Macroeconomcs

Professor Hisahiro Naito

In this chapter you will learn:

- what determines the economy's total output/income
- how the prices of the factors of production are determined
- how total income is distributed
- what determines the demand for goods and services
- how equilibrium in the goods market is achieved

Outline of model

A closed economy, market-clearing model

Supply side
- factor markets (supply, demand, price)
- determination of output/income

Demand side
- determinants of ***C***, ***I***, and ***G***

Equilibrium
- goods market
- loanable funds market

Factors of production

K = capital,
tools, machines, and structures used in production

L = labor,
the physical and mental efforts of workers

The production function

- denoted $Y = F(K, L)$
- shows how much output (Y) the economy can produce from K units of capital and L units of labor.
- reflects the economy's level of technology.
- exhibits ***constant returns to scale***.

4

Returns to scale: a review

Initially $Y_1 = F(K_1, L_1)$

Scale all inputs by the same factor z:

$K_2 = zK_1$ and $L_2 = zL_1$

(If $z = 1.25$, then all inputs are increased by 25%)

What happens to output, $Y_2 = F(K_2, L_2)$?

- If *constant returns to scale*, $Y_2 = zY_1$
- If *increasing returns to scale*, $Y_2 > zY_1$
- If *decreasing returns to scale*, $Y_2 < zY_1$

5

Exercise: *determine returns to scale*

Determine whether each of the following production functions has constant, increasing, or decreasing returns to scale:

(a) $F(K, L) = \sqrt{KL}$ (b) $F(K, L) = \frac{K^2}{L}$

(c) $F(K, L) = 2K + 15L$

(d) $F(K, L) = 2\sqrt{K} + 15\sqrt{L}$

(e) $F(K, L) = 2K^2 + 15L^2$

6

Assumptions of the model

1. Technology is fixed.
2. The economy's supplies of capital and labor are fixed at

$$K = \bar{K} \quad \text{and} \quad L = \bar{L}$$

7

Determining GDP

Output is determined by the fixed factor supplies and the fixed state of technology:

$$\overline{Y} = F(\overline{K}, \overline{L})$$

8

The distribution of national income

- determined by **factor prices**, the prices per unit that firms pay for the factors of production.
- The **wage** is the price of L, the **rental rate** is the price of K.

9

Notation

W	= nominal wage
R	= nominal rental rate
P	= price of output
W/P	= real wage (measured in units of output)
R/P	= real rental rate

10

How factor prices are determined

- Factor prices are determined by supply and demand in factor markets.
- Recall: Supply of each factor is fixed.
- What about demand?

11

Demand for labor

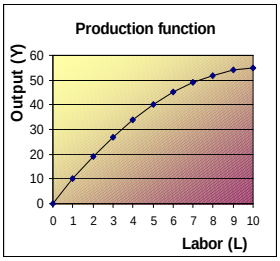
- Assume markets are competitive:
  each firm takes ***W***, ***R***, and ***P*** as given
- Basic idea:
  A firm hires each unit of labor
  if the cost does not exceed the benefit.
  cost = real wage
  benefit = ***marginal product of labor***

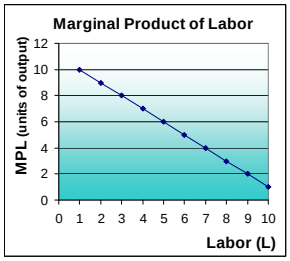
Marginal product of labor (*MPL*)

def:
The extra output the firm can produce using an additional unit of labor (holding other inputs fixed):

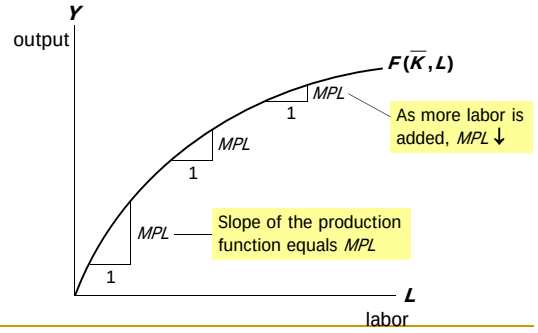
$$MPL = \Delta Y / \Delta L$$

answers:





The MPL and the production function



Diminishing marginal returns

- As a factor input is increased, its marginal product falls (other things equal).
- Intuition:
  ↑L while holding K fixed
  ⇒ fewer machines per worker
  ⇒ lower productivity

16

Check your understanding:

Which of these production functions have diminishing marginal returns to labor?

a) $F(K, L) = 2K + 15L$

b) $F(K, L) = \sqrt{KL}$

c) $F(K, L) = 2\sqrt{K} + 15\sqrt{L}$

17

Exercise (part 2)

Suppose $W/P = 6$.

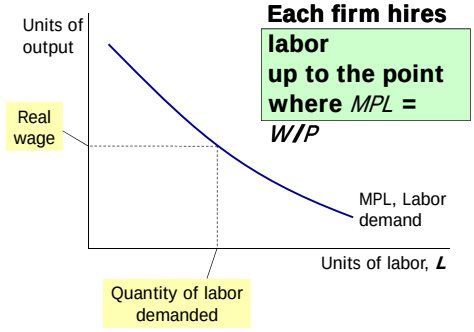
d. If $L = 3$, should firm hire more or less labor? Why?

e. If $L = 7$, should firm hire more or less labor? Why?

L	Y	MPL
0	0	n.a.
1	10	10
2	19	9
3	27	8
4	34	7
5	40	6
6	45	5
7	49	4
8	52	3
9	54	2
10	55	1

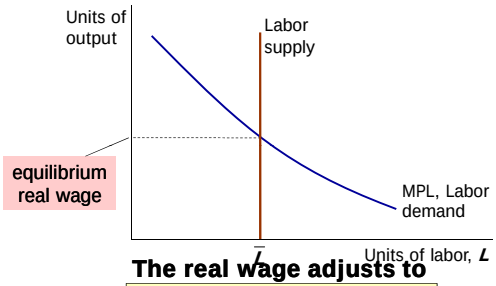
18

MPL and the demand for labor



19

The equilibrium real wage



The real wage adjusts to equate labor demand with supply.

20

An Application of the wage model

- Looking at the British History
- Around, 1350 there was an important historical event.
- That affected British population substantially.

21

Figure 1: British Population and Wages, 1210-1500

22

Determining the rental rate

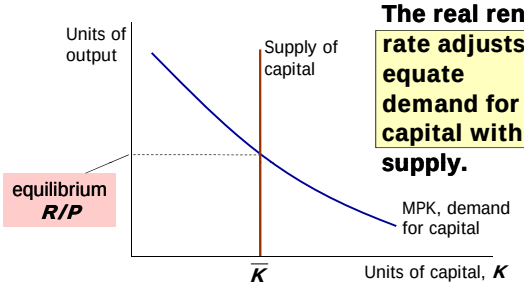
We have just seen that ***MPL*** = ***W/P***

The same logic shows that ***MPK*** = ***R/P***:

- diminishing returns to capital: ***MPK*** ↓ as ***K*** ↑
- The ***MPK*** curve is the firm's demand curve for renting capital.
- Firms maximize profits by choosing ***K*** such that ***MPK*** = ***R/P***.

23

The equilibrium real rental rate



The real rental rate adjusts to equate demand for capital with supply.

The Neoclassical Theory of Distribution

- *states that each factor input is paid its marginal product*
- *accepted by most economists*

How income is distributed:

total labor income = $\frac{W}{P}\bar{L} = MPL \times \bar{L}$

total capital income = $\frac{R}{P}\bar{K} = MPK \times \bar{K}$

If production function has constant returns to scale, then

$$\bar{Y} = \underbrace{MPL \times \bar{L}}_{\text{labor income}} + \underbrace{MPK \times \bar{K}}_{\text{capital income}}$$

$\bar{Y}$: national income

Outline of model

A closed economy, market-clearing model

Supply side

DONE ✓ factor markets (supply, demand, price)

DONE ✓ determination of output/income

Demand side

- determinants of ***C***, ***I***, and ***G***

Next ➔ Equilibrium

- goods market
- loanable funds market

Demand for goods & services

Components of aggregate demand:

C = consumer demand for g & s

I = demand for investment goods

G = government demand for g & s

(closed economy: no ***NX***)

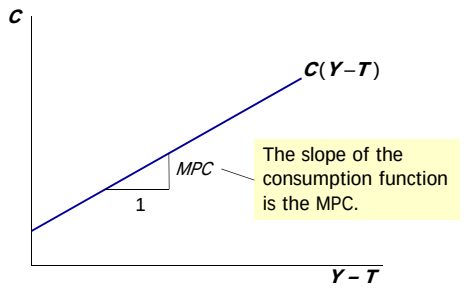
28

Consumption, *C*

- def: **disposable income** is total income minus total taxes: $Y - T$
- Consumption function: $C = C(Y - T)$
  Shows that $\uparrow(Y - T) \Rightarrow \uparrow C$
- def: The **marginal propensity to consume** is the increase in ***C*** caused by a one-unit increase in disposable income.

29

The consumption function



30

Investment, *I*

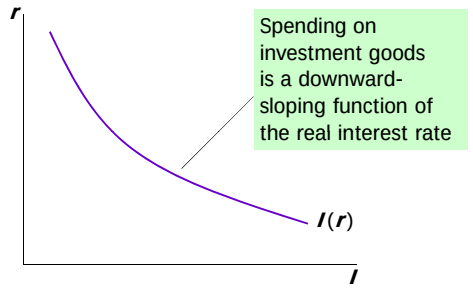
- The investment function is $I = I(r)$,
  where ***r*** denotes the **real interest rate**, the nominal interest rate corrected for inflation.
- The real interest rate is
  - the cost of borrowing
  - the opportunity cost of using one's own funds

  to finance investment spending.

  So, $\uparrow r \Rightarrow \downarrow I$

31

The investment function



32

Government spending, G

- G includes government spending on goods and services.
- G excludes *transfer payments*
- Assume government spending and total taxes are exogenous:

$$G = \bar{G} \quad \text{and} \quad T = \bar{T}$$

33

The market for goods & services

- Agg. demand: $C(\bar{Y} - \bar{T}) + I(r) + \bar{G}$
- Agg. supply: $\bar{Y} = F(\bar{K}, \bar{L})$
- Equilibrium: $\bar{Y} = C(\bar{Y} - \bar{T}) + I(r) + \bar{G}$

The real interest rate adjusts to equate demand with supply.

34

The loanable funds market

A simple supply-demand model of the financial system.

One asset: "loanable funds"

demand for funds: investment

supply of funds: saving

"price" of funds: real interest rate

35

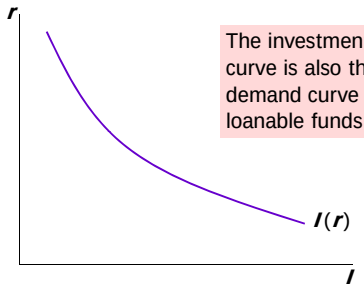
Demand for funds: Investment

The demand for loanable funds...

- comes from investment:
  Firms borrow to finance spending on plant & equipment, new office buildings, etc. Consumers borrow to buy new houses.
- depends negatively on ***r***, the "price" of loanable funds (the cost of borrowing).

36

Loanable funds demand curve



The investment curve is also the demand curve for loanable funds.

37

Supply of funds: Saving

The supply of loanable funds comes from saving:

- Households use their saving to make bank deposits, purchase bonds and other assets. These funds become available to firms to borrow to finance investment spending.
- The government may also contribute to saving if it does not spend all of the tax revenue it receives.

38

Types of saving

- **private saving** $= (Y - T) - C$
- **public saving** $= T - G$
- **national saving**, S
  = private saving + public saving
  $= (Y - T) - C + T - G$
  $= Y - C - G$

39

Notation: Δ = change in a variable

- For any variable ***X***, **Δ*X*** = "the change in ***X***"
  Δ is the Greek (uppercase) letter *Delta*

Examples:

- If **Δ*L*** = 1 and **Δ*K*** = 0, then **Δ*Y*** = ***MPL***.
  More generally, if **Δ*K*** = 0, then $\boldsymbol{MPL} = \frac{\Delta \boldsymbol{Y}}{\Delta \boldsymbol{L}}$.
- **Δ(*Y*–*T*)** = **Δ*Y*** – **Δ*T***, so

$$\Delta C = MPC \times (\Delta Y - \Delta T)$$
$$= MPC\ \Delta Y - MPC\ \Delta T$$

EXERCISE:

Calculate the change in saving

Suppose MPC = 0.8 and MPL = 20.

For each of the following, compute **Δ*S***:

a. **Δ*G*** = 100
b. **Δ*T*** = 100
c. **Δ*Y*** = 100
d. **Δ*L*** = 10

Answers

$$\Delta S = \Delta Y - \Delta C - \Delta G = \Delta Y - 0.8(\Delta Y - \Delta T) - \Delta G$$
$$= 0.2\Delta Y + 0.8\Delta T - \Delta G$$

a. $\Delta S = -100$

b. $\Delta S = 0.8 \times 100 = 80$

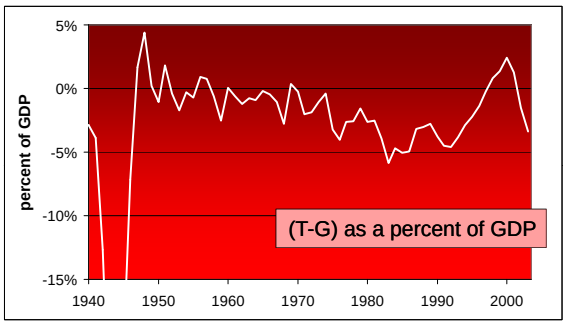
c. $\Delta S = 0.2 \times 100 = 20$

d. $\Delta Y = \text{MPL} \times \Delta L = 20 \times 10 = 200$,
$\Delta S = 0.2 \times \Delta Y = 0.2 \times 200 = 40$.

digression:
Budget surpluses and deficits

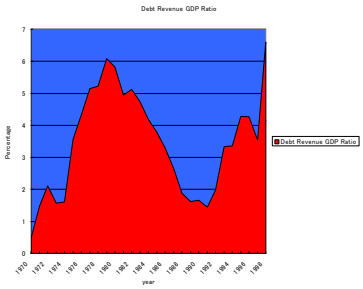
- When ***T*** > ***G***,
  budget surplus = (***T*** – ***G***) = public saving
- When ***T*** < ***G***,
  budget deficit = (***G*** – ***T***)
  and public saving is negative.
- When ***T*** = ***G***,
  budget is balanced and public saving = 0.

The U.S. Federal Government Budget



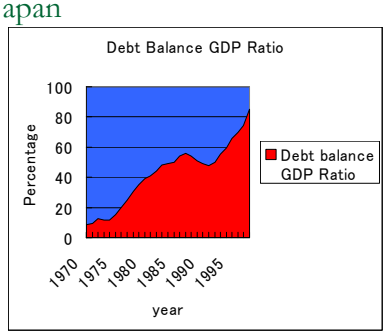
44

Debt revenue GDP Ratio of Japan



45

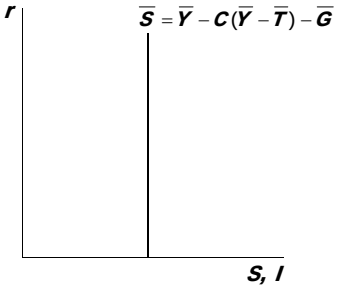
Debt Balance GDP Ratio of Japan



46

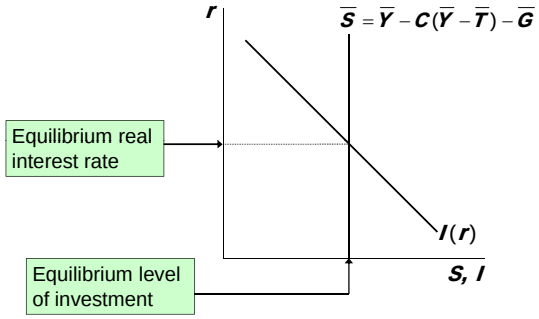
Loanable funds supply curve

National saving does not depend on r, so the supply curve is vertical.



47

Loanable funds market equilibrium



48

The special role of *r*

r adjusts to equilibrate the goods market and the loanable funds market simultaneously:

If L.F. market in equilibrium, then

$Y - C - G = I$

Add ($C + G$) to both sides to get

$Y = C + I + G$ *(goods market eq'm)*

Thus,

Eq'm in L.F. market ⇔ Eq'm in goods market

49

Digression: mastering models

To learn a model well, be sure to know:

1. Which of its variables are endogenous and which are exogenous.
2. For each curve in the diagram, know
   a. definition
   b. intuition for slope
   c. all the things that can shift the curve
3. Use the model to analyze the effects of each item in 2c .

50

Mastering the loanable funds model

1. Things that shift the saving curve
   - public saving
     - fiscal policy: changes in ***G*** or ***T***
   - private saving
     - preferences
     - tax laws that affect saving
       - 401(k)
       - IRA
       - replace income tax with consumption tax

51

CASE STUDY

The Reagan Deficits

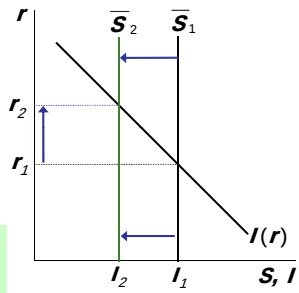
- Reagan policies during early 1980s:
  - increases in defense spending: $\Delta \bar{G} > 0$
  - big tax cuts: $\Delta \bar{T} < 0$
- According to our model, both policies reduce national saving:

$$\bar{S} = \bar{Y} - C(\bar{Y} - \bar{T}) - \bar{G}$$

$\uparrow \bar{G} \Rightarrow \downarrow \bar{S}$ $\qquad$ $\downarrow \bar{T} \Rightarrow \uparrow C \Rightarrow \downarrow \bar{S}$

1. The Reagan deficits, cont.

1. The increase in the deficit reduces saving…
2. …which causes the real interest rate to rise…
3. …which reduces the level of investment.



Are the data consistent with these results?

variable	1970s	1980s
$T - G$	–2.2	–3.9
S	19.6	17.4
r	1.1	6.3
I	19.9	19.4

T–G, S, and I are expressed as a percent of GDP

All figures are averages over the decade shown.

Another application of the long run model

- Harvard Professor Robert Barro looked at the British Data
- Why is the British data ?
- Special events in the last 500 years
- Very long time series data is available
- Let's see the data

Now you try…

- Draw the diagram for the loanable funds model.
- Suppose the tax laws are altered to provide more incentives for private saving.
- What happens to the interest rate and investment?
- (Assume that ***T*** doesn't change)

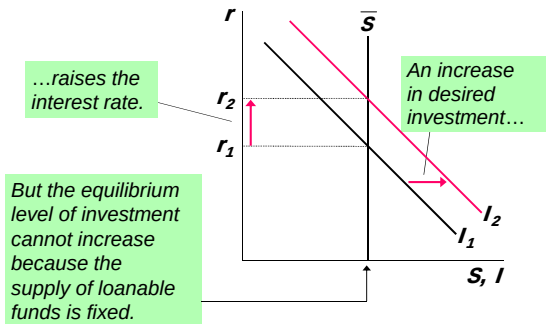
56

Mastering the loanable funds model

2. Things that shift the investment curve
   - certain technological innovations
     - to take advantage of the innovation, firms must buy new investment goods
   - tax laws that affect investment
     - investment tax credit

57

An increase in investment demand



58