Markets, Prices, Supply, Demand and Budget Constraint

（宏观经济学的一些微观经济基础）

Markets in the Macroeconomy

- Assuming that households perform all of the functions in the economy.
- Reprentative households: 宏观经济学使用“代表性家庭”，他的集合就是宏观经济体。
- Each household runs a family business and uses labor, *L*, and capital, *K*, to produce goods, *Y*, through the production function.

$$Y = A \cdot F(K, L)$$

Markets in the Macroeconomy

- The Goods Market
  - Households sell all the goods they produce on a **goods market**. Then households buy back from this market the goods that they want.
  - Household buys goods
    - To consume, or,
    - To increase the stock of goods in the form of capital used for production, called **investment**.

Markets in the Macroeconomy

- The Labor Market
  - Households demand and supply labor on a **labor market**.
  - Assume that the quantity supplied, L^s, is a constant, L, then we have $L^s = L$.

Markets in the Macroeconomy

- The Rental Market
  - Each household rents out capital it owns and rents in capital it needs on a **rental market**.
  - We think of the capital offered on the rental market as the supply of capital services, K^s.
  - Assumed that the quantity of capital supplied is constant, then we have $K^s = K$.

Markets in the Macroeconomy

- The Bond Market
  - A borrowing household receives a loan from another household, whereas a lending household provides a loan to another household.
  - A household that makes a loan receives a piece of paper called a bond, and we call the market on which households borrow or lend the **"bond market"**.
  - The holder of a bond (the lender) has a claim to the amount owed by the borrower.

Markets and Prices

- We assume that the exchanges on each of these markets use a single form of **medium of exchange**.
  - A medium of exchange is an object held, not for its own sake, but rather to trade fairly soon for something else, such as goods and services.
  - We call the medium of exchange in our model **money**.
  - Money is used to measure **Price.**

Markets and Prices

- The Goods Market
  - The price, denoted by *P*, expresses the number of curreny that exchange for one unit of goods.
  - We call *P* the **price level**.
  - Y= A· F(K, L)
    - Since all of these goods are sold on the goods market, the variable *Y* will also represent the quantity of goods per year sold and bought on the goods market.
    - The quantity ***PY*** is the nominal value per year of the goods bought and sold on the goods market.

Markets and Prices

- For a seller of goods, the price level, *P*, is the number of currency obtained for each unit of goods sold.
- For a buyer, *P* is the number of currency paid per unit of goods.
- Since *P* buy 1 unit of goods, 1 currency buys 1/*P* units of goods.
- *M* currency exchange for: $(M) \cdot (1/P) = M/P$, units of goods.
- An expression like *M/P* is in **real terms**, in units of goods, whereas a quantity like *M* is in nominal terms.

Markets and Prices

- The Labor Market
  - Households buy and sell labor in the labor market at the **nominal wage rate**, *w*.
  - The **real wage rate** is *w/P*.

Markets and Prices

- The Rental Market
  - Households rent out capital, *K*, for **nominal rental price**, *R*
    - A household that rents in the amount of capital K^d , pays the nominal amount RK^d per year, and then use the capital as an input to production.
  - The **real rental price** is *R/P*.

Markets and Prices

- The Bond Market
  - The **principal** （本金）is the initial amount advanced on a loan.
  - Bonds have short **maturity**.
  - The variable ***i (nominal)*** is the **interest rate**, which is the ratio of the interest payment to the principal.
  - The interest rate, *i* , can vary over time.

Constructing the Budget Constraint

- The quantities and prices determined on the four markets will determine household income and expenditure.
  - Flows of income are **sources of funds**
  - Purchases of goods and assets are **uses of funds**
- The total sources of funds must equal the total uses of funds. This equality is called the household budget constraint**.**

Constructing the Budget Constraint

- Income
  - Profits
    - Households may earn profit, π —an excess of revenue over costs—from their business activities.
    - $Y = A \cdot F(K^d, L^d)$
    - $\pi = PY - (wL^d + RK^d)$

      $= PA \cdot F(K^d, L^d) - (wL^d + RK^d)$

Constructing the Budget Constraint

- Wage income
  - If households supply the quantity of labor L^s to the labor market, they receive the nominal wage income of wL^s per year.
  - Quantity of labor supplied is the fixed amount L, so nominal wage income is wL.

Constructing the Budget Constraint

- Rental income
  - If households supply the quantity of capital K^s to the rental market they receive the nominal rental income of RK^s per year.
  - Since the quantity of capital is fixed at K, so that $K^s = K$, the nominal rental income is RK.
  - The quantity δK of capital disappears each year. The nominal value of this lost capital is $P \cdot \delta K$.

Constructing the Budget Constraint

- Net nominal rental income

  = nominal rental income− value of depreciation

  = $RK - \delta PK$

  = $(R/P) \cdot P\,K - \delta PK$

  = $(R/P - \delta) \cdot PK$

- Then, rate of return on owning capital= $R/P - \delta$

Constructing the Budget Constraint

– Interest Income

- If a household's nominal bond holdings are *B*, the flow of nominal interest income received is *iB* per year.
- Since *B* equals zero for the whole economy, we have that the total of interest income across all households equals 0.

Constructing the Budget Constraint

- Income
  - Household **total nominal income**
    - = nominal profit +
      nominal wage income +
      nominal net rental income +
      nominal interest income
    - = $\pi + wL + (R/P - \delta) \cdot PK + iB$

Constructing the Budget Constraint

- Consumption
  - Households consume goods in the quantity *C* per year at price= *P*
  - Household nominal consumption= *PC*

Constructing the Budget Constraint

- Assets
  - Households hold assets in three forms:
    - Money, *M*;
    - Bonds, *B*;
    - Ownership of capital, *K*.

Constructing the Budget Constraint

- Assets
  - We assume that households hold a fixed amount of money in currency; that is, we assume that the change over time of a household's nominal money holdings is zero, that is, $\Delta M = 0$.

Constructing the Budget Constraint

- Assets
  - In considering whether to hold assets as bonds or capital, households would compare the rate of return on bonds (i), with the rate of return on ownership of capital ($R/P - \delta$).
  - At equilibrium, rate of return on bonds= rate of return on ownership of capital, that is:

    $i = R/P - \delta$
- Then, household nominal income:

  $\pi + wL + i \cdot (B+PK)$

Constructing the Budget Constraint

- Household Budget Constraint
  - nominal value of assets= $M+ B+ PK$
  - nominal saving: the **change** over time in the nominal value of assets(储蓄=净投资).

$$= (\Delta \textit{nominal value assets}) = \Delta M + \Delta B + P \cdot \Delta K$$

$$= 0 + \Delta B + P \cdot \Delta K$$

$$= \Delta B + P \cdot \Delta K$$

Constructing the Budget Constraint

- Household Budget Constraint

  nominal saving（储蓄=收入-消费）

  = nominal income− nominal consumption

  = $\pi + wL + i \cdot (B + PK) - PC$

  that is: $\Delta B + P \cdot \Delta K = \pi + wL + i \cdot (B + PK) - PC$

  that is: $PC + \Delta B + P \cdot \Delta K = \pi + wL + i \cdot (B + PK)$

  nominal consumption+nominal saving

  = nominal income（消费+储蓄=收入）

Constructing the Budget Constraint

- Household Budget Constraint in real terms

  $C+(1/P)\cdot\Delta B+\Delta K=\pi/P+(w/P)\cdot L+i\cdot(B/P+K)$

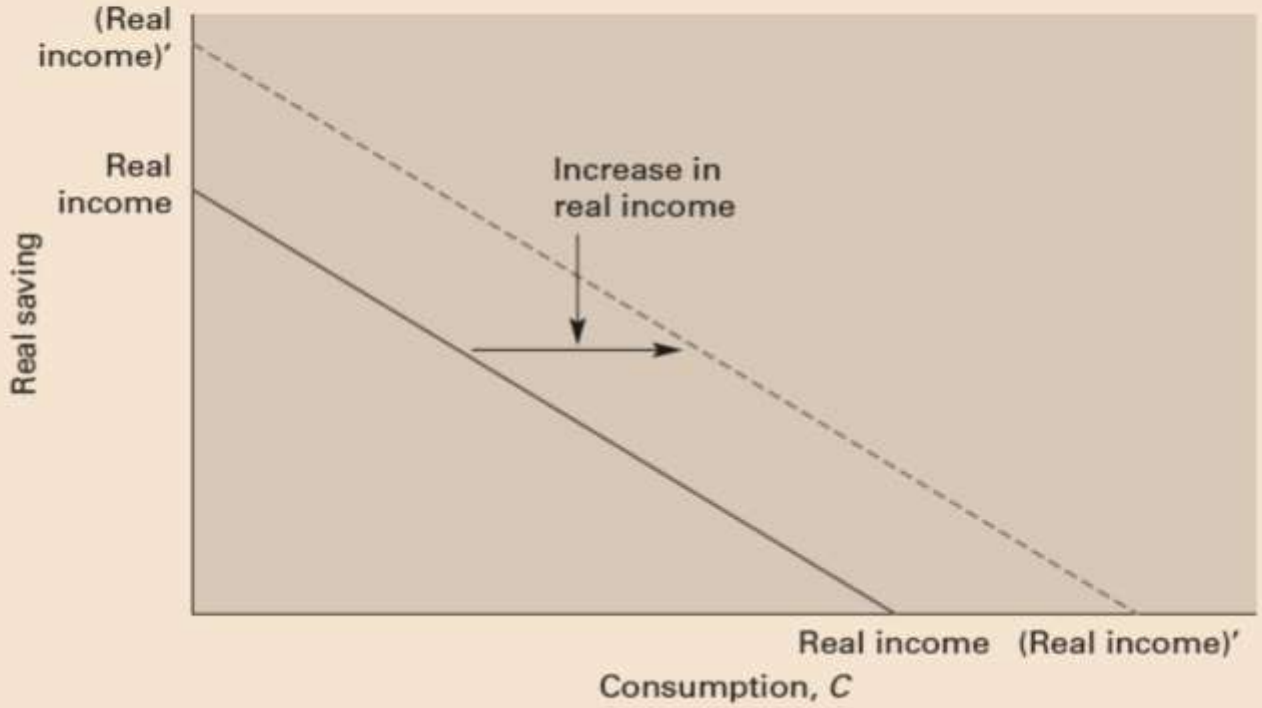
  That is:

  Consumption + Real saving = Real income

Constructing the Budget Constraint

Figure 7.3 Effect of an increase in real income on the household budget constraint

If household real income, $\Pi/P + (w/P) \bullet L + i \bullet (B/P + K)$, rises, the budget line moves outward from the solid line to the dashed line. That is, in the graph, (real income)′ is larger than (real income). In comparison with the solid line, the dashed line allows the household to have more consumption, C, for any given value of real saving, $(1/P) \bullet \Delta B + \Delta K$. Since households like more consumption, they prefer more real income to less.



Clearing of the Markets for labor and Capital Services

- Profit Maximization
  - Nominal Profit
    - $\pi = PA \cdot F(K^d, L^d) - (wL^d + RK^d)$
  - Real Profit
    - $\pi/P = A \cdot F(K^d, L^d) - (w/P) \cdot L^d - (R/P) \cdot K^d$

      =output −real wage payments−real rental payments

Clearing of the Markets for labor and Capital Services

- The labor Market
  - Demand for labor
    - $\Delta(\pi/P) = \Delta[A \cdot F(K^d, L^d)] - w/P = MPL - w/P$
      (对L^d求偏导) change in real profit
      = marginal product of labor− real wage rate
    - Household demand L^d , so that $MPL - w/P = 0$.
    - If w/P decreases, MPL also decreases which implies L^d increases, so a downward sloping labor demand curve.

Clearing of the Markets for labor and Capital Services

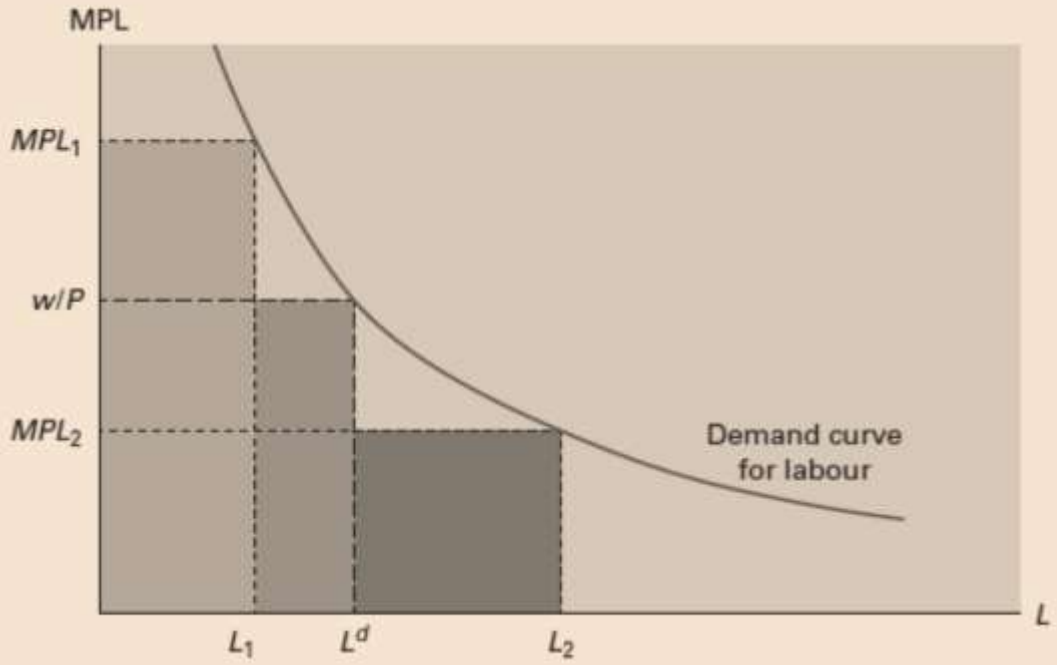


Figure 7.4 Labour demand

For a given technology level, A, and capital input, K^d, the marginal product of labour, MPL, decreases as labour input, L, increases. Therefore, the MPL, given by the downward-sloping curve, declines on the vertical axis as L rises on the horizontal axis. The household chooses labour input, L^d, where the MPL equals the real wage rate, w/P. At a lower labour input, such as L_1, MPL_1 is greater than w/P, and at a higher labour input, such as L_2, MPL_2 is less than w/P. If w/P decreases, L^d increases.

Clearing of the Markets for labor and Capital Services

- Supply of labor
  - We are assuming the aggregate or market supply of labor, L^s, is the given amount L.

Clearing of the Markets for labor and Capital Services

- Clearing of the labor market
  - w/P is determined to equate the aggregate quantity of labor demanded, L^d, to the aggregate quantity supplied, L.
  - (w/P)* = *MPL* (evaluated at L)

Clearing of the Markets for labor and Capital Services

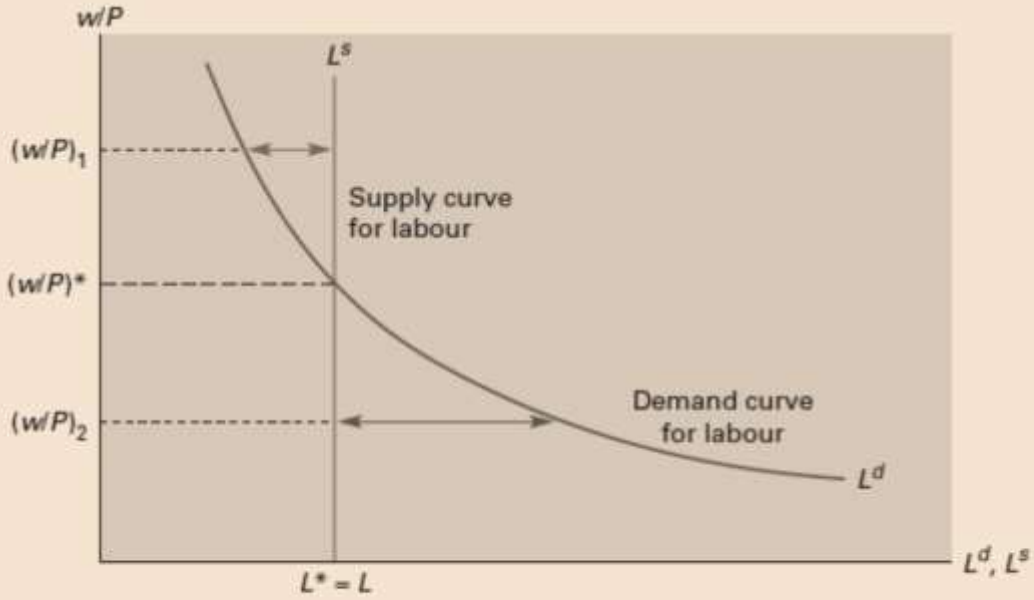


Figure 7.5 Clearing of the labour market

The downward-sloping labour-demand curve, L^d, comes from Figure 7.4. We assume that labour supply, L^s, is fixed at L. The market-clearing real wage rate is $(w/P)^*$. The market-clearing quantity of labour input is $L^* = L$. At a higher real wage rate, such as $(w/P)_1$, the quantity of labour supplied, L^s, exceeds the quantity demanded, L^d, in the amount shown by the upper arrows. At a lower real wage rate, such as $(w/P)_2$, the quantity of labour supplied, L^s, falls short of the quantity demanded, L^d, in the amount shown by the lower arrows.

[4]Note that the curve for MPL in Figure 7.4 applies for a given capital stock, K. A change in K would shift the MPL associated with a given value of L^d and would therefore change $(w/P)^*$ in Figure 7.5.

Clearing of the Markets for labor and Capital Services

- The Market for Capital Services
  - Demand for capital services
    - $\Delta(\pi/P) = \Delta[A \cdot F(K^d, L^d)] - R/P = MPK - R/P$
      (对K^d求偏导) change in real profit=
      marginal product of capital− real rental price
    - Capital demanded K^d , so that $MPK - R/P = 0$.
    - If R/P decreases, MPK also decreases, implying K^d increases, so a downward sloping capital demand curve

Clearing of the Markets for labor and Capital Services

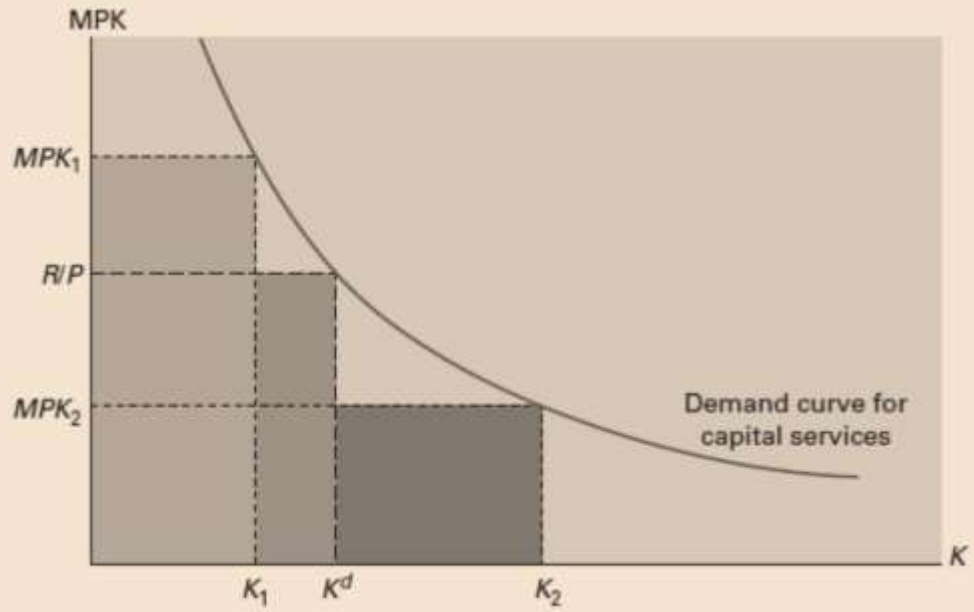


Figure 7.6 Demand for capital services

For a given technology level, A, and labour input, L^d, the marginal product of capital, MPK, decreases as capital input, K, increases. Therefore, the MPK, given by the downward-sloping curve, declines on the vertical axis as K rises on the horizontal axis. The household chooses capital input, K^d, where the MPK equals the real rental price, R/P. In contrast, at a lower capital input, such as K_1, MPK_1 is greater than R/P, and at a higher capital input, such as K_2, MPK_2 is less than R/P. If R/P decreases, K^d increases.

Clearing of the Markets for labor and Capital Services

- The Market for Capital Services
  - Supply of capital services
    - For the economy as a whole, the aggregate quantity of capital, K, is given from past flows of investment.
    - In the short run, the aggregate or market quantity of capital services supplied, K^s, equals K.

Clearing of the Markets for labor and Capital Services

- The Market for Capital Services
  - Clearing of the market for capital services
    - *R/P* will be determined to clear the market—that is, so that the aggregate quantity of capital services supplied, *K*, equals the aggregate quantity demanded, K^d
    - $(R/P)^* = MPK$(evaluated at *K*)

Clearing of the Markets for labor and Capital Services

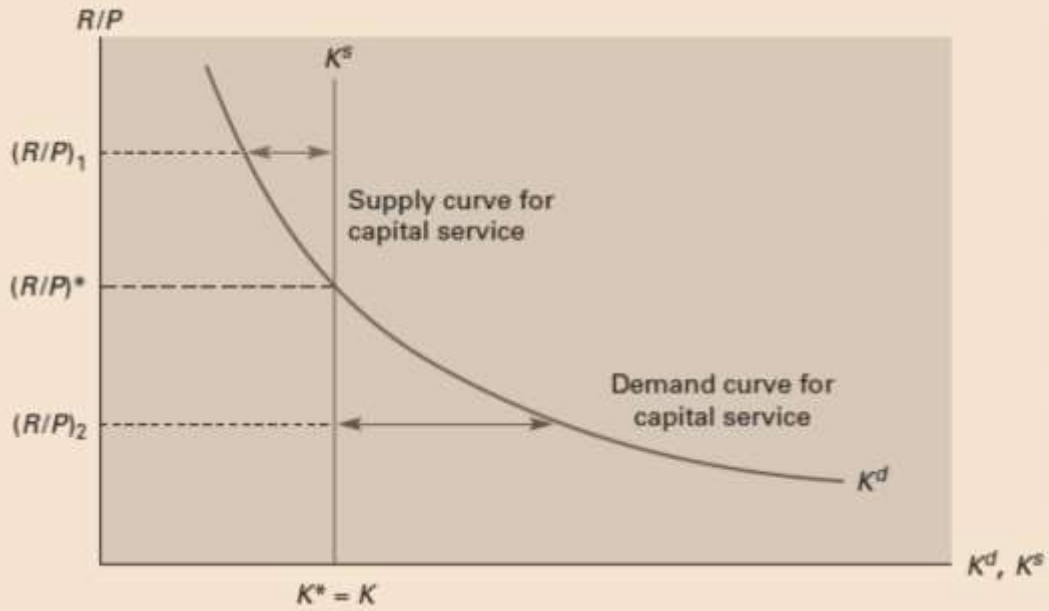


Figure 7.7 Clearing of the market for capital services

The downward-sloping demand curve for capital services, K^d, comes from Figure 7.6. The supply of capital services, K^s, is fixed at K. The market-clearing real rental price is $(R/P)^*$. The market-clearing quantity of capital services is $K^* = K$. At a higher real rental price, such as $(R/P)_1$, the quantity of capital services supplied, $K^s = K$, exceeds the quantity demanded, K^d, in the amount shown by the upper arrows. At a lower real rental price, such as $(R/P)_2$, the quantity of capital services supplied, $K^s = K$, falls short of the quantity demanded, K^d, in the amount shown by the lower arrows.

Clearing of the Markets for labor and Capital Services

- Profit in Equilibrium

$\pi/P = A \cdot F(K,L) - (w/P) \cdot L - (R/P) \cdot K$

At equilibrium:

$w/P = MPL$

$R/P = MPK$

So: $\pi/P = A \cdot F(K, L) - MPL \cdot L - MPK \cdot K$