Growth and Ideas

Prof. Lutz Hendricks

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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.

Non-rivalry

How then do ideas differ from phyiscal 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)p
- 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 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. devloping blueprints

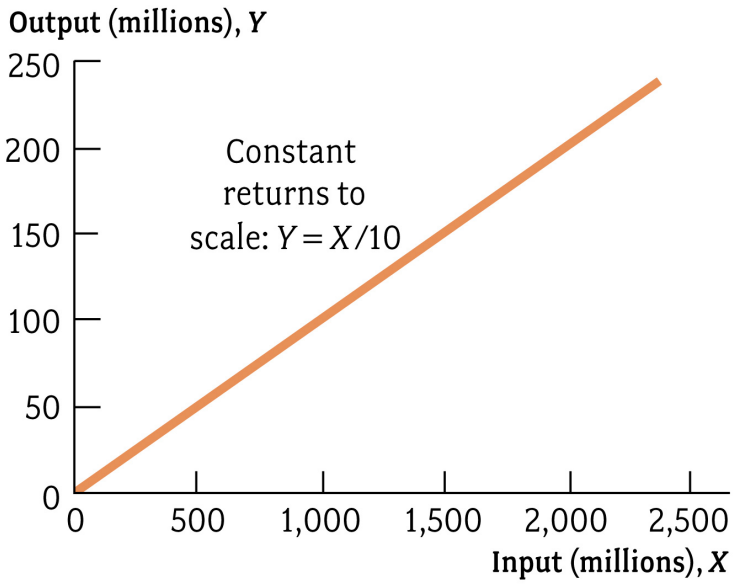
Cost of the first unit of Y: 11 K and L

- average productivity $1/11$

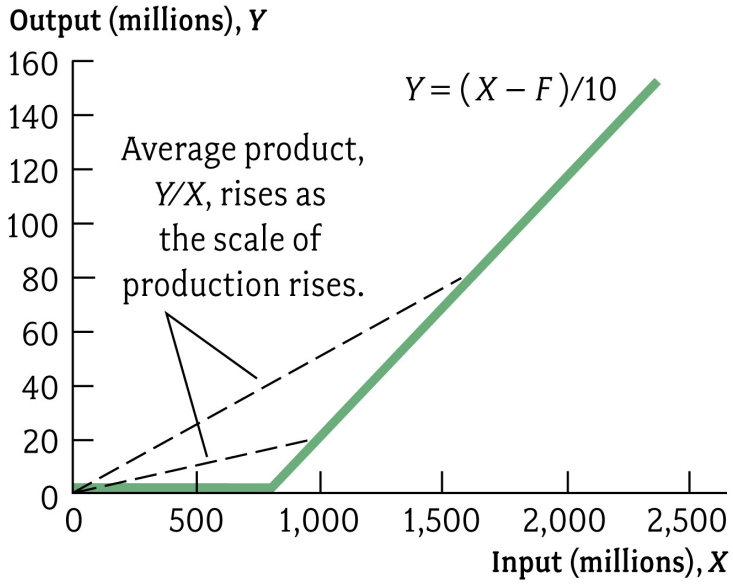
Cost of the 1,000th unit of Y: 1,001 K and L

- average productivity ≈ 1

Example: Increasing returns to scale



(a) Constant returns to scale: $Y = X/10$.



(b) Increasing returns from fixed cost: $\bar{F} = 800$.

FIGURE 6.1 How a Fixed Cost Leads to Increasing Returns: The Antibiotic Example

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.

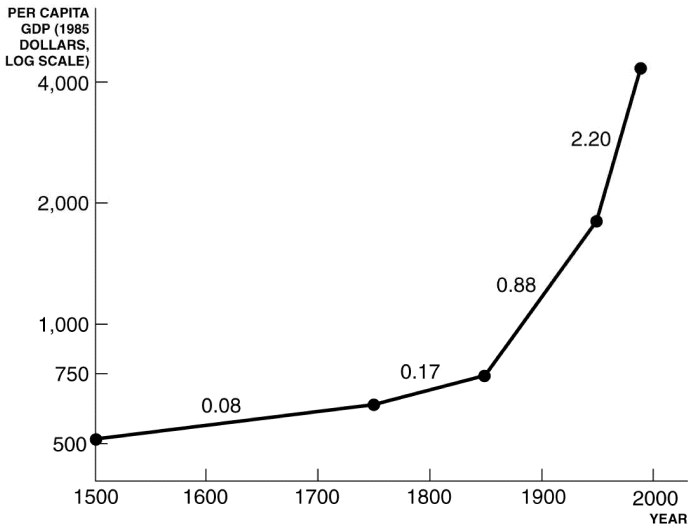


FIGURE 1.3 **WORLD PER CAPITA GDP AND GROWTH RATES, 1500–1990**

Economic Growth,
Copyright © 2004 W. W. No

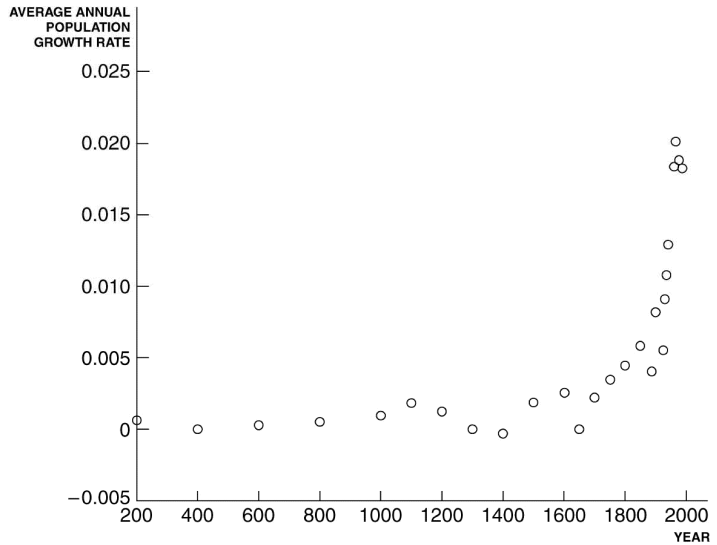


FIGURE 4.4 **WORLD POPULATION GROWTH, 1 A.D. TO 1990**

Economic Growth, 2nd
Copyright © 2004 W. W. Norton &

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?

What would happen without patents?

How do innovators make money without patents?

See Boldrin and Levine (2013)

What is the cost of the patent system?

See The Patent, Used as a Sword, NY Times, 2012

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?

Reading

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

Further reading:

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

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

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