Growth and Ideas

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Questions

1. How does TFP growth come about?
2. What types of policies could manipulate long-run growth?

The dominant view today:

Innovation (the production of new "ideas") is what drives TFP growth.

Objectives

In this section you will learn:

1. how ideas differ from ordinary goods (non-rivalry)
2. how non-rivalry generates scale effects
3. how scale effects make sustained growth possible

Ideas

We take the view that productivity growth is due to new "**ideas**".

Ideas are broadly defined to include:

- Designs for **new products**: the microchip, the steam engine,...
- New ways of **organizing** production: Walmart, the assembly line.

Key assumption: **Ideas are produced** like other goods.

- By profit maximizing firms.
- The profit of innovation is the rent of owning a patent.

The stock of knowledge is a form of capital.

Non-rivalry

How then do ideas differ from physical capital?

- they are produced by investing goods
- they are accumulated over time

There is just one difference: non-rivalry

Non-rivalry

Most goods are **rival**

- only a limited number of people can use a good at the same time
- examples: cars, computers, ...

Ideas can be used by many at the same time.

- software, music
- product designs (blueprints)
- production methods (just-in-time production, assembly line).

Why Does Non-rivalry Matter?

We know: capital accumulation cannot sustain growth.

We will show:

Accumulation of non-rival "knowledge capital" can sustain growth.

Excludability

Non-rivalry is a **technological** property.

- it is technologically possible for 2 people to use calculus at the same time

It may be possible to **exclude** others from using an idea.

- Patents
- Secrecy

Excludability is a legal arrangement.

Scale Effects

Non-rivalry and Growth

Why is it not possible to sustain growth through physical capital accumulation?

Non-rivalry offsets this by introducing **increasing** returns to scale.

If the balance is just right, we can get sustained growth.

Increasing Returns to Scale

Nonrivaly $\Rightarrow$ Increasing returns to scale.

Production uses rival inputs (capital and labor) and non-rival inputs (ideas).

It seems safe to assume (at least) constant returns to rival inputs

- Doubling K and L should (at least) double Y. - Why?

That means:

Doubling all inputs (including ideas) $\rightarrow$ more than doubling of output.

Example: Increasing returns to scale

Suppose it takes 1 unit of K and L to produce 1 unit of Y.

- constant returns to rival factors

Starting production takes 10 units of K and L

- e.g. developing blueprints

Cost of the first unit of Y: 11 units of K and L

- average productivity $1/11$

Cost of the 1,000th unit of Y: 1,001 K and L

- average productivity ≈ 1

Average productivity increases with the scale of production.

Scale Effects

Increasing returns $\rightarrow$ Scale effects.

Scale effects mean:

- larger economies produce more innovations

Larger means:

- Endowments of rival factors are larger.

Scale Effects: Intuition

Go back to the previous example

Small economy

$\Longrightarrow$ small market for Y

$\Longrightarrow$ small K and L

$\Longrightarrow$ high average cost

This is the mechanical reason for scale effects

Scale Effects: Intuition

There is also an economic reason

Innovation requires a **fixed cost**.

The larger the market (size of the economy), the more profitable innovation becomes.

The fixed cost can be amortized over more units of Y

Scale Effects: Empirically Plausible?

Large countries are not richer / do not grow faster.

Does this provide evidence against scale effects?

Scale Effects: Evidence

Before ocean travel became feasible, larger countries were indeed richer and technologically more advanced

- Europe / America / Australia / Tasmania / Flinders Island.

Per capita incomes in 1,000 AD line up nicely with population sizes.

Scale Effects: Evidence

When the world population was small, productivity growth was slow.

FIGURE 1.3 WORLD PER CAPITA GDP AND GROWTH RATES, 1500–2000

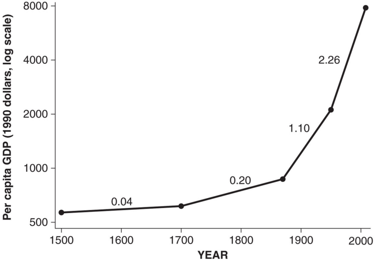
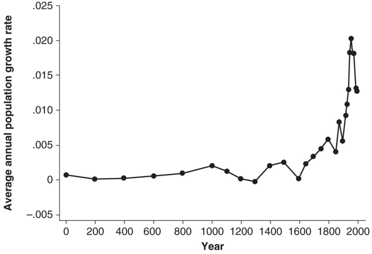


FIGURE 4.4 WORLD POPULATION GROWTH, 1 CE TO 2000 CE.



Summary

- The main hypothesis is: Productivity growth is due to innovation / ideas.
- Ideas are nonrival.
- Nonrival inputs + constant returns to rival inputs $\rightarrow$ increasing returns to scale.
- The key insight is therefore:

$$\text{Nonrivalry} \Rightarrow \text{Increasing Returns} \Rightarrow \text{Scale effects}$$

Why Do Scale Effects Matter?

Can you think of policy questions where scale effects matter?

Efficiency and the Patent System

Why do firms innovate?

Patents give the firm a temporary monopoly

- Examples: drugs, Apple

Monopolists can charge high prices and earn profits.

- Example: Epipen and many other drugs.

Innovation without patents?

One might expect: no patents $\Longrightarrow$ no innovation

- competitors could immediately copy new products

But there are many innovations that are not patent protected

- e.g., products that are given away: google, facebook

How do innovators make money without patents?

See Boldrin and Levine (2013)

What is the cost of the patent system?

1. **Monopoly prices** are inefficiently high
   - above marginal cost
   - marginal costs of some drugs are very small
2. The Patent, Used as a Sword, NY Times, 2012
   - Patent trolls use lawsuits for extortion
   - Patents are held "hostage" to prevent other companies from entering a market
   - Cost of insuring compliance with existing patents (Apple vs Samsung)

Optimal patent design

- Which policies induce efficient innovation is an easy question in theory, but hard in practice.
- Most countries seem to invest almost nothing in R&D.
  - They free-ride on innovations in the leading countries (U.S., Japan, Germany).
- One implication: it is not clear how much an increase in U.S. R&D would increase U.S. productivity.
  - In the long-run, the effect could be quite small.

Patents: The trade-off

- If patents are too long / generous: prices are inefficient
  - there could also be too much innovation
- If patents are too short: not enough incentive for innovation
- The problem: how can the government figure out the right patent duration for each product?

Recap Questions

1. Is perfect competition in R&D heavy industries feasible?
2. Consider two products
   2.1 A smartphone contains many parts, each of which is covered by a separate patent.
   2.2 A medical drug which is basically a patented chemical compound with no other ingredients.

   Which product should get longer patent protection?

Reading

- Jones (2013b), ch. 4.
- Blanchard and Johnson (2013), ch. 12

Further reading:

- Jones (2013a), ch. 6
- Romer (2011), ch. 3.1-3.4.
- Jones (2005)

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Blanchard, O. and D. Johnson (2013): *Macroeconomics*, Boston: Pearson, 6th ed.

Boldrin, M. and D. K. Levine (2013): "The case against patents," *The journal of economic perspectives*, 27, 3–22.

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Romer, D. (2011): *Advanced macroeconomics*, McGraw-Hill/Irwin.