Absolute Convergence “big time” for a short time (since 2000) reduces global inequality

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Economic Growth & Development
Econ 6470 Spring 2016
Falling Global inequality: Absolute convergence finally SS growth models start to work... at a cost...

• Inequality is some nations has increased (USA and China) but inequality among people and nations has decreased since 2000, absolute convergence...

• LatAm inequality highest but falling since 2000.

• Many nations closing gap with OECD see chapter 4 of Eclipse and DESA’s Inequality Matters

• Openness has played a role.... China, Asia, RER

• Convergence in health, education and longevity faster than incomes see HDR 2010
The reality of convergence is important for people and nations (and sustainable development)

- Inequality among nations has increased, but inequality among people has decreased.
- Many nations are catching up with the U.S. see chapter 4 of Eclipse and see Milanovic, 2016.
- Openness has played a role.... China, Asia, RER
- Convergence in health, education and longevity faster than incomes (or is happening despite diverging incomes) see HDR 2010
Figure C-2 Convergence, "big-time" 2000-2013

These 12 "above the line" countries are home to almost 4 billion people.

\[ y = -0.0307x + 3.64 \]

\[ R^2 = 0.15 \]

Source: IMF WEO database October 2012 the size of each bubble is proportional to the population of that country.
Figure C-2A updates C-2 using WEO October 2015 data: there is still absolute convergence but the unweighted relationship is weaker… rich nations are recovering and poor nations growth has slowed… (click here for a larger version or the data spreadsheet).
Global Sigma convergence correlated with 2007 OECD crisis

Figure C-3: Std Deviation of log per capita Income $PPP current US dollars April 2016 WEO

Source: IMF WEO Database April 2016
Falling Global inequality: Absolute convergence...

global growth incidence curve from Porter & Bruno Milanovic

Figure PB-1 World Growth Incidence curve

Inequality at Home and Abroad
Fast growth in China, India and other Asian countries has risen the income of the global middle class, reducing income inequality on a global scale over the last two decades.

Income growth across the income distribution

<table>
<thead>
<tr>
<th>Poorer</th>
<th>Income distribution in percentiles</th>
<th>Wealthier</th>
</tr>
</thead>
<tbody>
<tr>
<td>5th</td>
<td>10th</td>
<td>15th</td>
</tr>
<tr>
<td>$0.7</td>
<td>$1.1</td>
<td>$1.5</td>
</tr>
<tr>
<td>$2.0</td>
<td>$2.6</td>
<td>$3.7</td>
</tr>
<tr>
<td>$5.7</td>
<td>$9.4</td>
<td>$21.2</td>
</tr>
<tr>
<td>$64.8</td>
<td></td>
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</table>

Average income per day in each decile

1988 to 2008
Falling Global inequality: Absolute convergence finally SS growth models start to work... at a cost...

global growth incidence curve from Eduardo Porter & Branko Milanovic (read NY Times) see web page

The global dynamics bolstering incomes in China are also contributing to widening inequality in the United States and other countries.

1986 to 2008

United States

<table>
<thead>
<tr>
<th>5th</th>
<th>10th</th>
<th>15th</th>
<th>20th</th>
<th>25th</th>
<th>30th</th>
<th>35th</th>
<th>40th</th>
<th>45th</th>
<th>50th</th>
<th>55th</th>
<th>60th</th>
<th>65th</th>
<th>70th</th>
<th>75th</th>
<th>80th</th>
<th>85th</th>
<th>90th</th>
<th>95th</th>
<th>99th/100th</th>
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<tbody>
<tr>
<td>$9</td>
<td>$19</td>
<td>$27</td>
<td>$35</td>
<td>$43</td>
<td>$53</td>
<td>$64</td>
<td>$80</td>
<td>$104</td>
<td>$200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Average incomes are for 2008, measured in constant 2005 dollars. Global incomes are measured at 2005 purchasing power parities

Source: Branko Milanovic

This is astonishing progress. And although incomes of workers in the developed world didn’t rise much as the Asian poor moved up the ladder, they didn’t fall either: Globalization lifted all boats.
Fig 4: Globalization benefits everyone but OECD middle class:

Washington Post & B. Milanovic see more slides like this
See Milanovic on Hidden economics of Populism

Milanovic: This is about right. You have large increases in real income, which is really the middle class in Asia, essentially. (China, but not only China, it’s also India, Indonesia, Vietnam and so forth.) And the global top 1%
Composition of global inequality changed: from being mostly due to “class” (within-national), today it is mostly due to “location” (where people live; between-national)

Increasing gains for the rich with a widening urban-rural gap

Urban and rural China

Urban and rural Indonesia

Branko Milanovic
The reality of convergence is important to everyone but backlash in the North is a reality... a “huge” problem.

How to address U.S. backlash:

- Expand EITC to all workers, create wage insurance for all displaced by trade (Schiller, 2016)
- Subsidize higher education for low-income HHs...
- Carbon tax, lower wage tax (Stiglitz)

How not to address trade adjustment:

- Raise minimum wage to $15
- Return to more protectionist regimes
- Close borders to immigration
Figure D-1: International income inequality, 1980-2010

Figure D-2: Gini coefficient and GNI per capita by country: aka the Kuznets Curve

Figure D-1: International income inequality, 1980-2010

Gini (weighted)

Gini, excluding China (weighted)

Gini (unweighted)

THE POVERTY CURVE: FROM TWO HUMPS TO ONE

A half-century ago, the distribution of income in the world looked like a camel with two humps. The first hump represented the so-called developing world. The second hump represented people in wealthier countries (mostly in the West). But the world is no longer separated into the West and the rest. More than a billion people have risen out of extreme poverty, and most of humanity is now in the large dromedary-like hump in the middle.

Figure G-5: World income distribution now and fifty years ago

Source Gates Foundation Letter 2015: 3 myths that block progress for the poor

Figure P-1.1
Reversal of Fortune reverses post 1950

Source: Chapter 1
Piketty 2014
Figure D-4: Gini Coefficient for education

The reality of convergence is very important in growth theory

• Endogenous growth driven by savings or R&D need not lead to absolute convergence...

• Absolute convergence is implied by diminishing returns, in the SolowSwan model for example,

• Openness should accelerate convergence... this is why Sachs & Warner so warmly received...

• Conditional convergence is key empirical result of new growth literature
No absolute convergence: for example Jones Appendix C
data Set: growth 60-97 not related to Y60

Dependent Variable: G6097
Method: Least Squares
Date: 03/20/13  Time: 17:58
Sample: 1109
Included observations: 109
White heteroskedasticity-consistent standard errors & covariance

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<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
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<tbody>
<tr>
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<td>0.017540</td>
<td>0.002330</td>
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<table>
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<td>Mean dependent var</td>
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<td>Sum squared resid</td>
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<td>Log likelihood</td>
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<td>Hannan-Quinn criter.</td>
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<tr>
<td>Prob(F-statistic)</td>
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<td>Wald F-statistic</td>
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<tr>
<td>Prob(Wald F-statistic...)</td>
<td>0.740307</td>
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No Absolute convergence, 1980 to 2000 Stanley Fischer, 2003, AER, Ely Lecture

Figure 4. Average Annual Growth (1980–2000) on Initial Level of Real GDP per Capita

Note: The data are values for real GDP in U.S. dollars per equivalent adult.

Source: Penn World Tables, version 6.1 (available online: http://pwt.econ.upenn.edu/).
Figure 5: Average Annual Growth (1980–2000) on Initial Level of Real GDP per Capita (as in Fig. 4, but with Area Proportional to Population in 1980)

Note: The data are values for real GDP in U.S. dollars per equivalent adult.

Source: Penn World Tables, version 6.1 (available online: [http://pwt.econ.upenn.edu/](http://pwt.econ.upenn.edu/))
But we do find absolute convergence, 2000 to 2013, all IMF WEO countries with >2 million population.

Figure C-2 Absolute converge 2000-2013

\[ y = -0.031x + 3.6392 \]
\[ R^2 = 0.1491 \]
Conditional convergence works if we add education as in the MRW or augmented Solow model using data from Jones Appendix C 2nd edition.

```plaintext
Dependent Variable: G6097
Method: Least Squares
Date: 03/20/13   Time: 18:06
Sample: 1 109   Included observations: 88
White heteroskedasticity-consistent standard errors & covariance

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<tr>
<th>Variable</th>
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<th>Prob.</th>
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R-squared          0.441698   Mean dependent var 0.019163
Adjusted R-squared 0.428561   S.D. dependent var 0.015126
S.E. of regression  0.011435   Akaike info criterion -6.070845
Sum squared resid   0.011114   Schwarz criterion -5.986391
Log likelihood      270.1172   Hannan-Quinn criter. -6.036821
F-statistic         33.62362   Durbin-Watson stat 1.927451
Prob(F-statistic)   0.000000   Wald F-statistic 40.63922
Prob(Wald F-statistic...) 0.000000
```
Regressing per capita growth from 2000 to 2013, on initial income as a % of U.S. reveals absolute convergence

<table>
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<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
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<td>S.E. of regression</td>
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<td>F-statistic</td>
<td>24.17410</td>
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<tr>
<td>Prob(F-statistic)</td>
<td>0.000002</td>
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- Dependent Variable: PCG2
- Method: Least Squares
- Date: 03/19/13
- Time: 01:04
- Sample (adjusted): 1140
- Included observations: 140 after adjustments
Absolute convergence, 2000 to 2013, large countries, at either end, people’s incomes converging as well.

**Figure C-2 Absolute convergence 2000-2013**

\[ y = -0.0307x + 3.6392 \]

\[ R^2 = 0.1491 \]

1980 $PPP GDP as % of U.S. Source: IMF WEO database Oct2 012
Convergence rare unless conditioned on something...
Conditional Convergence? (OECD countries)

Figure 2.
Long-term convergence among rich countries
The previous slide show one of two cases of spurious convergence read the title carefully and see Jones Exercise 6 Ch 3)

- OECD convergence is a non-sequitur “among rich countries” tips you off... being rich is not valid condition... it in fact reflects selection bias, see Chapter 3 of Jones, Exercise 5 and 6

- Galton’s fallacy (Exercise 5): Creates illusion of beta convergence via regression to the mean, rich countries grow poor, poor countries grow rich, but std Deviation of income can stay the same over time (this is why we need to test for Sigma convergence too)
David Dollar was remiss in mentioning this but his Figures 4 and 5 below are valid examples of conditional convergence...

• Why was Dollar remiss writing this paper in 2001? Read on..

• (Exercise 6): Reconsidering the Baumol results. J. Bradford DeLong (1988), in a comment on Baumol's convergence result for the industrialized countries over the last century, pointed out that the result could be driven by the procedure through which the countries were selected. In particular, DeLong noted two things. First, only countries that were rich at the end of the sample (i.e., in the 1980s) were included. Second, several countries not included, such as Argentina, were richer than Japan in 1870. Use these points to criticize and discuss the Baumol results. Do these criticisms apply to the results for the OECD? For the world? See also B&S chapter 1 Fig 1.8.
Figure 4. Convergence among countries with good rule of law, 1975-1999

Conditional Convergence (rule of law....)

Source: Kaufmann, Kraay, and Zoido-Lobaton (1999)
Conditional Convergence (Sachs & Warner...)

Figure 3.
Convergence among open economies, 1975-1999

GDP per capita growth, 1975-99

\[ y = -0.01x + 0.13 \]
\[ R^2 = 0.41 \]

Absolute beta convergence in the U.S.

see Barro and Sala-i-Martin, 2004 page 47 Chapter 1

Figure 1.9
Convergence of personal income across U.S. states: 1880 personal income and income growth from 1880 to 2000. The relation between the growth rate of per capita personal income from 1880 to 2000 (shown on the vertical axis) is negatively related to the level of per capita income in 1880 (shown on the horizontal axis). Thus absolute convergence holds for the states of the United States.
Lack of absolute beta convergence in the World

Figure 1.7 page 45, Barro and Sala-i-Martin, 2004 Chapter 1

Convergence of GDP across countries: Growth rate versus initial level of real per capita GDP for 114 countries. For a sample of 114 countries, the average growth rate of GDP per capita from 1960 to 2000 (shown on the vertical axis) has little relation with the 1960 level of real per capita GDP (shown on the horizontal axis). The relation is actually slightly positive. Hence, absolute convergence does not apply for a broad cross section of countries.
U.S. growth has been remarkably constant for the last 16 years at just under 2%, using the rule of 70, this income per person doubles every 35 years. Since 1950, other nations have begun to catch up....

Figure: Evolution of income per capita in various countries.
Wynne (2011) “Will China become as rich as the U.S.?”

**Chart 1**

Per Capita GDP Growth Slows as Countries Develop
(Ten-year average growth rate versus level of real per capita GDP, 1950–2009)

**Note:** Each square represents a single country over a decade.
**Sources:** Penn World Tables, version 7.0; author’s calculations.
Wynne (2011) “Will China become as rich as the U.S.?”

Countries Approach but Don’t Surpass U.S. Per Capita GDP
(Data for the period 1950–2009)

Real per capita GDP relative to U.S. per capita GDP (percent)

U.S. real per capita GDP

Real per capita GDP in 2005 purchasing power parity-adjusted dollars

NOTE: Each square represents a single country over a one-year period.
SOURCES: Penn World Tables, version 7.0, author’s calculations.
Wynne (2011) “Will China become as rich as the U.S.?”
Convergence across countries rare unless make conditional on something... for example, Sachs-Warner "openness" index implying one way for poor countries to catch up is to open their economies, look at South East Asia...
Absolute beta convergence in OECD countries? (not really: selection bias)

see Barro and Sala-i-Martin, 2004 page 46 Chapter 1

Figure 1.8
Convergence of GDP across OECD countries: Growth rate versus initial level of real per capita GDP for 18 OECD countries. If the sample is limited to 18 original OECD countries (from 1961), the average growth rate of real per capita GDP from 1960 to 2000 is negatively related to the 1960 level of real per capita GDP. Hence, absolute convergence applies for these OECD countries.
Lack of absolute beta convergence

**Figure 1.7**
Convergence of GDP across countries: Growth rate versus initial level of real per capita GDP for 114 countries. For a sample of 114 countries, the average growth rate of GDP per capita from 1960 to 2000 (shown on the vertical axis) has little relation with the 1960 level of real per capita GDP (shown on the horizontal axis). The relation is actually slightly positive. Hence, absolute convergence does not apply for a broad cross section of countries.
Absolute beta convergence among U.S. States

see Barro and Sala-i-Martin, 2004 page 47 Chapter 1

Figure 1.9
Convergence of personal income across U.S. states: 1880 personal income and income growth from 1880 to 2000. The relation between the growth rate of per capita personal income from 1880 to 2000 (shown on the vertical axis) is negatively related to the level of per capita income in 1880 (shown on the horizontal axis). Thus absolute convergence holds for the states of the United States.
Convergence controversies

• PPP necessary to compare initial income levels, not perfect, but now several sources and iterations (PWT 8.1)
• L Pritchett (1997) argued for “Divergence, Big Time” and clubs of rich and poor countries, binomial distribution
  – 1870-1990, rich countries got much richer
  – 9/1 ratio in 1870; up to 50 to 1 ratio by 1990
• Since 2000 we have absolute convergence… See Figure 2-C
• Conditional convergence widely accept perhaps most important result of post 1990 growth theory revival… since government influences many OSVs creates a bridge to Poverty trap theories (which require government intervention). Consistent with focus on institutions, geography and integration…
Convergence debate

• Following slides discuss the above issue, which is not included in detail in book

• However, it may be a topic to include in a course on macroeconomics of growth, see:
Convergence: key ideas do we expect poorer countries grow faster than rich countries?

Two ways to assess convergence
1. Beta (β) convergence uses growth rates
2. Sigma (σ) convergence focuses on dispersion of income levels

**β-convergence** often uses regression analysis

\[
growth_i = \text{constant} + \beta (\text{initial GDP p.w.}) + \text{other state variables (OSV: e.g. education, savings, for countries, } i = 1 \ldots n)\]

If $\beta < 0$ significant and negative we have beta convergence... if beta only significant in presence of OSV, we have conditional convergence...

**σ-convergence**

measure dispersion (variance) of GDP per worker across countries in a given year. If dispersion **falls** over time can say countries ‘converging’.
\( \beta \)-convergence, 110 countries, 1965-2000

Source: Rogers powerpoint, based on PWT 6.1

Estimated \( \beta \) for above = 0.000. No beta convergence.
sigma (\( \sigma \)) convergence

- Variance (110 countries GDP per worker) increases over time \( \Rightarrow \) **divergence since 60s**
- **But**, if you **weight** countries according to population, evidence shows **convergence**
- (note: if you do **not** weight you give China and, say, Togo the same ‘importance’ or ‘weight’)
- Finally, researchers now working on ‘true’ world inequality data (i.e. combine within country, and across country, inequality). Initial results show ‘world’ inequality increasing since late 1980s
Growth theory references

Solow Swan Model takes TFP, aka $A$ in $y = Ak^\alpha$ as given “exogenous”

- Endogenous growth models make productivity growth endogenous: for example learning by doing (lbd) creates a surge. As Consider Alan Searle's 1945 study of the manufacture of Liberty Ships during World War II. From December 1941 through December 1944, 14 shipyards in the U.S. produced a total of 2458 Liberty Ships, all to the same standardized design. On average, with each doubling of cumulative output, the reduction in hours required per ship ranged from 12 to 24 percent across the 14 shipyards. Similar reductions in unit hour requirements were also seen in the production of other ships as well. Leonard Rapping (1965) showed that after accounting for variations in labor hours and capital used in each of the shipyards, the effect of learning was to increase TFP between 11 and 29 percent over the three-year period, i.e., to increase TFP at an annual rate between 4 and 10 percent. While learning effects can be quite substantial over a two- to three-year period, industry studies also show that TFP growth from learning ultimately stops. For instance, in the case of Liberty Ships, the maximum productivity gain had been achieved by the end of 1943, and productivity was roughly constant over the last year of production.” Source: Chatterjee, Satyajit (1994) Making More out of less, recipe for long term growth, May/June 1994, Liberty Ships, page 10, Business Review, Federal Reserve Bank of Philadelphia http://www.phil.frb.org/research-and-data/publications/business-review/1994/brmj94sc.pdf
Exogenous Growth: Solow-Swan or “neoclassical Growth Model”

1. **Key equations**: \( y = A k^\alpha \).

2. **Key properties**:
   1. Convergence if \( \alpha < 1 \), absolute or conditional.
   2. Technical change or TFP growth **exogenous**
   3. Savings rate/pop growth affect steady state & ST growth, but do not affect LT Growth

3. **Bottom line**: more a model of “steady state” income levels than a theory of growth

4. **Strengths**: Augmented Solow model +
Solow Swan Model: growth rate diagram (see 3 growth models handout)

Long term growth rate: \[ \gamma^* \]

Capital stock per worker: \[ k_L, k^*, k^H \]

Figure 2
Absolute Convergence

transitional growth component

Long term growth rate: \[ sA k^{\alpha-1} \]

growth rate

\[ n + \lambda \]
Solow Swan Model: growth rate diagram (conditional convergence)

\[ \gamma^* \]

\[ n + \lambda \]

\[ sA_H k^{\alpha - 1} \]

\[ sA_L k^{\alpha - 1} \]

Figure 3
Conditional Convergence

Capital stock per worker

6% 5% γ*

k_L k*_L k_H k*_H
Exogenous Growth: Solow-Swan or “neoclassical Growth Model”

1. Key equations: \[ y = A k^\alpha \]

2. Key assumptions:
   1. Population growth exogenous, assume \( n \).
   2. Capital & labor substitutes
   3. Savings rate exogenous (but there is “golden rule”)

3. Bottom line: more a model of “steady state” income levels than a theory of growth

4. Strengths: Augmented Solow + institutions can explain up to 90% of variation in income levels...