Principles of Macroeconomics

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Touro College Berlin

2015

Save the Date: April 15th, 6:15pm

Bitcoin and other digital currencies: opportunities and threats

We invited Frank Braun, a computer scientist, for this talk. His interests include IT security, digital currencies, and economics.

The talk is highly relevant for us as we cover **"The Financial System"** on April 2nd and **"Money and Inflation"** on April 16th!

Real GDP in 1929 (peak): $323 billion
Price level in 1929: 33
Real GDP in 1933 (trough): $206 billion
Price level in 1933: 24

Calculate the percent change in real GDP and the percent change in the price level from 1929 to 1933. First, calculate the total change, and then divide it by the number of years to get the more typical measure of "percent per year."

Real GDP in 1933 (trough): $206 billion
Price level in 1933: 24
Real GDP in 1945: $596 billion
Price level in 1945: 38
Again, first calculate the total change, and then divide it by the number of years to get the more typical measure of "percent per year."

During World War II, the government did a good job measuring nominal GDP. But if the price level was calculated incorrectly, we might get a completely wrong idea about what happened with real GDP. During World War II, price ceilings were in place. That means that some things that would've been expensive were artificially cheap instead. Within a few years of the war's end, price controls finally ended, and the price level spiked up about 20%. **If the true price level during the war was actually 20% higher than reported, would that mean that real GDP is higher than the official number, lower than that number, or is it still the same as that number?**

Using data from the World Bank, calculate the annual growth rate of GDP per person at Purchasing Power Parity and "International Dollars" for China and for Germany for each of the last four years for which the data is available (online).

Economists use the term "human capital" to refer to education and job skills. How is education like a piece of capital?

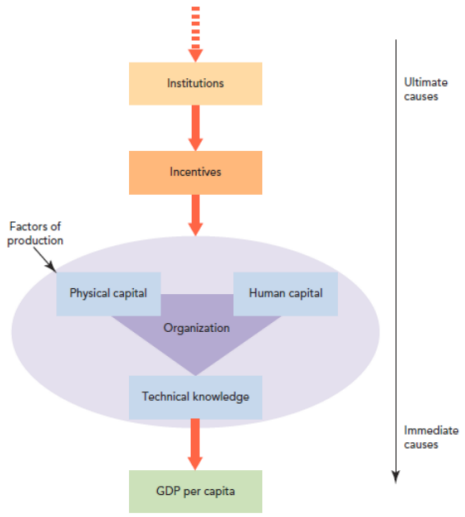
Communists believed that their system would be much more efficient than capitalism:They thought that competition between companies was wasteful. Why build three separate headquarters for carmakers (General Motors, Chrysler, and Ford), when you can just build one? Why have three advertising budgets? Why pay for three CEOs? Why not put all the factories together, so that the same engineers can fix problems at all of the plants? Doesn't one large firm maximize economies of scale? These are all good questions. **So why do you think Communism turned out to be such a disaster, when it sounded like it would be so efficient?**

Sources of Growth

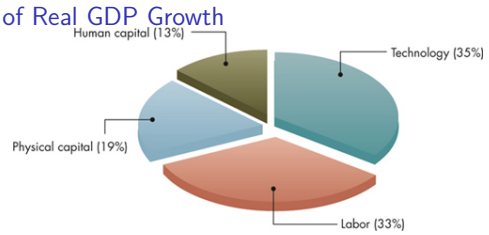
Economists identify five important sources of growth:

1. Growth-compatible institutions
2. Capital accumulation – investment in productive capacity
3. Available resources
4. Technological development
5. Entrepreneurship

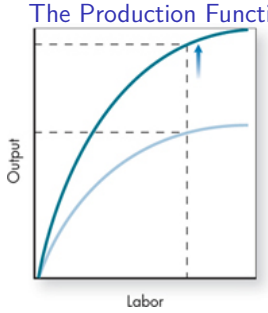
What Causes GDP Growth?



Sources of Real GDP Growth



The Production Function & Growth



- Growth can be shown by a shift in the production function

There are two types of growth

- Catch-up growth
  takes advantage of ideas, technologies, or methods of management already in existence focuses on capital accumulation
- Cutting-edge growth
  developing new ideas focuses on developing new technology for resources.

The Solow Model and Catch-Up Growth

Total Output, Y, of an economy depends on:

- Physical capital: K
- Human capital: education x Labor = eL
- Ideas: A

This can be expressed as the following "production function":

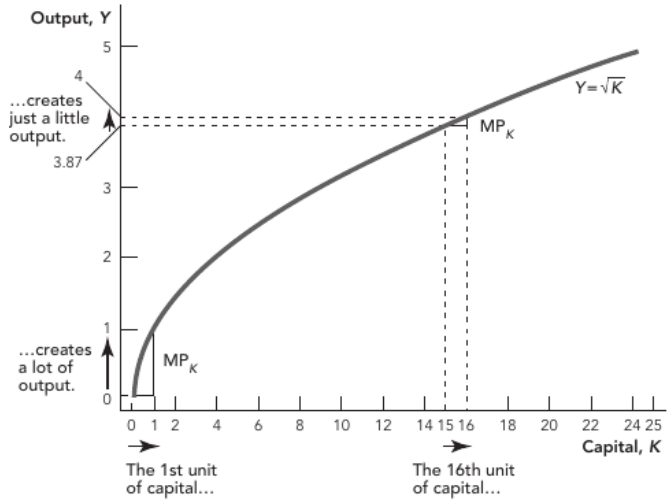
$$Y = F(A, K, eL)$$

For now, ignore changes in ideas, education, and labor so that A, e, and L are constant. The production function becomes:

$$Y = F(K)$$

- If L is constant, then increases in K mean more capital per worker
- MP_K : marginal product of capital : The additional output resulting from using an additional unit of capital.
- MP_K diminishes the more capital is added.

The Solow Model and Catch-Up Growth



The logic of diminishing returns largely explains why...

The Chinese economy is able to grow so rapidly.

- It turned toward markets which increased incentives.
- The capital stock was low.
- The MP was high.

→ China will not be able to achieve these high growth rates indefinitely.

Bombing a Country Can Raise Its Growth Rate:

- Much of the capital stock was destroyed during WWII — so MP was high.
- After the war, Germany and Japan had much higher growth rates than the U.S. as they caught- up.

Investment and Accumulated Capital

- Capital is much more than physical machines and includes:
  - **Human capital** are skills that workers gain from experience, education, and on-the-job training
  - **Social capital** is the habitual way of doing things that guides people in how they approach production
- Although capital is a key element in growth, capital accumulation does not necessarily lead to growth
- Capital may become obsolete

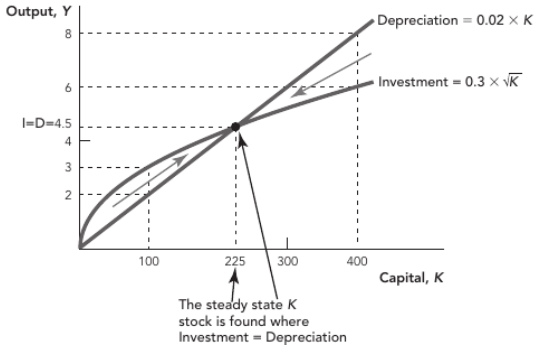
Capital Growth Equals Investment minus Depreciation

- Capital is output that is saved and invested.
- Let $\gamma = 0.3$ be the fraction of output that is invested in new capital.
- Depreciation: amount of capital that wears out each period
- Let $\delta =$ depreciation / K be the fraction of capital that wears out each period. This is called the depreciation rate.

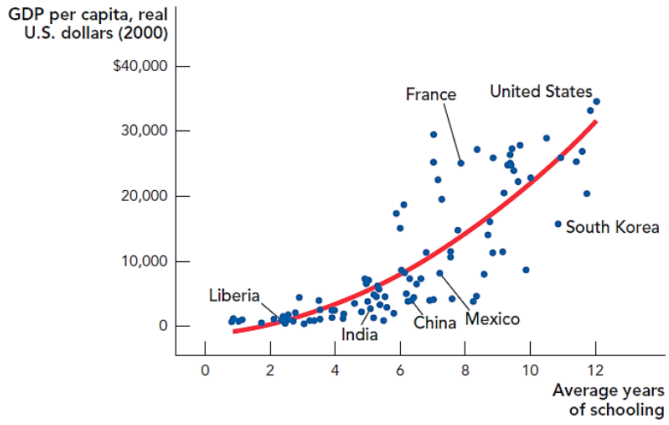
Capital Alone Cannot be the Key to Economic Growth

As capital increases,

- depreciation increases at a constant rate of δ
- output increases at a diminishing rate.
- Because investment is a constant fraction of output, at some point depreciation will equal investment.
- The capital stock will stop growing and output slows.



Human Capital Investment Pays Off



Technology

Technological advance is the result of what the economy does, it:

- Invests in research and development
- Makes advances in pure science
- Works out new ways to organize production
- The common knowledge aspect of technology creates positive externalities which is a key to growth
- **Positive externalities** are positive effects on others not taken into account by the decision maker

Learning by Doing

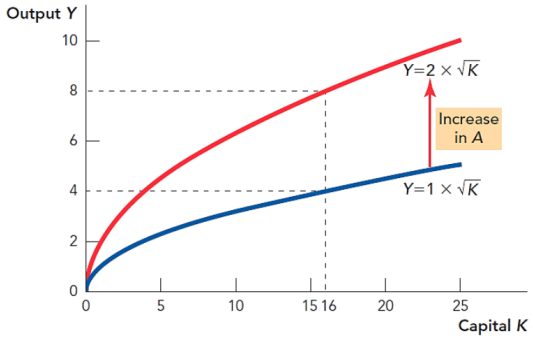
- The (New) Growth Theory also highlights learning by doing
- Learning by doing is to improve the methods of production through experience
- Learning by doing overcomes the law of diminishing marginal productivity because it increases the productivity of workers
- Learning by doing leads to increasing returns to scale

Better Ideas Drive Long Run Economic Growth

Technological knowledge:

- Is a way of getting more output from the same input (an increase in productivity).
- We represent this in our model by letting A stand for ideas that increase productivity.

Now the production function is: $Y = A \times F(K)$



Technological knowledge / better ideas are the key to long run economic growth

Solow estimated that better ideas are responsible for 3/4 of our increased standard of living.

The Solow Model – Details and Further Lessons

What we know so far:

- If Investment $>$ Depreciation $\rightarrow$ K and Y grow.
- If Investment $<$ Depreciation $\rightarrow$ K and Y fall.
- If Investment $=$ Depreciation $\rightarrow$ K and Y are constant.

Two important conclusions:

1. Steady state equilibrium occurs when investment equals depreciation.
2. When K is in steady state equilibrium, Y is in steady state equilibrium.

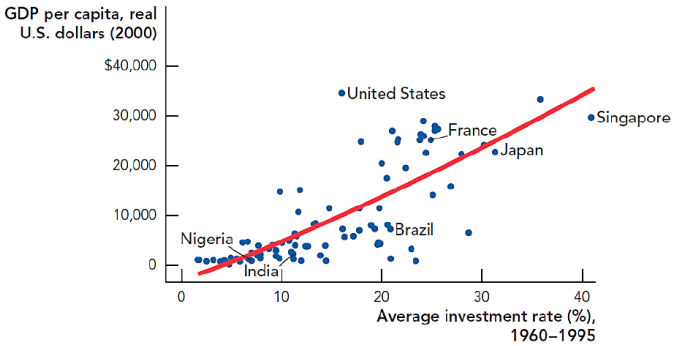
The Solow Model and an Increase in the Investment Rate

What happens when the fraction of output that is saved and invested increases?

$$\uparrow \gamma \rightarrow K \rightarrow \uparrow Y$$

Conclusion: an increase in the investment rate increases a country's steady state level of GDP.

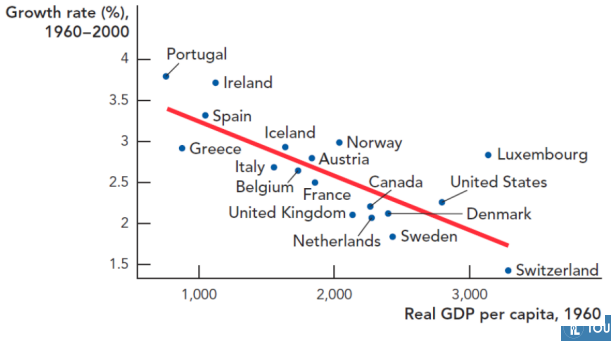
Countries with higher rates of investment will be wealthier:



The Solow Model and Conditional Convergence

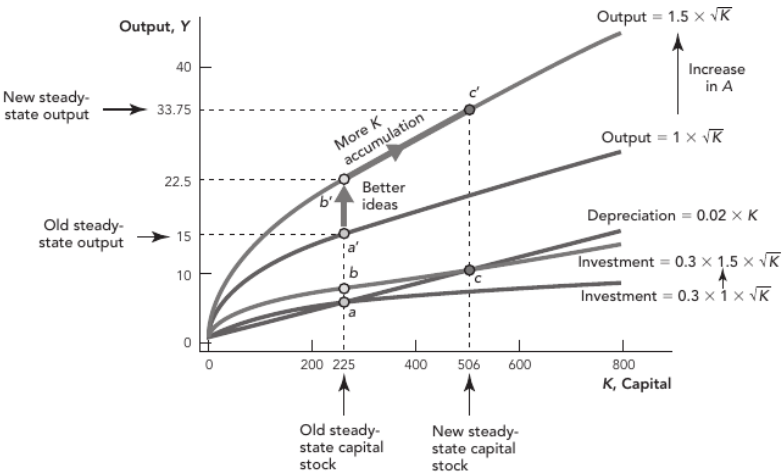
Among countries with similar steady state levels of output, poorer countries tend to grow faster than richer countries, and so converge in income.

The Solow model predicts that a country will grow faster the farther its capital stock is below its steady state value.



Solow and the Economics of Ideas

New ideas results in long run economic growth.



Research and development is investment for profit

All kinds of people come up with new ideas.

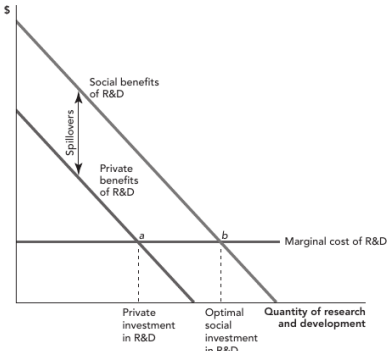
- Business culture and institutions are also important.
- Appreciation of entrepreneurs is a relatively recent (identified) phenomenon.

Institutions that are especially important:

- Commercial settings that help innovators to connect with capitalists
  - Ideas without financial backers are dead.
- Intellectual property rights
  - New processes, products, and methods can be copied by competitors.
  - Patents grant temporary monopoly.
    But they can slow down the spread of technology.
- A high-quality education system
  - Important at all levels of education.
  - Universities generate basic and applied research.

Spillovers, and why there aren't enough good ideas

- Ideas are non-rivalrous.
- Ideas can be used simultaneously.
  Use of an idea by one individual does not mean less of the idea available to someone else.
- The spillover (or "diffusion") of new ideas generates widespread economic growth.



- Implication: Spillovers mean that the generator of the idea doesn't get all of the benefits.
  Result? Too few ideas are produced.

Government's Role in the Production of New Ideas

- Ideas in science have many applications so spillovers can be large.
- Problem: Even if the social benefits are large, the private benefits can be small.
- Solution: Subsidize the production of new ideas or give tax breaks for R&D expenditures.
- Both shift the MC of R&D down.

- Large spillovers to basic science suggest a role for government subsidies to universities.
  Especially those parts of the universities that produce innovations and the basic science behind those innovations.
- Universities produce scientists.
  Most scientists were trained in government-subsidized universities.

Market Size and Research and Development

- Innovations like pharmaceuticals, new computer chips, software, and chemicals require large R&D expenditures.
- Companies will avoid investing in innovations with small potential markets.
- Larger markets mean increased rewards (thus incentives) for R&D.
- As the world market grows some companies get bigger and will increase their R&D investments.

The Future of Economic Growth

A (ideas) = Population x Incentives x Ideas/Hour

↑ population →↑ number of people with new ideas

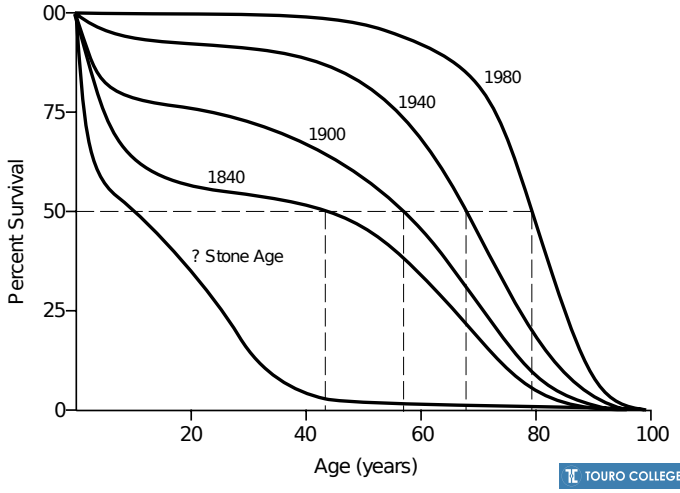
At the moment, much of the world is poor:

- thousands of potentially great scientists are laboring in menial jobs.
- As the world gets richer: ↑ production of ideas → everyone benefits

What about demographic ageing?

We all live longer than our ancestors

Survival Curves - from stone age until today



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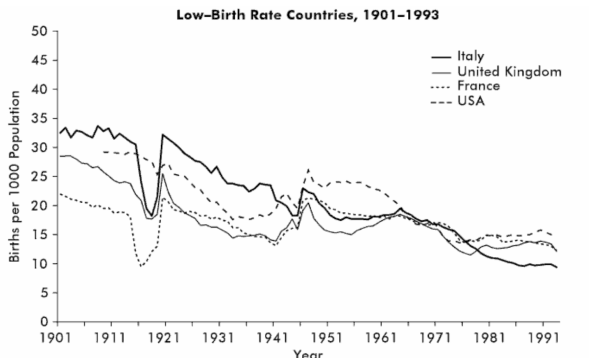
Birthrate declines

Birthrates



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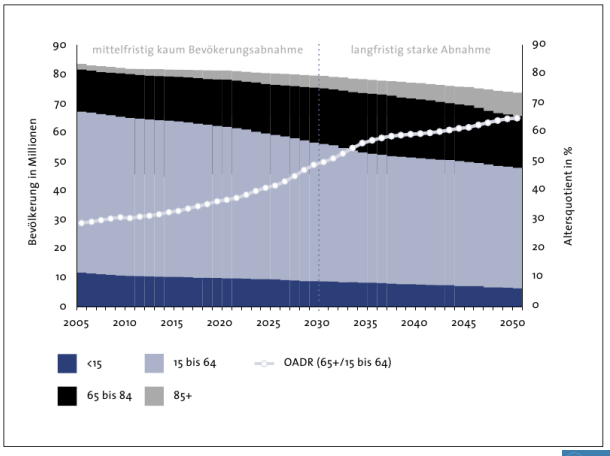
Population ages and shrinks

Population dynamics Germany



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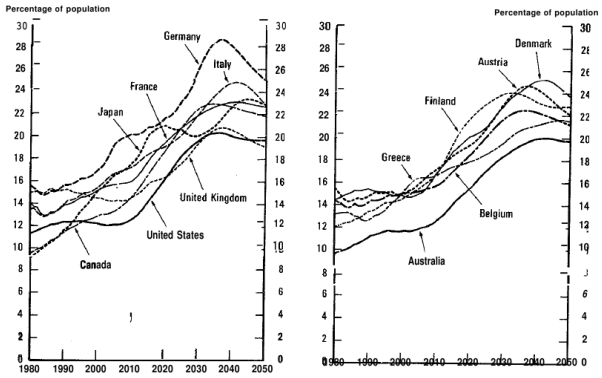
Proportion of older people increases

Projected trends in the proportion of people over 65



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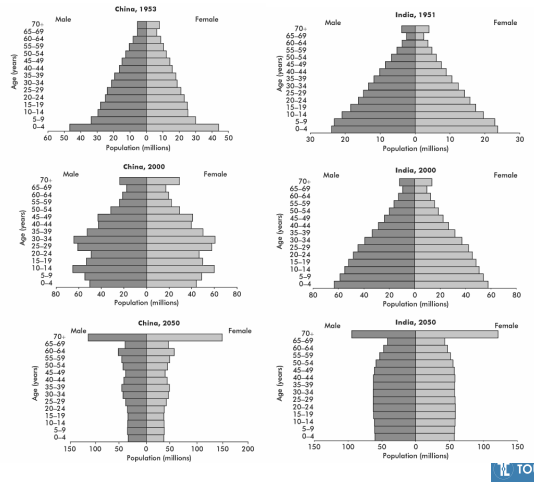
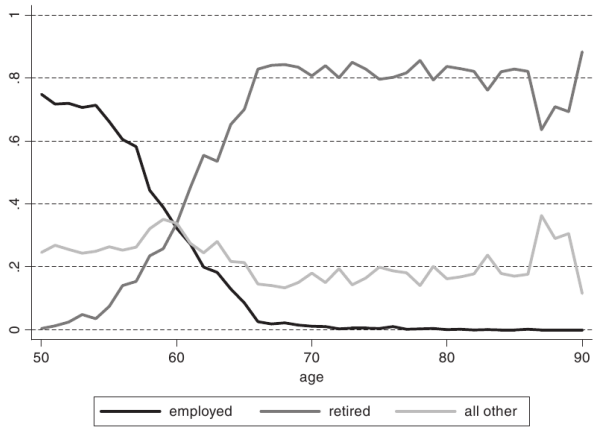
Proportion of older people increases

Projected trends in the population composition



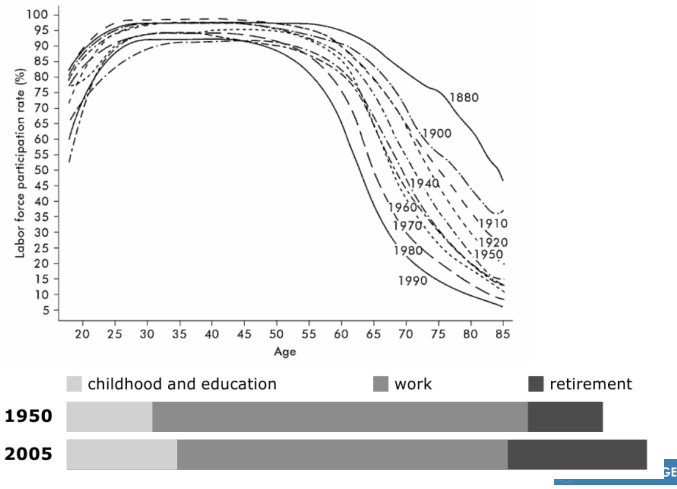
Older people are less often economically active

Economic Activity & Age in Germany



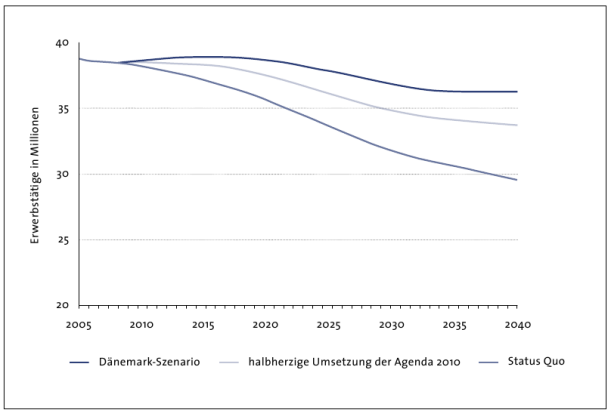
Working time over life course is reduced

Labor force participation, USA



Size of Workforce shrinks

Employment dynamics Germany



Summary

- We get older
- We get fewer children
- We work a relatively shorter period of our lives