Income Differences Across Countries

Pete Klenow
Stanford University

Society for Economic Dynamics
July 6th, 2006
Vancouver, Canada
2000 PPP Income per capita

<table>
<thead>
<tr>
<th>Percentile Range</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>90th/10th</td>
<td>25.6</td>
</tr>
<tr>
<td>75th/25th</td>
<td>8.8</td>
</tr>
<tr>
<td>S.D. of logs</td>
<td>1.16</td>
</tr>
</tbody>
</table>

Source: Penn World Table 6.1 (86 countries)
Relative Income Per Capita 2000

Source: Penn World Table
Production function

\[ Y = K^\alpha (AhL)^{1-\alpha} \]

\[ Y = \text{PPP GDP} \quad \text{pop} = \text{population} \]
\[ L = \text{hours worked} \quad K = \text{PPP physical capital} \]
\[ h = \text{human capital per worker} \quad A = \text{a residual} \]
A useful decomposition

\[ \frac{Y}{pop} = L \left( \frac{K}{Y} \right)^{\frac{\alpha}{1-\alpha}} A h \]
Quality:

Perhaps 30% higher in rich vs. poor.

ICP: services are “comparison resistant”.

⇒ half is missed in PPP calculations.

Source: Hummels and Klenow (2005)
Price of Medical Care

Source: Penn World Table (114 countries in 1996)
Price of Education

Source: Penn World Table (114 countries in 1996)
Point 1: Quality and Variety

Variety:

Perhaps 15% higher in rich vs. poor.

Suppose 2/3 (consumer portion) missed.

Taken together, factor of 30 rather than 24!

Point 2: L/pop

Prescott, Rogerson:

Explains income gap b/w U.S., Western Europe

Alwyn Young:

Explains 20% of growth in Asian Tigers, China

Parente, Rogerson & Wright:

Poor do more home work, less market work
Labor Force / Population

Source: ILO via Penn World Table (97 countries in 1996)
Source: WDI via Caselli (2005)
Source: ILO via Caselli (2005), 41 countries in 1996
Development Accounting

\[
\frac{Y}{\text{pop}}_{24} = \frac{L}{\text{pop}}_1 \left[ \frac{K}{Y} \right]^{\alpha} h A
\]
ILO data suspect?

10% of Asian growth, vs. Young’s 20%

Hours worked per agricultural worker?

Alternatively, count home production.
Point 3: K/Y

Richer countries have higher PPP I/Y (corr 0.6).

Estimate K/Y using perpetual inventory and an initial stock guess.

⇒ richer countries have higher K/Y (corr 0.7).
Source: Penn World Table (97 countries in 1996)
\[
\frac{Y}{\text{pop}_{24}} = \frac{L}{\text{pop}_{1}} \left( \frac{K}{Y} \right)^{\frac{\alpha}{1-\alpha}} h A
\]
Forces driving K/Y variation
Forces driving K/Y variation

Saving rates?
Investment Rates at Domestic Prices

Source: Penn World Table
Forces driving K/Y variation

Saving rates? NO
Forces driving K/Y variation

Saving rates? NO

Investment prices?
1996 Price of Equipment

Source: Penn World Table
Forces driving K/Y variation

Saving rates? NO

Investment prices? NO
Forces driving K/Y variation

Saving rates?  NO

Investment prices?  NO

Consumption prices?
Source: Penn World Table
Forces driving K/Y variation

Saving rates? NO

Investment prices? NO

Consumption prices? YES
K/Y: Open Questions

Why are richer countries better at making $K$?

Just a reflection of $h$ differences?

Eaton & Kortum:

Quality differences mask import barriers?
Lucas: why doesn’t capital flow from rich to poor?

Lately it has: $S/Y$ is more correlated with $Y/L$ (0.5) than is $I/Y$ (0.05 at domestic prices).

Why doesn’t capital flow to equalize MPK’s?

Caselli & Feyrer: It does!
Caselli & Feyrer MPK’s

Naive MPK \equiv \frac{\alpha Y}{K}

Corrected MPK \equiv \frac{\alpha P_Y Y - \text{land rents}}{P_K K}
Naive MPK

Source: Caselli & Feyrer (2006), 52 countries in 1996
MPK Corrected for Prices, Land Rents

Source: Caselli & Feyrer (2006), 52 countries in 1996
MPK: Open Questions

Why does K’s share rise with development?
   Caselli & Coleman, Hansen & Prescott

No single MPK?
   Banerjee & Duflo.
Higher attainment in rich countries (corr 0.9).

Can estimate $h$ using Mincerian formulation

(log of $h$ is linear in schooling).

1 more year of schooling $\approx 10\%$ higher $h$
Source: Penn World Table and Barro-Lee (97 countries in 1996)
Development Accounting

\[ \frac{Y}{\text{pop} \frac{24}{1}} = \frac{L}{\text{pop} \frac{1}{2}} \left( \frac{K}{Y} \right)^{\frac{\alpha}{1-\alpha}} \cdot \frac{h}{2} \cdot A \]
\[
\frac{Y}{\text{pop}_{24}} = \frac{L}{\text{pop}_1} \left[ \frac{K}{Y} \right]^{\frac{\alpha}{1-\alpha}} \frac{h}{2} \frac{A}{6}
\]
Point 6: MPH

Single Mincerian return in all countries?

Psacharopoulos & collaborators:
  higher Mincerian return in poor countries

Banerjee & Duflo:
  when well-measured, similar across countries
Mincerian returns vs. schooling

Source: Banerjee and Duflo (2005); 38 countries, various years
Mincerian returns vs. schooling (better data)

Source: Banerjee and Duflo (2005); 59 countries, various years
Limits to the Mincerian Approach

Manuelli & Seshadri / Erosa, Koreshkova, Restuccia:

\[
\ln h_i = f(s_i, y_i, a_i), \quad y = \text{inputs, } a = \text{ability}
\]

\[
\frac{d \ln h_i}{ds_i} = \frac{\partial f}{\partial s_i} + \frac{\partial f}{\partial y_i} \frac{\partial y_i}{\partial s_i} + \frac{\partial f}{\partial a_i} \frac{\partial a_i}{\partial s_i}
\]

But x-country = x-individual?
x-country vs. x-individual

Country TFP differences

\[ \Rightarrow \text{x-country } \frac{\partial y_i}{\partial s_i} \gg \text{x-individual } \frac{\partial y_i}{\partial s_i} \]

Even more so with public schools?

Yet perhaps x-country \( \frac{\partial a_i}{\partial s_i} \ll \text{x-individual } \frac{\partial a_i}{\partial s_i} \).
h: Open Questions

Production function for h?

Accumulation at home, on the job?

Externalities?

Sources of $h$ variation across countries?
Point 7: Immigrants and h

Immigrants provide useful info on h.

Different source countries, one market.

Hendricks: U.S. Census data for 1990
Immigrants vs. Natives in the U.S.

Real GDP per worker relative to the U.S. in 1990 vs. Earnings Relative to Natives (same age, education, sex)

Source: Hendricks (2002); 74 countries in 1990
Source: Hendricks (2002)
\[
\frac{Y}{\text{pop}\_24} = \frac{L}{\text{pop}\_1} \left[ \frac{K}{Y} \right]^{1-\alpha} \frac{h}{2-4} A
\]
\[ \frac{Y_{\text{pop}}}{24} = \frac{L_{\text{pop}}}{1} \sqrt[2]{\frac{K_{\text{Y}}}{2}}^{\frac{\alpha}{1-\alpha}} \frac{h}{2-4} \frac{A}{3-6} \]
Point 8: Technology and A

Same technology in all countries?

TFP gaps exist even within countries.

Firms may have to invest in adoption.

Why can’t FDI eliminate any differences?

See Chad Jones’ recent paper.
Years for Income per Capita to Grow from 2,000 to 4,000 (1990 $U.S.)

Source: Parente and Prescott (2005)
Technology and A: Open Questions

Data on barriers and investments?

Channels for international diffusion?

Right model? Parente & Prescott

Howitt

Klenow & Rodriguez-Clare
Points 9 & 10: Misallocation and A

Perhaps less efficient allocation of K and L within poor countries.

Maybe no higher average MPK, but more dispersion of MPK’s within poor countries.

Parente & Prescott
Schmitz
Restuccia & Rogerson
Point 9: Agriculture and A

*Within* agriculture, K and land less efficiently allocated in poor countries?

*Between* agriculture and rest of economy, L less efficiently allocated in poor countries?

Restuccia, Yang, & Zhu
Gollin, Parente & Rogerson
Caselli Handbook
Source: Caselli (2005)
Source: Caselli (2005)
## Productivity in Agriculture

<table>
<thead>
<tr>
<th></th>
<th>Ag.</th>
<th>Non-ag.</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.D. of log Y/L</td>
<td>1.47</td>
<td>0.57</td>
</tr>
<tr>
<td>90th/10th</td>
<td>45</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Source: Caselli (2005), 80 countries in 1985
## Counterfactual Calculation

<table>
<thead>
<tr>
<th></th>
<th>S.D.</th>
<th>90th/10th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual log Y/L</td>
<td>1.1</td>
<td>22</td>
</tr>
<tr>
<td>With U.S. emp. shares</td>
<td>0.6</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: Caselli (2005), 80 countries in 1985
Ag. vs. Non-ag.: Open Questions

Model of transition with Y/L gaps?
   Lucas, Hansen & Prescott

Gaps reflect h differences?
   Caselli & Coleman, Jeong & Kim

Gaps reflect home production?
   Parente, Rogerson & Wright
Big TFP gaps across plants within industries.

TFP gaps may imply MPK and MPL gaps.

If so, large potential gains from reallocation.
### TFP Dispersion within 4-digit industries

<table>
<thead>
<tr>
<th></th>
<th>90(^{th}/10^{th})</th>
<th>75(^{th}/25^{th})</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>1.9</td>
<td>1.3</td>
</tr>
<tr>
<td>China</td>
<td>5.6</td>
<td>2.5</td>
</tr>
<tr>
<td>India</td>
<td>5.7</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Potential A Gains from Reallocation

Melitz model (monopolistic competition between firms with different productivity).

Reallocate K and L to equalize MPK and MPL across plants.

Result: China and India could double A.

Mfg. Misallocation: Open Questions

Right model to gauge gaps and gains?

Gaps tied to observable distortions?

More measurement error in poor countries?
Recap of Development Accounting

\[ \frac{Y}{\text{pop}} = \frac{L}{\text{pop}} \left[ \frac{K}{Y} \right]^{\frac{\alpha}{1-\alpha}} \]

\[ \frac{h}{2-4} \quad \frac{A}{3-6} \]
Plenty of Open Questions

Quality and Variety

Magnitude and sources of h differences

Externalities

Extent and sources of misallocation