

Econ 102: Lecture Notes #7

Human Capital

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1 Why Doesn't Capital Flow from Rich Countries to Poor?

- Title from an article by Nobel-prize winner Robert Lucas.
- Last lecture we asked what variation in TFP required for model to explain income differences across countries.
- Now instead, lets assume TFP the same across countries.
- Basic insight: MPK implies capital should be MUCH more productive in poor countries. So where is the gigantic sucking sound of all capital being drained out of the rich countries?

– For cobb-douglas production:

$$r = MPk = f'(k) = \alpha \frac{y}{k}$$

– For concave production in general, this must be true (diagram).

- If model is correct, rate of return to capital is higher where k is lowest.
- Critical assumptions: marginal-cost factor pricing, CRS.
- Ignores risk: exchange-rate, expropriation, war etc.

1.1 Size of predicted gap in return to capital

- Example: India.
- Assume Cobb-Douglas production,

$$\begin{aligned}y &= Ak^\alpha \\r &= A\alpha k^{\alpha-1} \\k &= \left[\frac{y}{A}\right]^{\frac{1}{\alpha}}\end{aligned}$$

- Measurements
 - PWT measure of y/l for U.S. about 15 times that of India

- average across both countries: labor share of income = .6 , so $\alpha = .4$
- plug formula for capital into that for r :

$$r = A\alpha k^{\alpha-1} = A\alpha \left(\left[\frac{y}{A} \right]^{\frac{1}{\alpha}} \right)^{\alpha-1} = A\alpha \left[\frac{y}{A} \right]^{\frac{\alpha-1}{\alpha}} = A^{\frac{1}{\alpha}} \alpha y^{\frac{\alpha-1}{\alpha}}$$

- Assume same technology A in both countries.
- relative rental rate:

$$\frac{r_I}{r_{US}} = \left[\frac{y_I}{y_{US}} \right]^{\frac{\alpha-1}{\alpha}} = \left[\frac{1}{15} \right]^{-1.5} = 15^{1.5} = 58$$

- average annual US rental rate: $r = 0.04$. So Indian interest rate would be about 2.3 (230% per year).

- Differences are very large: should be able to compensate for a lot of risk!
- Conclusion: must be something wrong with our assumptions.

1.2 Possible Explanation: Human Capital

- We assumed labor input equal to number of workers in each country.
- Suppose countries differ in level of human capital per worker, h

$$y = [Ah]^{1-\alpha} k^\alpha$$
$$\tilde{y} = \frac{y}{[Ah]^{1-\alpha}} = \tilde{k}^\alpha$$

- Then what we thought was high productivity due to lots of capital per worker is instead partly due the workers themselves rather than capital.
 - low level of h will reduce the implied rate of return to capital because there is less effective labor per unit capital

$$\begin{aligned} r &= \frac{dy}{dk} = \alpha [Ah]^{1-\alpha} k^{\alpha-1} \\ &= \alpha \tilde{k}^{\alpha-1} \end{aligned}$$

- since $\tilde{y} = \tilde{k}^{\alpha-1}$, then $\tilde{k} = \tilde{y}^{1/\alpha}$, so

$$r = \alpha \tilde{y}^{\frac{\alpha-1}{\alpha}}$$

- Measurement: Compute h relative to US using 1968 estimates of capital

per worker:

$$\frac{h_I}{h_{US}} = \frac{y_I}{y_{US}} \times \left(\frac{k_{us}}{k_I} \right)^\alpha$$

- Estimate h relative to US varies across countries, ranging from 0.2 for India, Indonesia and Ghana to 1 for Canada.
 - US worker about 5 times more productive.
 - Implies that in 1987 when US average earnings were \$24,000, average Indian would have earned about \$4800 if transplanted to the US.
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- Income per effective worker is 3 times higher in the US than in India.
 - Difference in capital per *effective* worker is lower than difference in capital per worker.

- So difference in rental rate of capital will be smaller

$$\frac{r_I}{r_{US}} = \left[\frac{\tilde{y}_I}{\tilde{y}_{US}} \right]^{\frac{\alpha-1}{\alpha}} = \left[\frac{1}{3} \right]^{-1.5} = 3^{1.5} = 5$$

- Result: Difference in output per worker is due to both capital and differences in worker quality, so differences in predicted rental rate much smaller than previously predicted.
- This goes a long way to explaining lack of capital flows, but not far enough. A rate of return 5 times higher is still astronomical.

1.3 Extension: Externalities in Human Capital

- Suppose that in addition to the effect of one's own HC on production, the HC of people around you also makes you more productive.
- This effect of my education on your productivity is an example of an "externality".
 - People don't invest in education just because it makes their co-workers more productive; so this benefit is external to individual benefits and costs that people take into account when choosing how much education to acquire.
 - Individual optimizing at market prices means people will choose less than the socially optimal level of education

– Can be corrected by subsidies. Eg Govt pays part of the cost of education.

- Assume output per EFFECTIVE worker:

$$\begin{aligned}y &= [Ah]^{1-\alpha} k^\alpha h^\gamma \\ \tilde{y} &= A\tilde{k}^\alpha h^\gamma \\ \frac{dy}{dk} &= \alpha [Ah]^{1-\alpha} k^{\alpha-1} h^\gamma\end{aligned}$$

- h^γ is the *external effect* of human capital.
- Now the rate of return to capital depends not just on capital per effective worker:

$$r = \frac{dy}{dk} = \alpha \left(\frac{k}{Ah} \right)^{\alpha-1} h^\gamma = \frac{\alpha \tilde{k}^\alpha h^\gamma}{\tilde{k}} = \alpha \frac{\tilde{y}}{\tilde{k}}$$

- From the production function,

$$\tilde{k} = \left[\frac{\tilde{y}}{A(h)^\gamma} \right]^{\frac{1}{\alpha}} = A^{-1/\alpha} [\tilde{y}]^{1/\alpha} [h]^{-\gamma/\alpha}$$

,Then

$$r = \alpha \frac{\tilde{y}}{\tilde{k}} = \alpha \frac{\tilde{y}}{A^{-1/\alpha} [\tilde{y}]^{1/\alpha} [h]^{-\gamma/\alpha}} = \alpha \tilde{y}^{1-\frac{1}{\alpha}} A^{1/\alpha} (h)^{\gamma/\alpha}$$

$$\frac{r_I}{r_{US}} = \left[\frac{\tilde{y}_I}{\tilde{y}_{US}} \right]^{\frac{\alpha-1}{\alpha}} \left(\frac{h_I}{h_{US}} \right)^{\gamma/\alpha}$$

- Measurement: over 1909-59,
 - Estimates imply that h grew at 0.009 per year in US.

* assumes that all increase in human capital due to schooling. (or that other HC grows at same rate).

* implies that $\gamma = 0.36$

– so a 10% increase in average labor quality improves my productivity by 3.6%

● result

$$\frac{r_I}{r_{US}} = \left[\frac{\tilde{y}_I}{\tilde{y}_{US}} \right]^{\frac{\alpha-1}{a}} = \underbrace{\left[\frac{1}{3} \right]^{-1.5}}_{\tilde{k}} \underbrace{\left[\frac{1}{5} \right]^{\frac{0.36}{0.36}}}_{\tilde{h}} = 1.04$$

● Differences in rate of return are now trivial.

2 Summary: Why Capital Doesn't Flow

- In general,

$$y = [Ah]^{1-\alpha} k^\alpha$$

- if $[Ah]^{1-\alpha}$ is the same across countries, then it must be that rate of return is higher in poorer countries
- Since capital does not flow from rich to poor, it must be that $[Ah]^{1-\alpha}$ is lower in poor countries.
- Jones (Page 60) prefers story in which A is higher in rich countries

- note that this implies A is correlated with education. (graph last lecture).

- Lucas prefers story in which h is higher in rich countries.
 - Differences in HC are large and relatively measurable; hence more convincing.

- Education rather than savings may be the key to increasing welfare of poor countries.

3 Last word on Solow Model

- Jones (p61): Richest countries are 32 times richer than poorest countries.
 - Differences in investment rates explains factor of 2,
 - Differences in education explain factor of 2
 - Remaining to explain: $32/(2+2) = 8$. Must be that TFP differences are by far the most important.
 - He neglects external effect of HC, but even by Lucas's account, this is at most a factor of 5.
- Solow model explains a lot of wealth inequality, but next step is to understand differences in TFP.

- Jones, Romer: it's all technology, patents and inventions. (rest of Jones book).
- Parente, Prescott: what are the barriers to growth? Bad government, lazy workers etc.
 - These differences exist because some countries erect barriers to the efficient use of readily available technology. The purpose of these barriers is to protect industry insiders with vested interests in current production processes from outside competition. Were this protection stopped, rapid TFP growth would follow in the poor countries, and the whole world would soon be rich.

4 Next Week: Consumer and Firm Behavior

- Notice that labor supply and investment decisions have not played an important role:
- we assumed everyone works the same amount all the time, and that investment is always a constant share of output
- In the long run, these are not bad assumptions:
 - labor supply per worker cannot grow because hours are bounded.
 - standard investment model generates result that investment in the long run is proportional to output.

- We now move to studying short run variations in GDP per capita, employment and the price level .
- Fluctuations in investment and labor will play key roles.
- Now we need to understand choices people make:
 - tradeoff between labor income and leisure
 - tradeoff between consuming today and consuming in the future.
 - this requires a model of preferences: utility function.
- Model of the representative consumer (W Chapter 4).