Accounting For Cross-Country Income Differences

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Standard Primal Growth Accounting

- Aggregate production possibilities frontier:

$$Y_t = F(T_t, K_t, L_t)$$

where

$$\begin{aligned} K_t &= \text{capital services} \\ L_t &= \text{labour services (total hours?)} \\ T_t &= \text{total factor productivity (residual)} \end{aligned}$$

- Change in output is

$$\dot{Y} = F_K \dot{K} + F_L \dot{L} + F_T \dot{T}$$

$\Rightarrow$ output growth:

$$\frac{\dot{Y}}{Y} = \left(\frac{F_K K}{Y}\right)\frac{\dot{K}}{K} + \left(\frac{F_L L}{Y}\right)\frac{\dot{L}}{L} + \left(\frac{F_T T}{Y}\right)\frac{\dot{T}}{T}$$

- Assuming perfect competition and CRS:

$$F_K = q \qquad \text{and} \qquad F_L = w$$

$\Rightarrow$ GDP growth:

$$\frac{\dot{Y}}{Y} = \alpha_t \frac{\dot{K}}{K} + (1 - \alpha_t)\frac{\dot{L}}{L} + \left(\frac{F_T T}{Y}\right)\frac{\dot{T}}{T}$$

where

$$\alpha_t = \frac{q_t K_t}{Y_t} = \text{capital share}$$

- So TFP growth is measured as

$$g = \frac{\dot{Y}}{Y} - \alpha_t \frac{\dot{K}}{K} - (1 - \alpha_t)\frac{\dot{L}}{L}$$

$\hookrightarrow$ estimate is only as good as measures of Y, K, L and α

Measuring Capital Growth

- Capital stock estimates typically use **perpetual inventory method**:

$$K_t = I_t + (1 - \delta) K_{t-1},$$

where

$$\begin{aligned} I_t &= \text{real investment} \\ \delta &= \text{rate of depreciation} \end{aligned}$$

- Successive iteration $\Rightarrow$

$$K_t = \sum_{s=0}^{t-1} (1 - \delta)^s I_{t-s} + (1 - \delta)^t K_0$$

where initial capital stock is proxied by

$$K_0 = \frac{I_0}{\delta}$$

Accounting for self employment

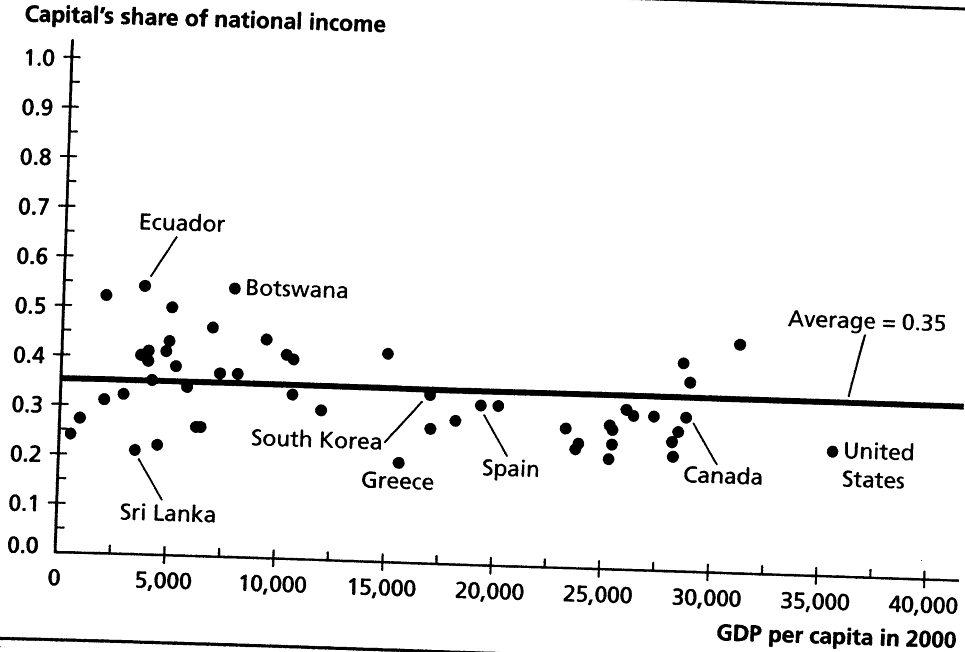
- To compute labour share, $1 - \alpha$, National Accounts data on "employee compensation" are used
- BUT what about self–employment income ?

$\hookrightarrow$ large component of income in developing countries (Gollin, 2002)

- Correcting for this, yields estimates across countries that average 0.65 and are not systematically related to income level

FIGURE 3.3

Capital's Share of Income in a Cross-Section of Countries



Source: Bernanke and Gürkaynak (2002), table 10 and note 18.

TFP Growth vs. Factor Accumulation

- Are differences in output per worker the result of differences in costly capital formation or due to differences in total factor productivity?
- Early estimates suggested most came from TFP, but others have argued that we should include human as well as physical capital
- But how do we measure "human capital" across countries ?

"Why do Some Countries Produce So Much More Output per Worker than Others ?" (Hall and Jones, 1999)

- Aggregate production function for country *i*:

$$Y_i = K_i^{\alpha}(A_i H_i)^{1-\alpha}$$

- Can be re–written as

$$\frac{Y_i}{L_i} = \kappa_i h_i A_i,$$

where

$$\begin{aligned} h_i &= \frac{H_i}{L_i} = \text{average human capital} \\ \kappa_i &= \left(\frac{K_i}{Y_i}\right)^{\frac{\alpha}{1-\alpha}} = \text{``capital intensity"} \end{aligned}$$

- How much of the cross-country variation in $\frac{Y_i}{L_i}$ can be accounted for by each component

Index of Human Capital

- Wage per unit of human capital is

$$v_i = \frac{(1-\alpha)Y_i}{H_i}$$

$\hookrightarrow$ wage of indvidual j in country i is

$$w_{ij} = v_i h_{ij}$$

$\hookrightarrow$ in logs:

$$\log w_{ij} = \log v_i + \log h_{ij}$$

- "Mincerian" wage regressions

$$\log w_{ij} = a_i + b_i s_{ij} + c_i X_{ij} + \varepsilon_{ij},$$

- Hall and Jones use index of average human capital:

$$h_i = e^{b_i E_i}$$

where E_i = average schooling.

- Use Mincerian return estimates to capture diminishing returns:

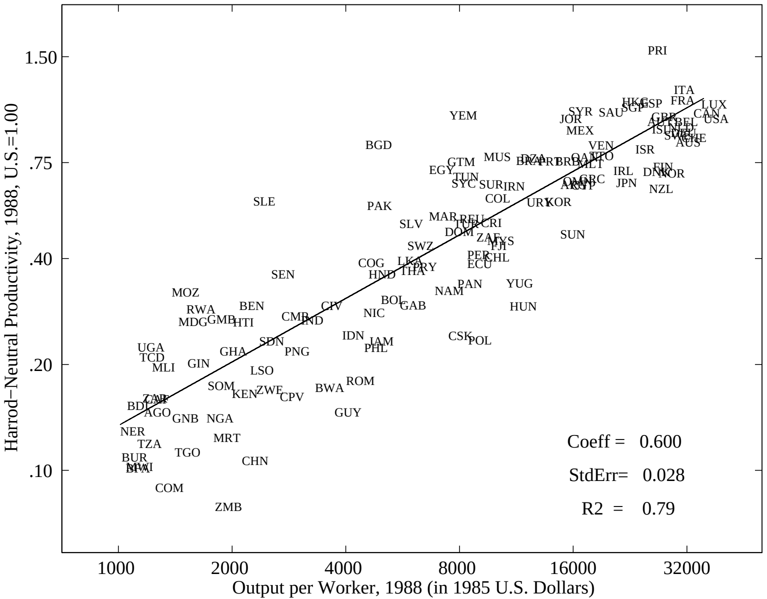
$$\begin{aligned} b_i &= 0.13 \text{ for average schooling} < 4 \text{ years} \\ &= 0.10 \ 4 - 8 \text{ years} \\ &= 0.07 \text{ over } 8 \text{ years} \end{aligned}$$

Table 1: Productivity Calculations: Ratios to U.S. Values

Country	Y/L	Contribution from $(K/Y)^{\alpha/(1-\alpha)}$	H/L	A
United States	1.000	1.000	1.000	1.000
Canada	0.941	1.002	0.908	1.034
Italy	0.834	1.063	0.650	1.207
West Germany	0.818	1.118	0.802	0.912
France	0.818	1.091	0.666	1.126
United Kingdom	0.727	0.891	0.808	1.011
Hong Kong	0.608	0.741	0.735	1.115
Singapore	0.606	1.031	0.545	1.078
Japan	0.587	1.119	0.797	0.658
Mexico	0.433	0.868	0.538	0.926
Argentina	0.418	0.953	0.676	0.648
U.S.S.R.	0.417	1.231	0.724	0.468
India	0.086	0.709	0.454	0.267
China	0.060	0.891	0.632	0.106
Kenya	0.056	0.747	0.457	0.165
Zaire	0.033	0.499	0.408	0.160
Average, 127 Countries:	0.296	0.853	0.565	0.516
Standard Deviation:	0.268	0.234	0.168	0.325
Correlation w/ Y/L (logs)	1.000	0.624	0.798	0.889
Correlation w/ A (logs)	0.889	0.248	0.522	1.000

Note: The elements of this table are the empirical counterparts to the components of equation (3), all measured as ratios to the U.S. values. That is, the first column of data is the product of the other three columns.

Figure 1: Productivity and Output per Worker



Main Findings

- Strong positive correlation between output per worker and TFP
- Strong positive correlation between average human capital and TFP
- Most of the difference between developed and less developed countries is due to TFP differences

$\hookrightarrow$ typical finding of most cross-country accounting exercises