Econ 201: Introduction to Economic Analysis

November 11 Lecture: Economic Growth

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Daily dose of The Far Side

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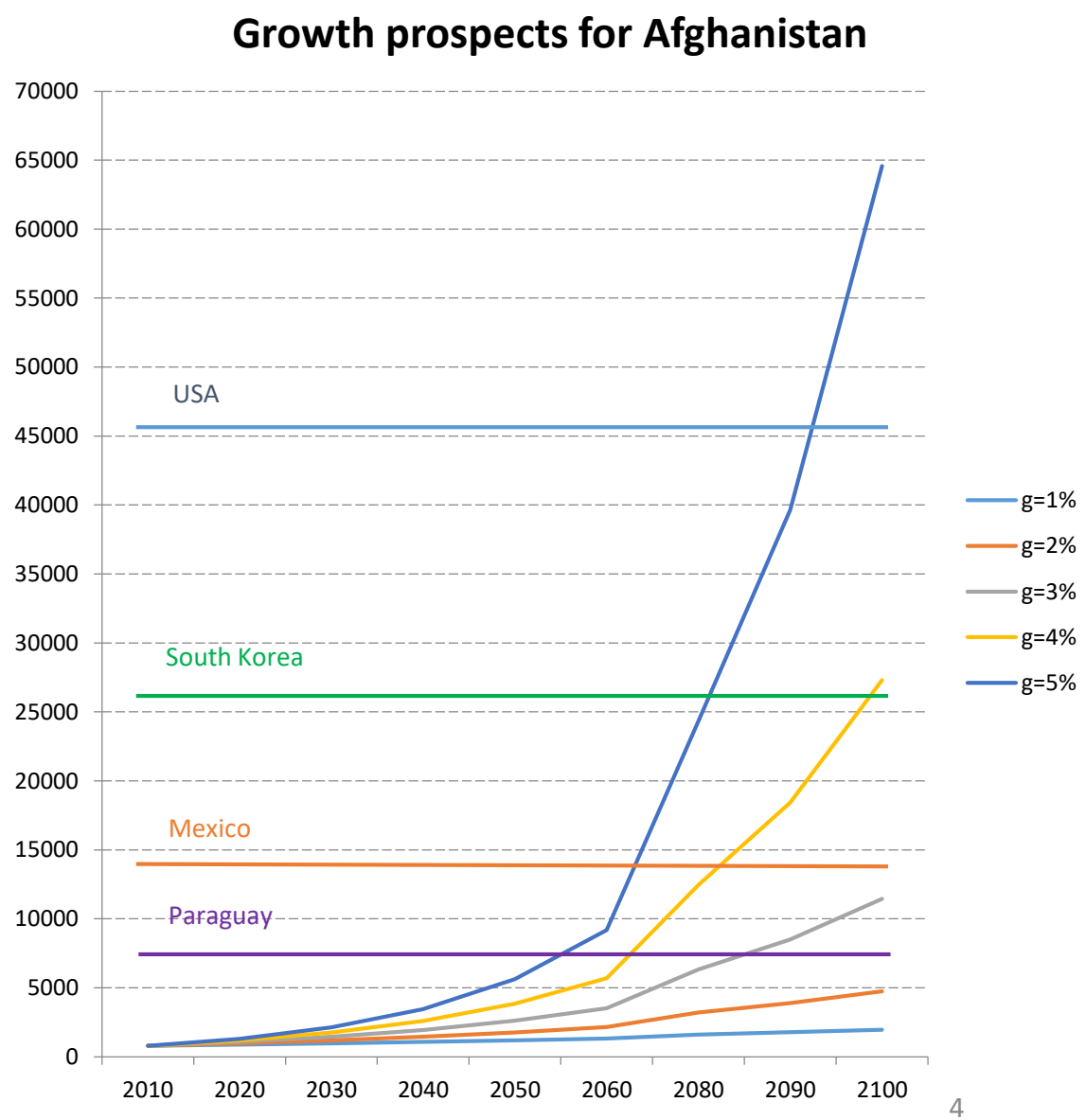
Cow philosophy

Preview of this class session

- Cumulative economic growth determines potential output
- Small differences in growth rates add up to massive differences in living standards over time
- Growth happens through increases in inputs or in productivity
- Solow model says that per-capita GDP grows in long run only due to productivity growth
- Similar economies should converge to comparable levels
- Endogenous growth based on knowledge capital predicts no convergence: rich stay richer
- Empirical evidence is mixed: Short samples and long-run theories

Importance of growth

- Randomly draw two people, one American and one Bulgarian
  - American is almost surely richer
  - Vast difference between overall levels of income in two countries
  - Growth happened in U.S. and less in Bulgaria
- In 2010, Afghanistan had per-capita GDP of ~$800
  - Graph at right shows outcome of growing at 1%, 2%, 3%, 4%, and 5% through 2100



Growth history in advanced economies

Average GDP Growth Rates (% per annum)

	Real GDP							GDP per capita
	1820-1870	1870-1913	1913-1950	1950-1973	1973-2001	2001-2010	1820-2010	1820-2010
Austria	1.4%	2.4%	0.2%	5.2%	2.5%	2.2%	2.0%	1.6%
Belgium	2.2%	2.0%	1.0%	4.0%	2.1%	2.0%	2.1%	1.5%
Denmark	1.9%	2.6%	2.5%	3.7%	2.0%	1.7%	2.4%	1.5%
Finland	1.6%	2.7%	2.7%	4.8%	2.4%	2.3%	2.6%	1.8%
France	1.4%	1.6%	1.1%	4.9%	2.3%	1.9%	1.9%	1.6%
Germany	2.0%	2.8%	0.3%	5.5%	1.8%	1.7%	2.2%	1.6%
Italy	1.2%	1.9%	1.5%	5.5%	2.3%	1.7%	2.1%	1.5%
Netherlands	1.7%	2.1%	2.4%	4.6%	2.4%	2.2%	2.4%	1.4%
Norway	2.2%	2.2%	2.9%	4.0%	3.4%	2.9%	2.7%	1.9%
Sweden	1.6%	2.1%	2.7%	3.7%	1.9%	1.9%	2.3%	1.6%
Switzerland	1.9%	2.5%	2.6%	4.4%	1.2%	1.3%	2.4%	1.7%
United Kingdom	2.0%	1.9%	1.2%	2.9%	2.1%	2.0%	1.9%	1.4%
Japan	0.4%	2.4%	2.2%	8.9%	2.7%	2.2%	2.6%	1.8%
United States	4.1%	3.9%	2.8%	3.9%	3.0%	2.7%	3.5%	1.7%

Is growth inevitable?

- Most of human history: Economic growth was very slow; living standards improved over centuries or millennia, not decades
- Only after Industrial Revolution in England around 1800 has growth been consistently positive
  - Each generation has been better off than predecessor
  - Shared by many, but not all, parts of the world
- Data before 1950 are fragmentary
  - U.S., Western Europe, and Japan grew rapidly after WWII
  - Growth slowed markedly in 1973
  - Brief period of rapid growth in later 1990s, otherwise stayed slower

Growth accounting

- We focus on growth in **potential output**, how much we can produce
- **Aggregate production function**:

$$Y = F(K, L, A)$$

- With human capital and resources:

$$Y = A \times F(L, K, H, N)$$

$$\frac{Y}{L} = A \times F\left(1, \frac{K}{L}, \frac{H}{L}, \frac{N}{L}\right) = A \times f\left(\frac{K}{L}, \frac{H}{L}, \frac{N}{L}\right)$$

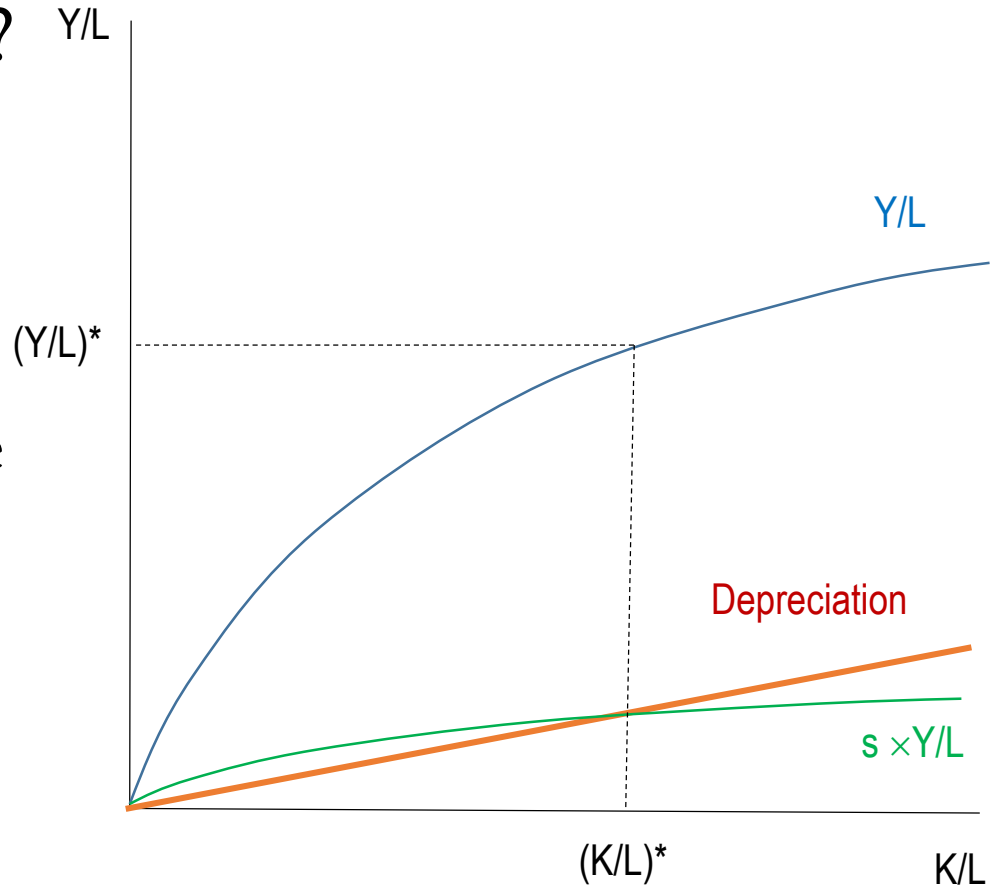
- Growth in per-capita potential GDP comes from A, K/L, H/L, N/L
- Maddison's evidence from case

Annual percentage rate of TFP growth in:	1950-73	1973-87
France	1.79	0.61
Germany	2.14	0.50
Japan	1.20	0.23
Netherlands	0.83	0.54
United Kingdom	0.73	0.73
United States	0.77	0.10

Theories of economic growth

Solow growth model

- Let K represent both physical and human
- Can Y/L grow forever based on just K/L?
  - Not with constant saving rate s and neoclassical assumptions of diminishing marginal product of K
  - Increase in K/L has diminishing effect on Y/L as it increases
  - Economy converges to level of capital where new saving is just enough to balance depreciation
- Without technological progress, growth eventually stops
- **Steady-state growth rate = rate of technological progress**

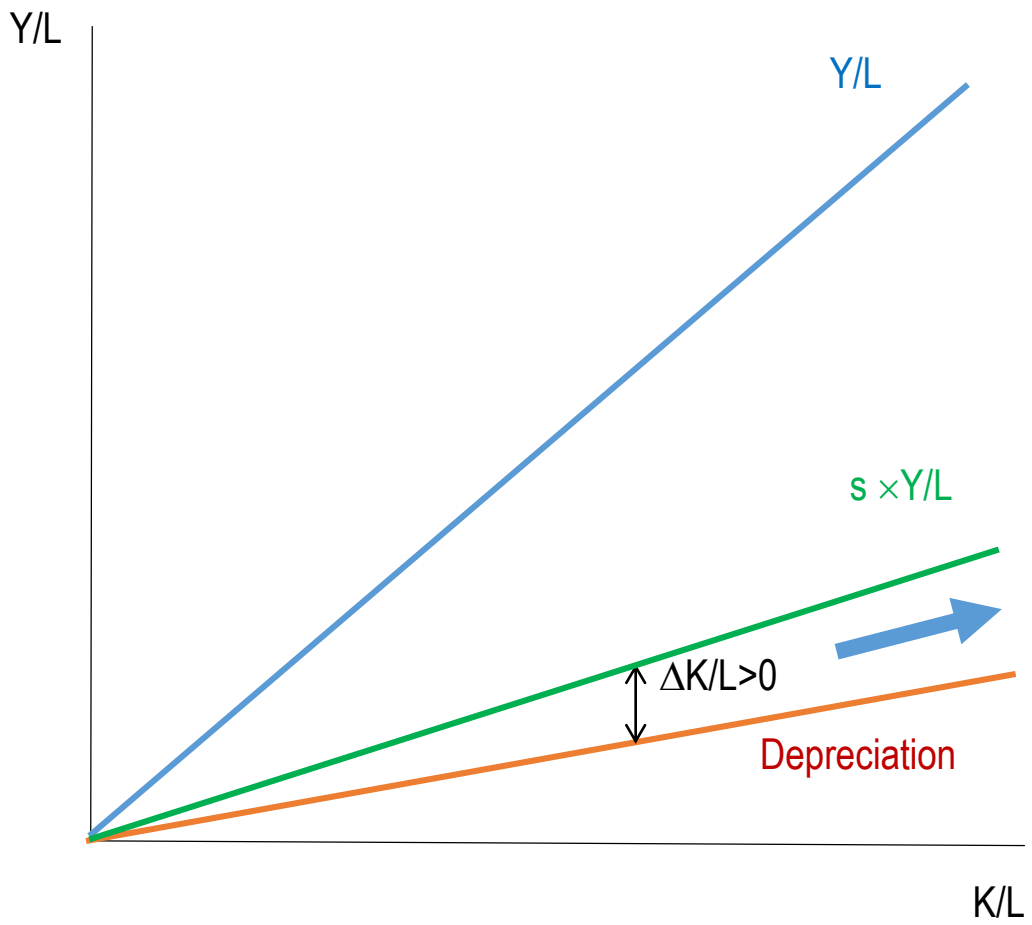


Convergence in Solow model

- Why would economies differ (according to Solow)?
  - Higher saving rate → higher Y/L
  - Differences in allocative efficiency
  - Rate of technological progress governs growth rate. Is it same?
    - Is technology nonexcludable?
  - Population age-structure and dynamics
- Countries with similar parameters should **converge** to same Y/L
  - East and West Germany following reunification
  - Western countries and Japan after WWII
  - Half-life of gap estimated to be 20 – 50 years
- There are examples of convergence … and failure to converge

Endogenous-growth models

- What if we didn't have diminishing returns to capital?
  - "**Knowledge capital**" might not diminish in MP as more is added
- Including knowledge capital into model means that production function need not bend down
- Ever-increasing K/L and Y/L
- Growth in all countries depends on saving rate
  - Faster-growing can continue to grow faster forever --- **no convergence**



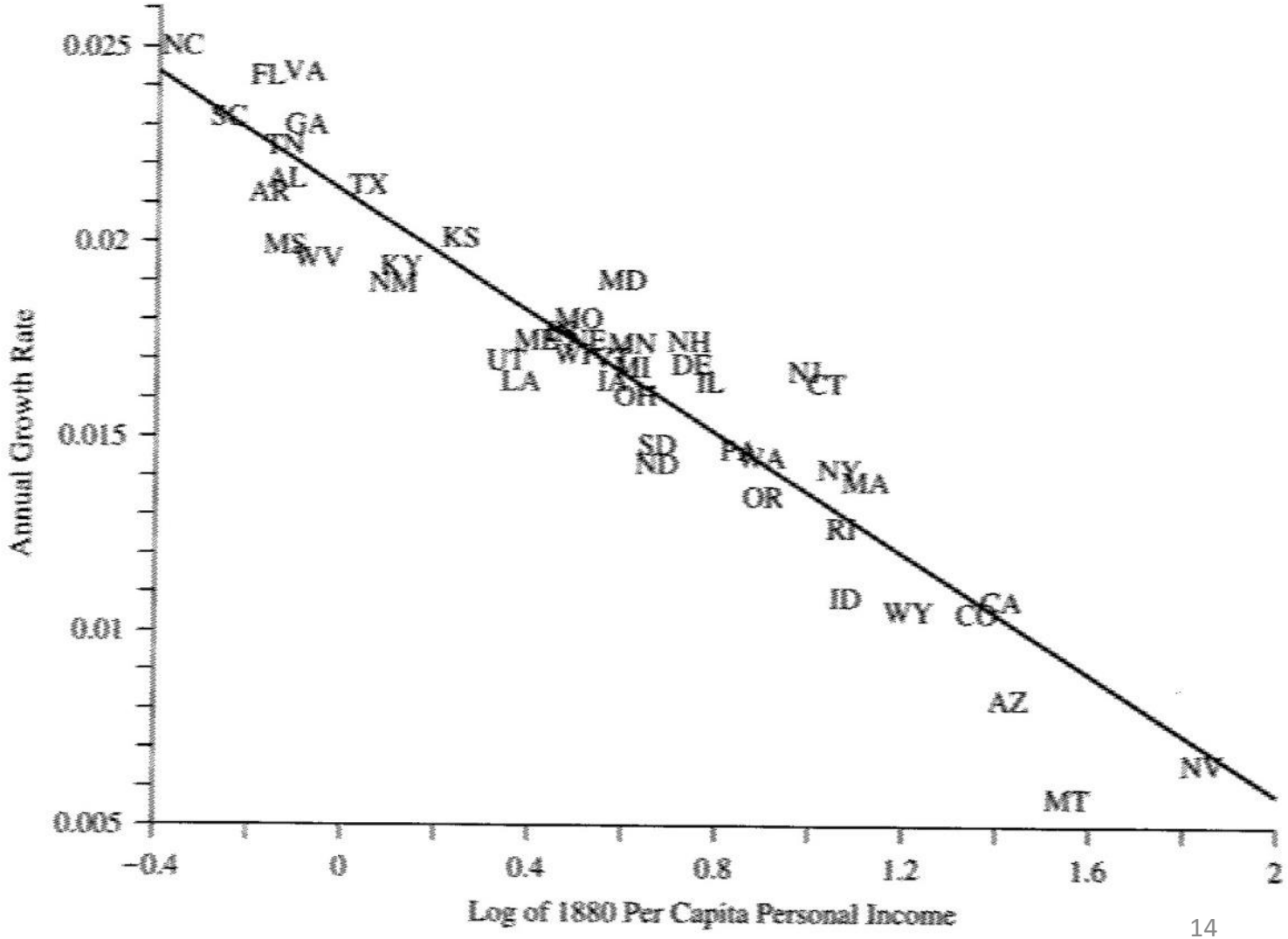
Convergence: Empirical Evidence

Absolute convergence of Y/L?

- Solow model predicts convergence of Y/L in economies with similar parameters
- Economies with **lower Y/L should grow faster** to catch up
  - This is **absolute convergence**: Y/L gaps shrink over time
- What if economies are not all the same?
  - **Conditional convergence** means that level of Y/L to which economy converges depends on its characteristics
  - For example, a higher saving rate should lead to higher Y/L in steady state
  - Other variables include efficiency of resource allocation, peace vs. war, political stability and rule of law, educational attainment

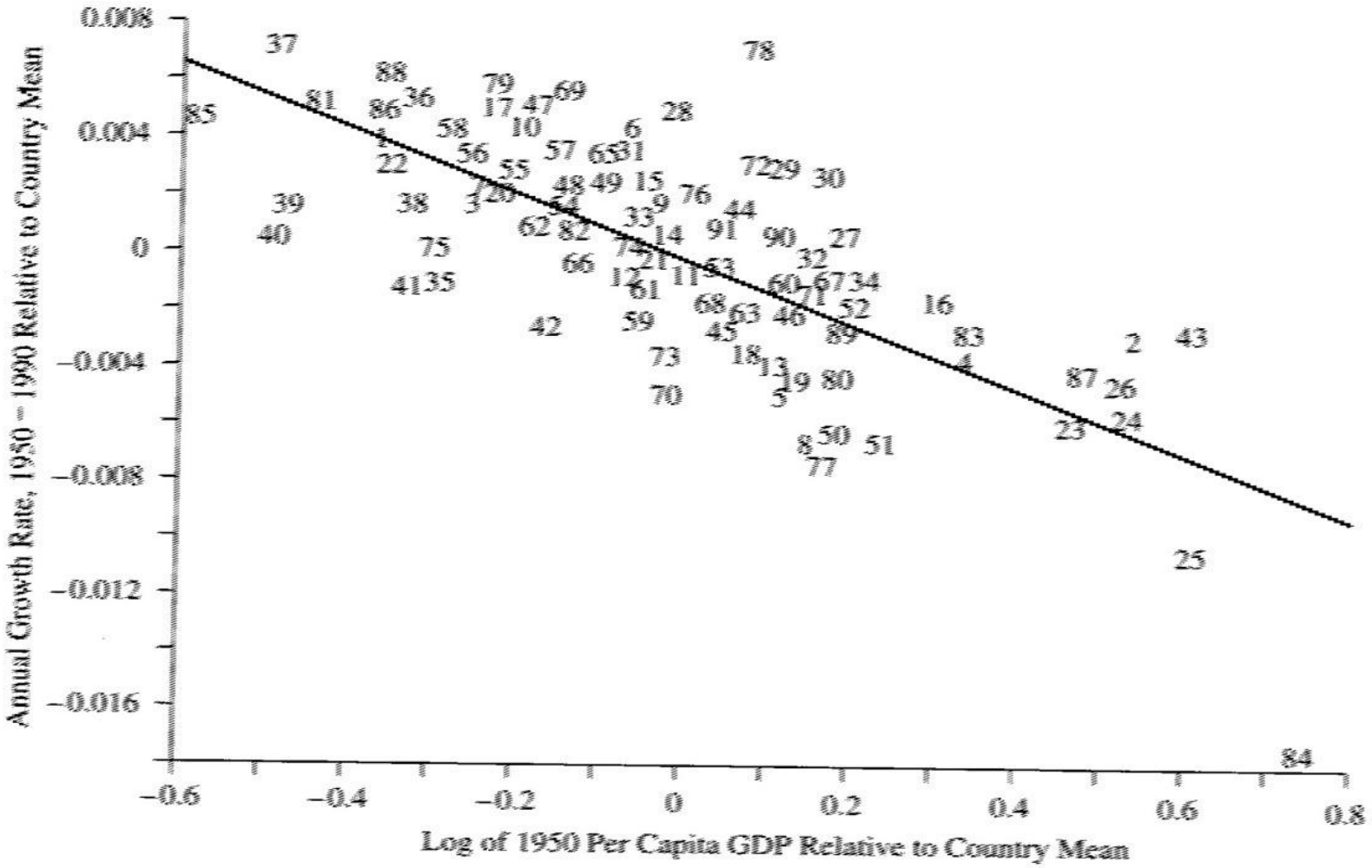
Evidence from U.S. states

- Barro and Sala-i-Martin (1991, 1992)
- Horizontal axis: Y/L in 1880
- Vertical axis: Growth in Y/L from 1880 – 1990
- Convergence: Negative relationship
- Absolute convergence?



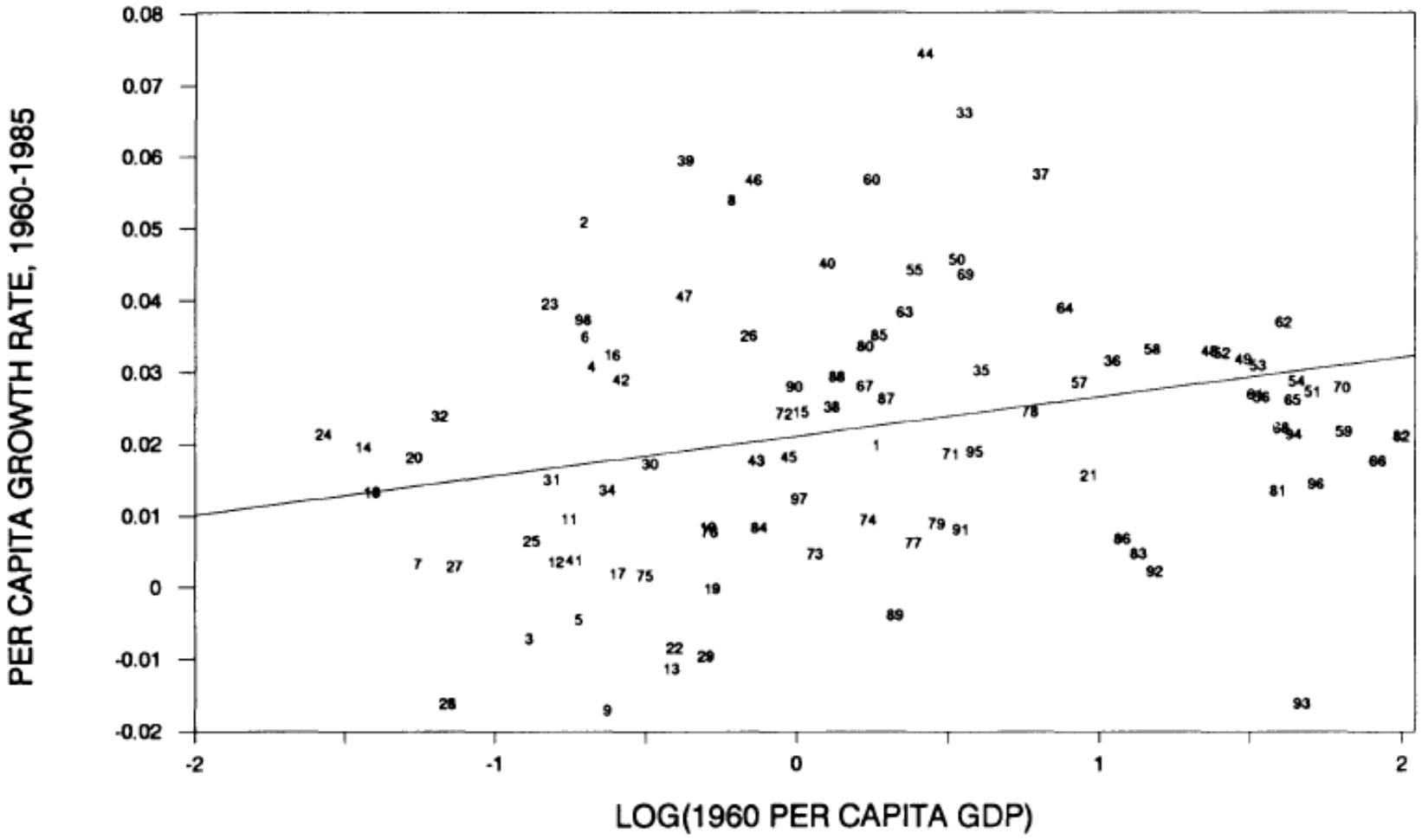
Evidence from European regions: 1950 – 85

- Also from Barro and Sala-i-Martin
- Clear negative relationship but more outliers
- Greater differences in economies and governance
- Absolute convergence?



Evidence from 98 countries: 1960 – 85

- Best-fit line is positively sloped!
- No absolute convergence for world
- Differences in economies overcomes tendency for convergence



Evidence on conditional convergence

- Basic econometric model of conditional convergence:

$$g_i = \alpha + \beta \ln y_{0,i} + \gamma X_i$$

  - g_i is growth rate in country i
  - $y_{0,i}$ is initial level of Y/L in i
  - X_i is a set of "other variables" that affect growth (saving rate, etc.)
- β should be negative to reflect convergence
- What other variables should be in X?
  - Dozens of empirical studies have proposed and tested candidates
  - Reading 100 papers gives you 100 different opinions
  - Which variables have a consistent, statistically significant effect?

“I just ran two million regressions”

Title of Sala-i-Martin paper from 1997 trying “all combinations” of 60 proposed variables for *X*. These had “robust” effects:

Regional variables: Sub-Saharan Africa (−), Latin America (−), Absolute value of latitude (+)
Political variables: Rule of law (+), Political rights (+), Civil liberties (+), Revolutions and coups (−), Wars (−)
Religious variables: Confucian (+), Buddhist (+), Muslim (+), Protestant (−), Catholic (−)
Market distortions and performance: Real-exchange rate distortions (−), Variation in black-market premium (−)
Investment: Equipment investment (+), Non-equipment investment (+)
Primary-sector production: Primary share in exports (−), Mining share of GDP (+)
Openness: Years of openness to trade (+)
Economic organization: Degree of capitalism (+)
Colonial heritage: Former Spanish colony (−)

Review

- Economic growth is crucially important for an economy's living standards
- Economies grow when the availability of labor and capital resources increases and when technology improves
- The Solow growth model predicts that growth through capital accumulation is limited by diminishing returns and that similar economies will converge in living standards
- Endogenous growth theories argue that diminishing returns need not apply to knowledge capital, so convergence may not occur
- Evidence suggests a limited degree of convergence, more across regions within countries than between countries

Daily diversion

Quotation for today:

"Money is like a sixth sense without which you cannot make a complete use of the other five."

W. Somerset Maugham, 1915,

quoted in Caroline Postelle Clotfelter in *On the Third Hand*

[Note: An economist would use "income," not "money."]

What comes next?

- The next class (Friday) focuses on the financial system and begins to examine its role in macroeconomics
- Friday's case study looks at some of the aspects of financial markets that were central to the financial crises in 2008
- Problem Set #7 is due next week Wednesday (11/18) and covers material through this Friday's class