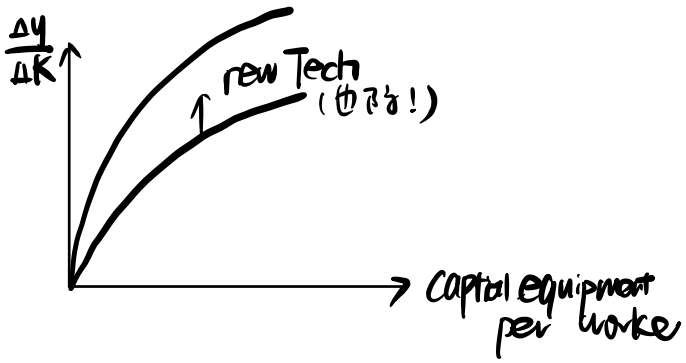
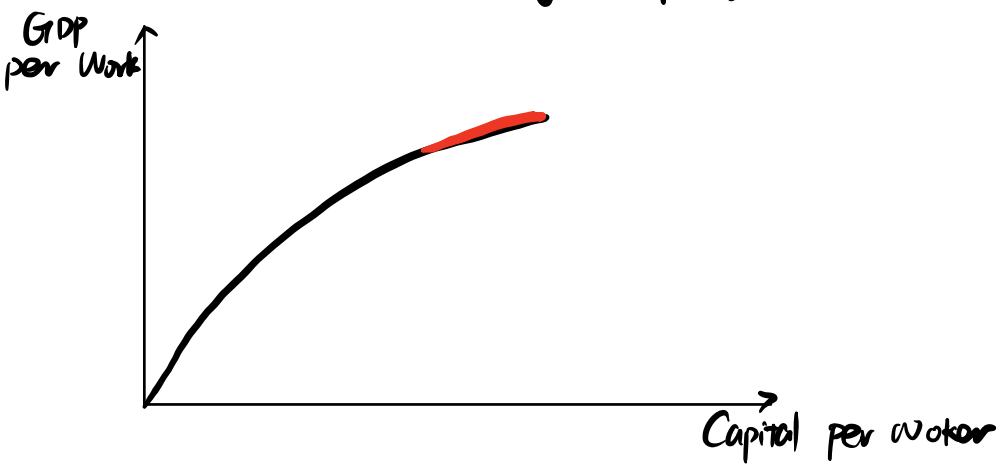
innovation rent ⌒

creative destruction ⌒

capital-intensive



accumulation of capital process proceed in the absence of technological progress



随着 Captital intensive ↑ 按理说 Capital productivity 应该 ↓. 但从长远来看，技术的进步抵消了边际递减

Solow Model explains

1. catching up of developing countries over time (with little accumulated capital per worker)
2. Long run only: tech↑ ⇒ econo growth↑

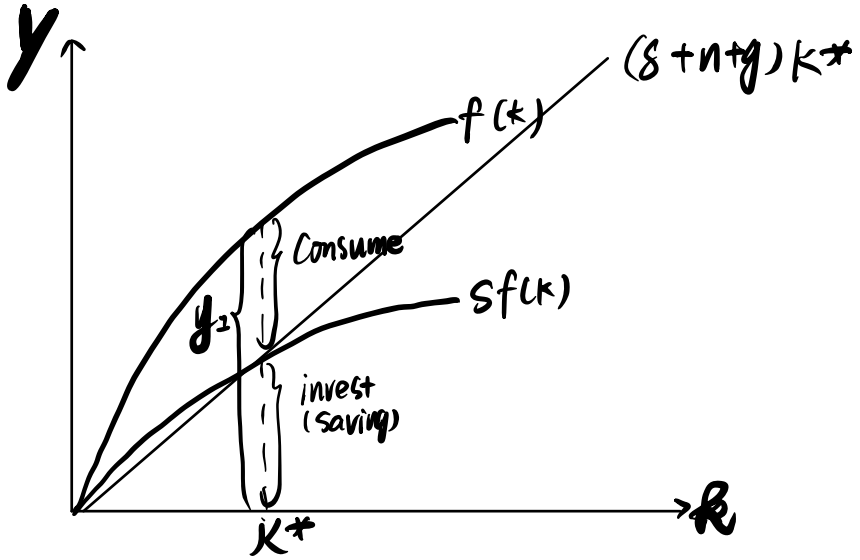
K: capital (资) L: 劳动力 E: 效率.

$y = Y/L$ $k = K/L$

$y = Y/LE = f(k)$ $k = K/LE$ (capital per unit of effective labour)

Saving: $S * y = S * f(k)$

Consume: $C = y - i = f(k) - sy$

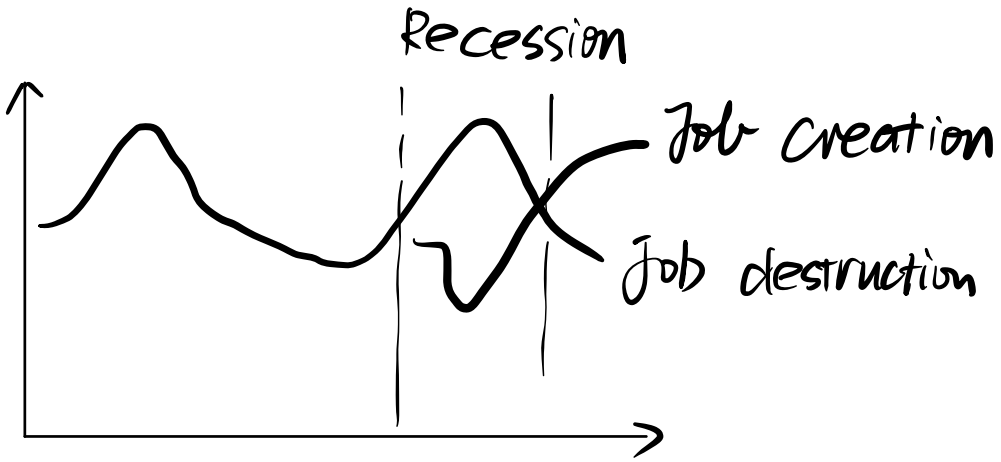


$\Delta k = sf(k) - (\delta + n + g)k$

$\Delta k = 0$ (K, L grow with same rate)

时

1. $sf(k^*) = (\delta + n + g)k^*$
2. golden rule level of capital
3. $f'(k^*) = \delta + n + g$
4. GDE per person grow with same rate as tech progress



Labour market matching

1. 能力不符 2. 地区不同 3. 互不相识

* Long run Labour Market Model

7. Technological progress, unemployment and living standards in the long run

I. Exercise Questions

Readings
Lecture slide set: #9
Macroeconomics ed.9 (Mankiw): *Steady state (8.1), technological progress (9.1), golden rule (8.2)*

Problem 1 (*Solow model*)

Consider an economy with the following Cobb-Douglas-production function:

$$Y = K^{0,5}(LE)^{0,5}$$

where K is the capital stock, L is the employed labour force and E is the efficiency of the economy.

Assume a savings rate of $s = 0,25$, a population growth rate of $n = 0,1$, a depreciation rate of $\delta = 0,3$ and a rate of $g = 0,1$ for the technological progress.

(a) What is the production function per unit of effective labour of the economy?

(b) What is the break-even investment in this economy (the investment needed to keep the capital stock per unit of effective labour constant)?

(c) Calculate the capital stock per unit of effective labour of the economy in the steady state.

(d) Calculate the income stock per unit of effective labour of the economy in the steady state.

(e) Calculate the consumption per unit of effective labour of the economy in the steady state.

(f) Calculate the savings rate that maximises the per unit of effective labour consumption of the economy in the steady state.

(g) Sketch the results of (a)–(f) in an appropriate Solow diagramme.

(h) Determine the growth rates of output per capita, the capital stock per capita, and consumption per capita in the steady state.

II. Multiple Choice

Select one answer.

1. **Technological progress and unemployment**
   The diagram plots GDP per worker vs capital per worker, both across countries in 1990 (the scatter plots) and the trajectories since 1760 for a few representative countries (the paths).

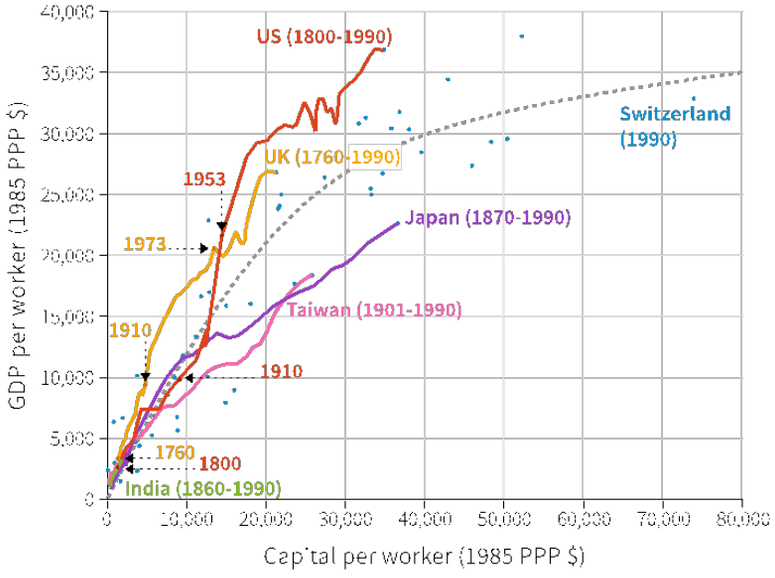


Figure 1

Which of the following statements is correct?

(A) There is no clear evidence of technological progress in the US GDP per worker.

(B) Switzerland has been the most successful country in attaining high GDP per worker by use of its capital.

(C) Taiwan is more capital intensive than the UK in 1990.

(D) The average product of capital has been higher in Japan than in the UK over the years shown.

2. Okun's Law

Figure 2 depicts the relationship between changes in real GDP (in percent) and unemployment rate (in percentage points) in Germany from 1993 to 2016. Each point represents one year.

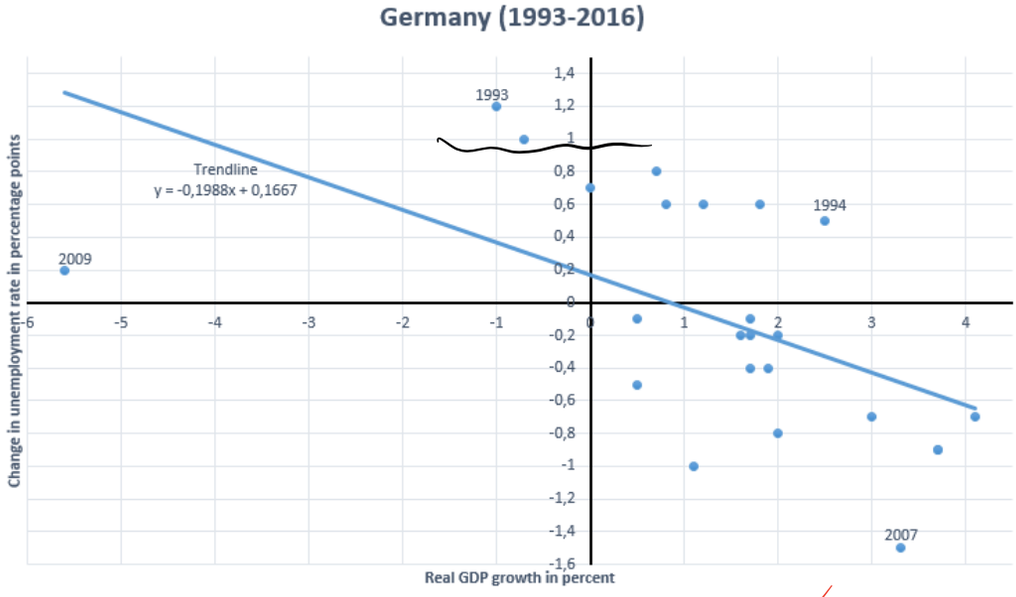


Figure 2

Which of the following statements is true?

(A) A growth in real GDP always results in a decline of the unemployment rate.

(B) A growth in real GDP above 0.9% on average is accompanied by a decline of the unemployment rate.

(C) In 1994 a growth in real GDP of approximately 2.5% led to a decrease of unemployment by approximately 0.5 percentage points.

(D) An increase of the unemployment rate of 0.1 percentage points on average leads to an increase of real GDP of 0.5%.