Economics of Innovation
1 Economics of Science and Technology

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Calendario

30/11 laboratorio di econometria spaziale, 4
1/12 lezione, 2
2/12 lezione, 2

6/12 presentazioni con prof Cerina, 2
7/12 laboratorio di econometria spaziale, 4

14/12 laboratorio di econometria spaziale, 4
15/12 lezione, 2
16/12 lezione, 2

11/1 lezione, 2
12/1 lezione, 2
13/1 presentazioni, 2

I. Why Study the Economics of Science &Technology?

- Why study the economics of science and technology?
  - Innovations in science and technology play an important role in economic growth.
  - Thus, it is useful to understand what factors influence the development of technology.
- In general, economists study the allocation of scarce resources.
  - In this course, the scarce resource is the *effort* utilized in the scientific process.
  - This could be money invested in R&D, labor efforts of scientists and engineers, etc.

I. Why Study the Economics of Science &Technology?

- Questions to ask:
  1. What determines how much effort is invested into the scientific process?
     - How do firms (or governments) decide how much to invest in R&D?
     - How do they decide *which* projects to invest in?
       - E.g. how much money for AIDS research vs. cancer research?
       - How do agents decide which technologies to use (adoption of technology)?

I. Why Study the Economics of Science &Technology

- Questions to ask:
  1. What determines how much effort is invested into the scientific process?
  2. How does government policy affect this process?
     - Why is intervention necessary?
       - What are the market failures?
     - How strong should intellectual property rights be?
       - E.g. do software patents help or hinder innovation? Should developing countries recognize patents on life-saving drugs?
     - How much money should the government spend on R&D?
       - How do we evaluate the effectiveness of government R&D investments?
     - Should it subsidize private R&D?
     - How do the public and private sector work together on research?

I. Why Study the Economics of Science &Technology?

- Questions to ask:
  1. What determines how much effort is invested into the scientific process?
  2. How does government policy affect this process?
  3. What effect does this research have on economic well-being?
     - As we'll see in a moment, increases in productivity greatly affect long-run economic growth. How do scientific gains translate into productivity gains?

I. Why Study the Economics of Science &Technology?

- Questions to ask:
  1. What determines how much effort is invested into the scientific process?
  2. How does government policy affect this process?
  3. What affect does this research have on economic well-being?
  4. How does technological change affect government policies?
     - What policies are needed to govern information technology?
     - How does globalization affect the outcomes of technological progress?
     - How can policy promote the development of clean energy technologies?

II. The Importance of Technology

- When economists look at the effects of science and technology, we look at *productivity*
  – Productivity is the amount of output per unit of input

- *Labor productivity* – output per worker
  – Labor productivity has tended to be strongly correlated with wages, and is thus a reasonable measure of changes in economic welfare.

II. The Importance of Technology

- *Total factor productivity (TFP)* – a measure of output per unit of combined inputs
  - Unlike labor productivity, this looks at the productivity of *all* inputs in the economy
  - A simple calculation focuses on capital and labor:
    - $\Delta Y = \Delta A + \Delta K + \Delta L$
  - We can measure changes in output, capital, and labor. Changes in technology are the residual.
  - TFP is simply the portion of growth that cannot be explained by changes in the inputs of the economy.

II. The Importance of Technology

- Contribution of productivity growth to U.S. GDP growth

	1948-2001	**1948-1973**	**1973-1979**	**1979-1990**	**1990-1995**	**1995-2000**	**2000-2010**
Real Output	3.7	4.2	3.2	3	2.8	4.6	1.7
= growth labor*share labor	1.2	1.0	1.4	1.4	1.3	1.7	-0.1
+ growth capital * share capital	1.3	1.2	1.4	1.3	0.9	1.8	0.8
+ TFP	1.3	1.9	0.4	0.2	0.6	1.1	1.0

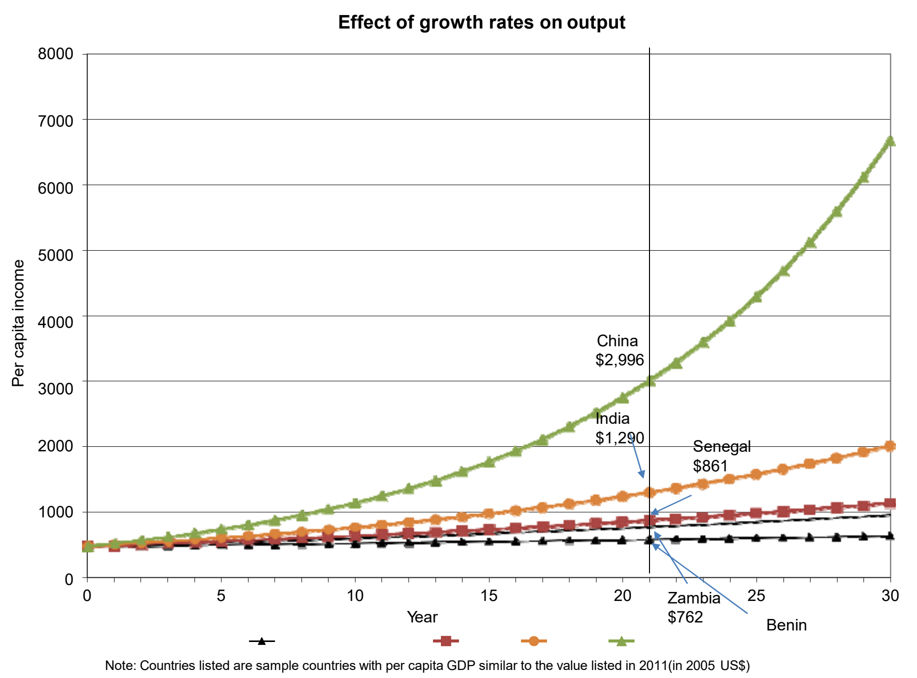
II. The Importance of Technology

- Small differences in growth rates lead to large long-term results
- Consider China in 1990
  - Per capita GDP: $463 (2005 US$)
    - Similar countries in 1990: Benin ($453), Guinea-Bissau ($497), Kenya ($550), India ($403)
  - China's growth rate 1990-2011: 9.3%

II. The Importance of Technology

Compare to other growth rates

- **World:** **2.4%**
- East Asia & Pacific: 7.5%
  - China 9.3%
  - India 4.9%
  - Korea 4.1%
  - Singapore 3.5%
  - Vietnam 6.0%
- Latin America & Caribbean 1.7%
  - Argentina 2.3%
  - Brazil 1.6%
  - Mexico 1.3%
- Selected high income countries
  - US 1.7%
  - Japan 0.7%
  - Germany 1.3%



III. Policy Relevance

- Technological change has three parts
  - *Invention*: the initial development of an idea. Could be represented, for example, by a patent
  - *Innovation*: adopting the invention for commercial use
  - *Diffusion*: the spread of the new innovation throughout the economy
- Different policies affect different parts of the process

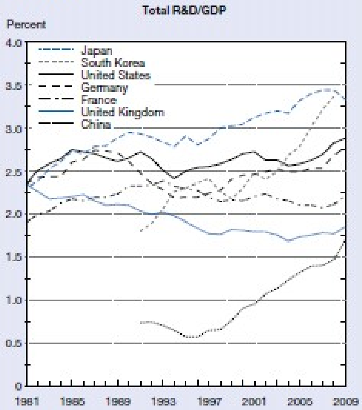
III. Policy Relevance

- R&D spending in selected countries

	Total R&D	% GDP	% Govt	% Industry	% Higher Ed
US	$402 b	2.88	11.7	70.3	13.5
Japan	$138 b	3.33	9.2	75.8	13.4
France	$48 b	2.21	16.3	61.9	20.6
Germany	$83 b	2.78	14.9	67.5	17.6
Canada	$25 b	1.92	10.1	51.7	37.6
South Korea (2008)	$44 b	3.36	12.1	75.4	12.1
China	$154 b	1.70	18.7	73.2	8.1
Brazil (2008; % from 2004)	$21.6 b	1.08	21.3	40.2	38.4

2009 data unless indicated. Source: *US Science & Engineering Indicators, 2012*

Figure 4-16
Gross expenditures on R&D as share of gross domestic product, for selected countries: 1981–2009



GDP = gross domestic product

NOTES: Top seven R&D performing countries. Data not available for all countries for all years. Figures for the United States reflect international standards for calculating gross expenditures on R&D, which differ slightly from the NSF protocol for tallying U.S. total R&D. Data for Japan, for 1996 onward, may not be consistent with earlier data due to changes in methodology.

SOURCE: Organisation for Economic Co-operation and Development, Main Science and Technology Indicators (2011/1). See appendix table 4-43.

Science and Engineering Indicators 2012