

$$A_k = \left(S_k/\alpha\right)^{1/\sigma} y/k \tag{6}$$

$$A_h = \left(S_h/\left(1-\alpha\right)\right)^{1/\sigma} y/h \tag{7}$$

where S_k, S_h are factor income shares.

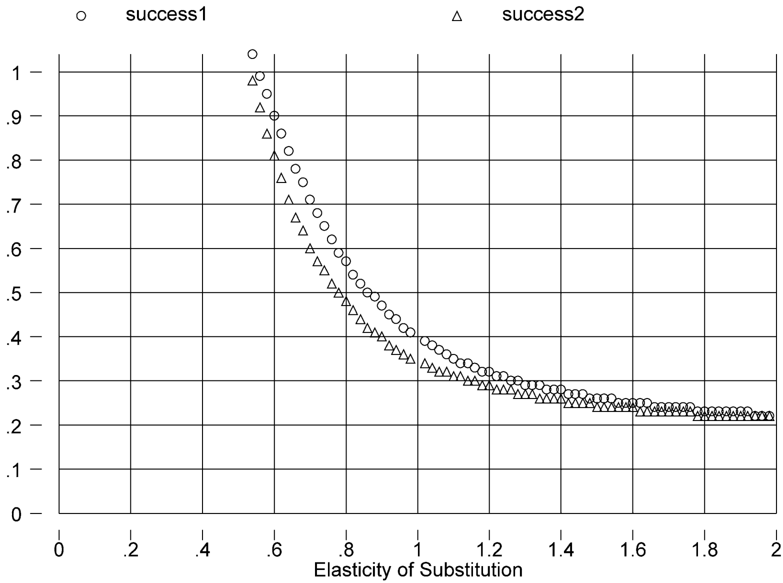
Problem: we don't know much about η.

Implications

1. For any reasonable value of η not close to 1 (Cobb-Douglas),
   (a) A_h is positively related to y, but
   (b) A_k is *negatively* related to y.
2. A generalization: extend the model to have skilled and unskilled labor, then: poor countries use
   (a) skilled labor less efficiently
   (b) unskilled labor *more* efficiently (Caselli and Coleman, 2006).
3. If the elasticity of substitution between factors is low enough, factor inputs account for a large share of cross-country income gaps.

Illustration from the 2 factor (k, h) model

Assume that all countries use the U.S. technology

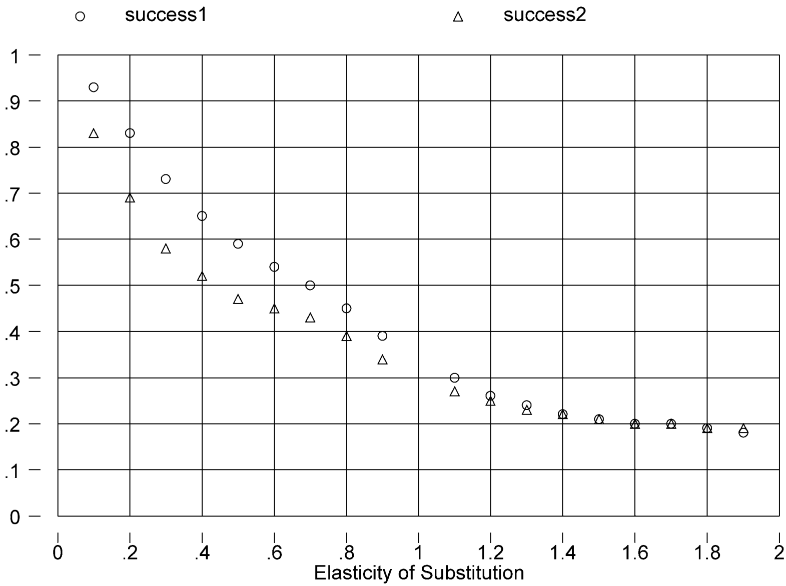


This experiment is a bit awkard.

It forces low income countries to use a k intensive technology, even though their endowments are h intensive.

Alternative experiment

Let each country choose from the menu of technologies observed in the data.



The conclusion remains: the Cobb-Douglas assumption matters.

Jones (2014) pushes this for the importance of human capital.

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