

# EC569 Economic Growth Technological Progress and Efficiency Lecture 9

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# Overview

- How is the level of innovation in a market economy determined?
- Role of efficiency in productivity

How is the level of innovation determined in a market economy?

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## 2-models of innovation

### Romer Model

- Developed by Paul Romer
- Technological progress in Romer:
  - increase in the number of differentiated intermediate goods
  - steam engines and electric motors are used alongside each other
- To produce a differentiated intermediate good,
  - one needs to own the blueprints of production
- Monopolistic competition in the intermediate goods
  - Main motive to innovate: expected discounted sum of future profits

### Schumpeterian model

- Developed by Aghion and Howitt (1992) and Grossman and Helpman (1991)
- Insights of Joseph Schumpeter, creative destruction
- Technological progress in the Schumpeterian model:
  - Technological progress: an innovation replaces an existing intermediate good
  - Walking → horse cart → the Model T Ford → modern cars
  - Hence the term **creative destruction**

# What motivates entrepreneurs to innovate?

Return to innovation: expected discounted sum of future profits

In equilibrium: expected return to innovation is equal to return on working in the production sector = wage rate

# Fraction of labor force working in R&D

Fraction of labor force working in R&D depends

- negatively on the discount rate
  - high discount rate means future consumption is valued less
  - the lower the value of future consumption, the lower the incentive to give up current consumption to have higher future consumption
  - lower incentives to innovate
- positively on the probability of innovation
  - The higher the chance of a successful innovation, the higher the incentives to innovate
- negatively on the probability of innovation
  - The higher the chance of being replaced by subsequent innovators, the lower the incentives to innovate
  - Notice that this motive is missing in the Romer model.

# Comparison of the Romer model and the Schumpeterian model

- In both models, long-run **growth** is independent of the fraction of labor force engaging in research
- Remember:  $\dot{A} = \frac{L_A^\lambda}{\mu} A^\phi$ , and assume  $\phi < 1$
- Diminishing marginal product of ideas in idea production
- In both models, **level** of income per capita in the long run is impacted by the fraction of labor force engaging in research
- If the discount rate applied to monopoly profits is large, the Schumpeterian model imply a larger fraction of labor force engaging in innovation
  - because relative importance of being replaced by others is small
- If the discount rate is relatively small, the Schumpeterian model imply a smaller fraction of labor force engaging in research
  - because people are sensitive to the future destruction of profits

# Socially optimal R&D

Because of the externalities in the innovation process, competitive equilibrium R&D level is not socially optimal.

Three distortions:

Remember that  $\dot{A} = \frac{L_A^\lambda}{\mu} A^\phi$

- if  $\phi > 0$  : "standing on shoulders"
  - Researchers do not benefit from the positive impact on the subsequent innovators
- if  $\lambda < 1$  : "stepping on toes"
  - Researchers do not take into account potential duplication of research efforts
- Consumer surplus effect
  - Private gain of an innovation = profit < Consumer surplus = Social gain



## Socially optimal R&D, cont'd

- Ground for government interference to correct for the externalities
- Also, specific to the Schumpeterian model:
- *Business stealing effect*: Innovators do not internalize the cost they impose on incumbent producers
- Notice that,
  - in standard markets, monopolies involve deadweight losses, hence inefficient
  - to provide incentive to innovate, markets need to be imperfect

# Interesting podcast episodes/video clips related to our lecture

## **Solo climbing to El Capitan and knowledge spillovers**

The indicator from Planet Money: [The Economic Lessons Of A Free Solo Climb](#)

## **Where does innovation come from?**

Prof. Stefanie Stancheva explains her [research](#) on the importance of interactions of innovators in deriving innovation and economic growth.

# Efficiency

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# Efficiency

Productivity = Technology  $\times$  Efficiency

- Technology: Knowledge about how factors of production can be combined to produce output
- Efficiency: How effectively given technology and factors of production actually used
- Productivity is much lower in poor countries than in rich countries
- Not obvious the only reason is a gap of technology
- Many of the most advanced technologies are being used in poor countries

# Types of Inefficiency

- Unproductive activities
- Idle resources
- Misallocation among sectors
- Misallocation among firms
- Technology blocking

# Unproductive Activities

- Illegal activities: theft, smuggling, kidnapping for ransom, ..
- Rent seeking: involve the use of laws or government institutions to bring private benefits
  - Economic rent: payment to a factor of production in excess of what is required to elicit the supply of that factor
  - E.g.: quotas to limit the imports of some goods, lobbying, ...
  - Costs: a good deal of effort, bright people work in unproductive activities

# Idle Resources

- Factors of production not used at all
- Unemployment, underemployment
- Factory that sits unused
- Factory running at less than full capacity
- Example: In 2001,
  - Air Afrique: 500 employees per airplane,
  - EasyJet: 66 employees per airplane
- Example: *Firemen* employed in diesel engines of the United States and Canada railroads during the middle of the 20th century

# Misallocation Among Sectors

**Misallocation among sectors:** marginal product of inputs are not equal across sectors

- barriers to mobility
  - geographical isolation
  - wage policy: e.g. sectoral minimum wage
- wages  $\neq$  marginal product of labor
  - market segmentation: potentially productive people are unable to work in certain sectors



# Efficiency Gains from Sectoral Reallocation

Reallocation from agriculture to manufacture

- Taiwan: 0.7% of 5.4% annual growth over 1966-1991
- Korea: 0.7% of 5.7% annual growth over 1960-1990
- US: fraction of agricultural labor decreased from 50% to 3% over 1880-1980
- China: fraction of agricultural labor decreased from 69% to 40% over 1980-2009

# Misallocation Among Firms

**Misallocation among firms:** marginal product of inputs are not equal across firms

- government-owned firms over-employ: political power
- monopolies under-employ: monopolistic profit
- financial frictions prevent efficient allocation of capital

# Technology Blocking

Agents deliberately prevent the use of technology

- Gutenberg's printing press (1453): scribes
- automated weaving loom (19th century): Luddites
- margarine (late 19th century): dairy farmers
- Netscape browser: Microsoft



*"Not everyone benefits from technological advances."*

# Isn't technological progress beneficial to the economy?

- creative destruction and technology blocking
  - the success of technology blocking depends on the relative power of the opposer/supporter
- rich countries are more prone to technology blocking
- technology blocking requires a well functioning government

# Summary

- Analyzed the motives of innovation
- Analyzed externalities in the innovation process, and justified the role of government intervention

**To review our lectures (lectures 7, 8 and 9) on technology and efficiency**

Read

- Chapters 4 and 5 of Introduction to Economic Growth by Jones and Vollrath
- Mathematical appendix to Chapter 9 of Economic Growth by David Weil
- Chapter 10 of Economic Growth by David Weil