Understanding Economic Growth

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The Parade of World Income

GDP per capita, 2009
(2005 Dollars)

Percentage of the World population that has passed by

World Average
$9,909
GDP per Capita in the United States, 1870–2009

GDP per capita (2005 Dollars)
GDP per Capita in the United States, the United Kingdom, and Japan, 1870–2009

GDP per capita (2005 Dollars, ratio scale)

United States

United Kingdom

Japan

Year
GDP per Capita by Country Group, 1820–2008

GDP per Capita (2005 Dollars, ratio scale)

Country group and population in 2009 (in millions)
- Western Europe: 408
- Western Offshoots: 366
- Eastern Europe: 114
- Former USSR: 275
- Latin America: 580
- China: 1,320
- India: 1,160
- Japan: 127
- Africa: 908
- World: 6,810

The Distribution of Growth Rates, 1975–2009

![Diagram showing the distribution of growth rates among countries from 1975 to 2009.](image)
World Inequality and Its Components, 1820–1992

Source: Bourguignon and Morrison (2002).
How do we explain all this stuff?

What would a proper explanation even look like?
Earth as Viewed by Aliens
How do we explain all this stuff?

What would a proper explanation even look like?

How do we put quantitative flesh on such an explanation?
Proximate vs. Ultimate Causes: The Death of Emma Bovary

- Consumption of arsenic
- Desire to commit suicide
- Infidelity and financial ruin
- Unrealizable romantic feelings
- Limited role for women in 19th Century French bourgeois society
My Approach

Economic Growth

Proximate Determinants

Accumulation of Factors of Production

Productivity
My Approach

Economic Growth

Proximate Determinants

Accumulation of Factors of Production

Productivity

Ultimate Determinants

1. _________

2. _________

3. _________

etc.
Output per worker vs. Factors of production per worker graph with a production function curve.
(a) Differences in output due to factor accumulation

Output per worker

Factors of production per worker

Country 2

Country 1

Production function in both countries

\[ y_1 \]

\[ y_2 \]

(b) Differences in output due to productivity

Output per worker

Factors of production per worker

Country 2

Country 1

Production function in Country 1

Production function in Country 2

(c) Differences in output due to both productivity and factor accumulation

Output per worker

Factors of production per worker

Country 2

Country 1

Production function in Country 1

Production function in Country 2
Factor Accumulation: Intellectual Underpinnings

- Thomas Malthus
- Robert Solow
- Joseph Stalin
- W. W. Rostow
- The World Bank
- Mankiw, Romer, and Weil (1992)
Saving Rate by Decile of Income per Capita

Average saving rate, 2009

Decile of GDP per capita, 2009
Relationship between Income per Capita and Population Growth

Population growth rate, 1975–2009 (% per year)

GDP per capita, 2009 (2005 Dollars, ratio scale)
Aside: The Effect of Reduced Fertility on Economic Growth

• One of the oldest questions in development economics
• Decades of ideological conflict
• Hard to answer because fertility is endogenous
• Decades of intellectually flawed attempts to address (cross-country regressions – yeech!)
• Recently published paper by Ashraf, Weil, and Wilde (Population Development Review, 2013) provides an answer
UN Medium and Low Variant Fertility Scenarios for Nigeria
Effect of changing from the UN medium fertility scenario to the UN low fertility scenario
Average Years of Schooling Versus GDP per Capita

Average years of schooling, 2010

GDP per capita, 2009 (2005 Dollars)
Student Test Scores Versus GDP per Capita

Average student test scores, 2009

GDP per capita, 2009 (2005 Dollars)
Life Expectancy Versus GDP per Capita

Life expectancy at birth, 2009

Real per capita GDP, 2009 (2005 Dollars)
How do we **Quantify** the Impact of Factor Accumulation?

\[
\text{Output per Worker}_i = \text{Factors of Production per Worker}_i \times \text{Productivity}_i
\]

\[
\frac{\text{Output per Worker}_i}{\text{Output per Worker}_j} = \left( \frac{\text{Factors of Production per Worker}_i}{\text{Factors of Production per Worker}_j} \right) \times \left( \frac{\text{Productivity}_i}{\text{Productivity}_j} \right)
\]
How do we know “structural” effects of factor accumulation?

• Factor accumulation raises income
• Income raises factor accumulation
• Different approach for each factor:

  Physical capital  look at rent on capital
  Education  look at “returns to schooling” (ala Mincer)
  Health  look at “returns to health”
Aside #2: Measuring the Returns to Health

• taller people earn more
  – but that is not structural

• mad scientist approach
  – vary health exogenously, look at effect on income
  – but that is not ethical

• natural experiment approach
Measuring Returns to Health Using Twins

- regress height, schooling, and ln(wage) on fetal growth
- coefficients:

  height: 3.76 (0.43)
  schooling: .657 (.211)
  ln(wage): .190 (0.77)

\[
\rho_{\text{height}} = \frac{d \ln(w)}{dx} \frac{d \text{height}}{dx} = \frac{.190}{3.76} = .051
\]
Development Accounting for Mexico

Output per Worker 0.35

Physical Capital per Worker 0.33
Human Capital per Worker 0.84

Factors of Production per Worker 0.61

Productivity 0.56

Data for year 2009. All quantities relative to United States.
Factors of Production vs. Productivity as Explanations for International Income Differences
The Conceptual Framework

Output per Worker

Factors of Production per Worker

Productivity
The Conceptual Framework

Output per Worker

Factors of Production per Worker

Productivity

Technology

Efficiency
Conceptual Framework for Productivity

Productivity\_i = Technology\_i \times Efficiency\_i

\[
\frac{Productivity\_i}{Productivity\_j} = \left( \frac{Technology\_i}{Technology\_j} \right) \times \left( \frac{Efficiency\_i}{Efficiency\_j} \right)
\]

- Analysis can be applied either between countries or over time
For changes in income over time *in leading countries*, technology is almost certainly the big story.

- We observe the introduction of new technologies and their productive effects
  - steam engine, network electricity, ICT, etc.

- Leaves open many interesting questions about future of technological progress
  - Robert Gordon and the “toilet test”
The Mysterious “Chad Jones Fact”

GDP per capita (2005 Dollars, ratio scale)
• For differences between countries in income, technology is not the big story

  Why: Poor countries would have to be too many years behind (viz. India: 75 years)
• For differences between countries in income, technology is not the big story

Why: Poor countries would have to be too many years behind (viz. India: 75 years)
So for cross-country differences in productivity, we have to look to efficiency
# Productivity in Selected Industries in the Early 1990s

<table>
<thead>
<tr>
<th>Industry</th>
<th>United States</th>
<th>Japan</th>
<th>Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobiles</td>
<td>100</td>
<td>127</td>
<td>84</td>
</tr>
<tr>
<td>Steel</td>
<td>100</td>
<td>110</td>
<td>100</td>
</tr>
<tr>
<td>Food Processing</td>
<td>100</td>
<td>42</td>
<td>84</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>100</td>
<td>51</td>
<td>42</td>
</tr>
<tr>
<td>Aggregate Productivity</td>
<td>100</td>
<td>67</td>
<td>89</td>
</tr>
</tbody>
</table>
Some Examples of Inefficiency

• Central Planning
• Margarine
Delicious DELRICH E-Z COLOR PAK Margarine

ENDS MIXING BOWL MESS!

America’s Finest Margarine
with “Sealed-In” Flavor and Freshness

Your first taste of the delicate flavor of Delrich convinces you! Here’s America’s Finest Margarine! You enjoy flavor as sweet as clover, dewy-fresh. It’s the perfect spread for toast, hot biscuits. A flavor-luxury for your cooking!

And, Delrich E-Z Color Pak Margarine is the new table spread that gives you “Sealed-In” flavor and freshness!

Thousands Are Switching to Delrich
There’s no mess—no mixing bowl is needed! Delrich quickly blends to a luscious golden yellow right inside the sealed bag.

Enriched with 15,000 units of Vitamin A per pound—Delrich supplies abundant natural food energy. Try it today. See why thousands of women are switching to Delrich E-Z Color Pak Margarine—America’s Finest!

- Delrich and E-Z Color Pak are the trademarks of The Cudahy Packing Co., for its margarine. Whether you ask for “Delrich” or “E-Z Color Pak”—they both mean America’s Finest Margarine.

CUDAHY’s
DELRICH
VEGETABLE
MARGARINE

1 PINCH COLOR BERRY
2 KNEAD THE BAG
3 REPLACE IN CARTON CHILL
4 SLICE AS NEEDED

The CUDAHY Packing Co.
Some Examples of Inefficiency

• Central Planning
• Margarine
• Firemen in Locomotives
• State Owned Enterprises
• Restrictions on International Trade
Determinants of Efficiency (very partial list)

- Institutional Framework
- Trade Restrictions (legal or physical)
- Barriers to Mobility (of factors)
- Monopolies
- Government Ownership of Firms
- Functioning of Financial System
Government Corruption Versus GDP per Capita, 2009

GDP per capita (2005 International Dollars, ratio scale)

Degree of control of corruption

Countries marked include:
- United States
- Norway
- South Korea
- Saudi Arabia
- Germany
- Hungary
- India
- Kenya
- Rwanda
- Zimbabwe
Rule of Law and Factor Accumulation, 2009

Factors of production relative to the United States

Rule of law index

- Zimbabwe
- Pakistan
- Kenya
- India
- Italy
- Israel
- France
- Portugal
- United States
- Norway
- Finland
Rule of Law and Productivity, 2009

Productivity relative to the United States

- Trinidad & Tobago
- United States
- Norway
- Finland
- Italy
- Israel
- Greece
- Chile
- Venezuela
- India
- Botswana
- Zimbabwe

Rule of law index
Why Do Poor Countries Have Bad Governments?

• Theory #1: Endogenous Gov. Quality
• Theory #2: Colonial Legacy
• Theory #3: Slowly Changing Culture

• Bottom line: we still don’t know if “it is all government / institutions”
Historical Determinants of Current Institutions (Puterman and Weil)

Table 6: Historical Determinants of Current Institutions

<table>
<thead>
<tr>
<th>Indep. Var.</th>
<th>Executive Constraints</th>
<th>Expropriation Risk</th>
<th>Government Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statehist</td>
<td>0.158 (0.274)</td>
<td>0.658 (0.287)</td>
<td>0.445 (0.271)</td>
</tr>
<tr>
<td>Ancestry Adjusted Statehist</td>
<td>0.670 (0.309)</td>
<td>1.33 (0.33)</td>
<td>1.32 (0.30)</td>
</tr>
<tr>
<td>Constant</td>
<td>1.95 (0.13)</td>
<td>1.71 (0.15)</td>
<td>-0.180 (0.114)</td>
</tr>
<tr>
<td>No. obs.</td>
<td>141</td>
<td>111</td>
<td>144</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.002</td>
<td>0.047</td>
<td>0.019</td>
</tr>
</tbody>
</table>

Note: All dependent variables are normalized to have a standard deviation of one.
20 Years of Growth Empirics on One Slide

SS Income = f(productivity, rates of factor accumulation)

(+)

Growth = f(SS Income, Current Income)

(+)

Predictions: China, N. Korea