

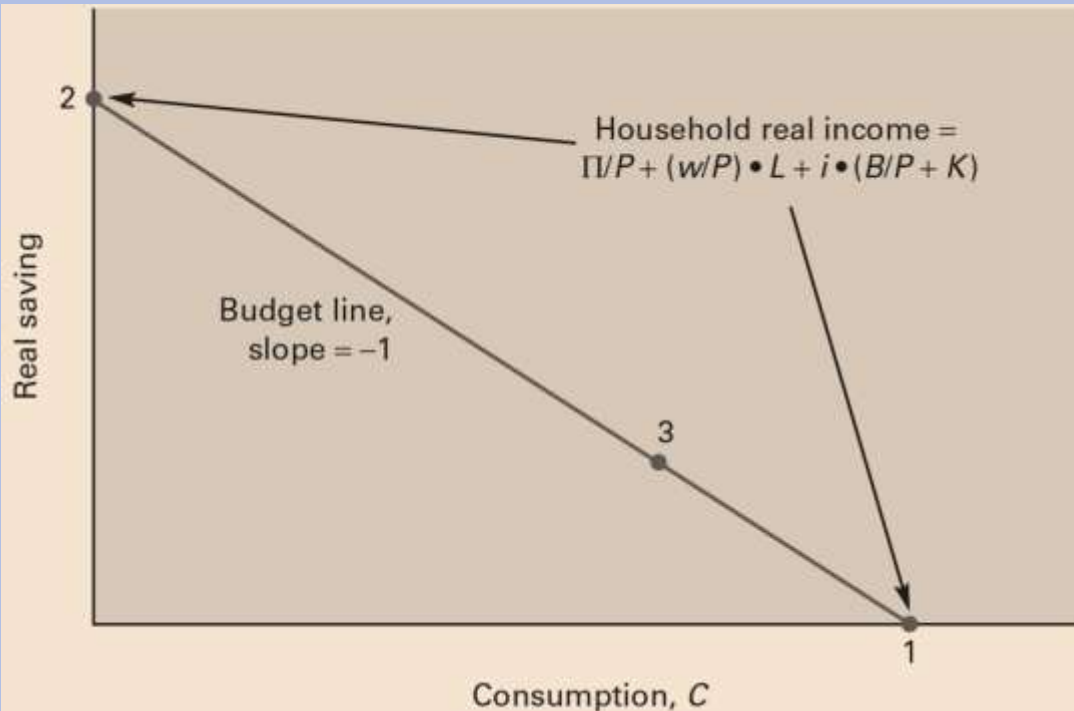


# Consumption, Saving and Investment

# Consumption and Saving

- Household budget constraint
  - consumption+ real saving = real income
$$C + (1/P) \cdot \Delta B + \Delta K = \pi/P + (w/P) \cdot L + i \cdot (B/P + K)$$
  - 假定： $\pi/P = 0$  (经济学利润=0),  
则： $C + (1/P) \cdot \Delta B + \Delta K = (w/P) \cdot L + i \cdot (B/P + K)$

# Consumption and Saving

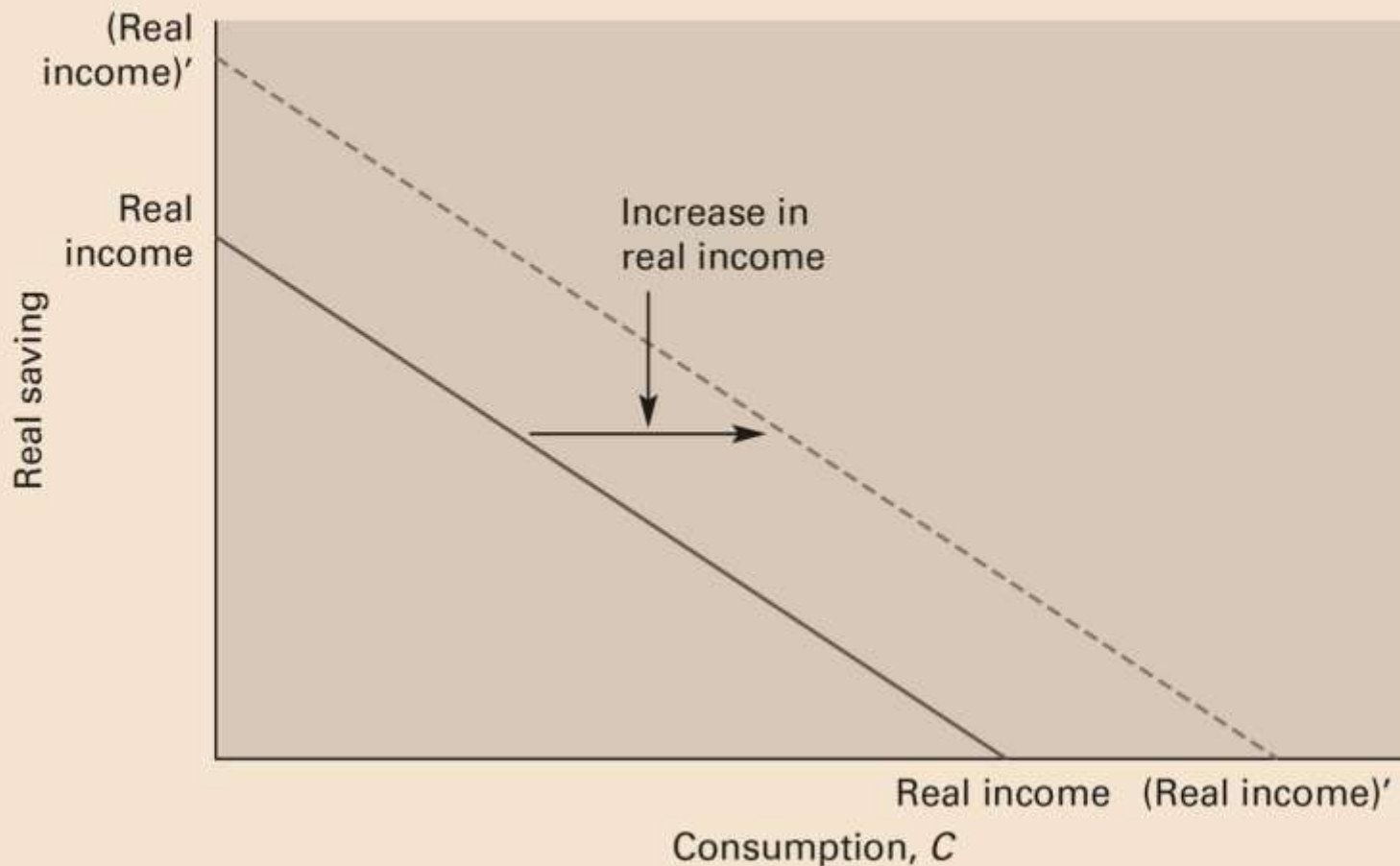


**Figure 7.2** The household budget constraint

Households have a given total of real income,  $\Pi/P + (w/P) \cdot L + i \cdot (B/P + K)$ . This total must be divided between consumption,  $C$ , and real saving,  $(1/P) \cdot \Delta B + \Delta K$ . Thus, if real saving is zero,  $C$  equals the total of real income along the horizontal axis at point 1. If  $C$  is zero, real saving equals the total of real income along the vertical axis at point 2. The budget constraint in equation (7.12) allows the household to select any combination of consumption and real saving along the budget line such as point 3. The budget line has a slope of -1. Therefore, along this line, one unit less of consumption corresponds to one unit more of real saving.

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

If household real income,  $\Pi/P + (w/P) \cdot L + i \cdot (B/P + K)$ , 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,  $(1/P) \cdot \Delta B + \Delta K$ . Since households like more consumption, they prefer more real income to less.



# Consumption and Saving

- Consumption Over Two Years

- Year<sub>1</sub>

- $C_1 + (B_1/P + K_1) - (B_0/P + K_0) = (w/P)_1 \cdot L + i_0 \cdot (B_0/P + K_0)$
    - consumption in year 1 + real saving in year 1 = real income in year 1

- Year<sub>2</sub>

- $C_2 + (B_2/P + K_2) - (B_1/P + K_1) = (w/P)_2 \cdot L + i_1 \cdot (B_1/P + K_1)$
    - consumption in year 2 + real saving in year 2 = real income in year 2

# Consumption and Saving

- Consumption Over Two Years
  - Combine the budget constraints to describe a household's choice between consuming this year,  $C_1$ , and next year,  $C_2$ .
  - From year 1 budget constraint:

$$B_1/P + K_1 = (1 + i_0) \cdot (B_0/P + K_0) + (w/P)_1 \cdot L - C_1$$

*Real assets end year<sub>1</sub>*

*= principle and interest of real assets end year<sub>0</sub>*

*+ real labor income year<sub>1</sub> - consumption year<sub>1</sub>*

# Consumption and Saving

- 复习: Present value
  - If the interest rate,  $i_1$ , is greater than zero, 1 unit currency received or spent in year 1 is equivalent to more than 1 unit in year 2.
  - Currency units received or spent in year 2 must be **discounted** to make them comparable to currency in year 1.
  - The term  $1+i_1$  is called a **discount factor**.

# Consumption and Saving

- Consumption Over Two Years

- $$B_1/P + K_1 = (1+i_0) \cdot (B_0/P + K_0) + (w/P)_1 \cdot L - C_1$$

- $$B_2/P + K_2 = (1+i_1) \cdot (B_1/P + K_1) + (w/P)_2 \cdot L - C_2$$

$$\rightarrow B_2/P + K_2 = (1+i_1) \cdot [(1+i_0) \cdot (B_0/P + K_0) + (w/P)_1 \cdot L - C_1]$$

$$+ (w/P)_2 \cdot L - C_2$$

$$\rightarrow B_2/P + K_2 = (1+i_1) \cdot (1+i_0) \cdot (B_0/P + K_0) + (1+i_1) \cdot (w/P)_1 \cdot L - (1+i_1) \cdot C_1 + (w/P)_2 \cdot L - C_2$$

$$C_1 + C_2/(1+i_1) = (1+i_0) \cdot (B_0/P + K_0) + (w/P)_1 \cdot L$$

$$+ (w/P)_2 \cdot L / (1+i_1) - (B_2/P + K_2) / (1+i_1)$$



# Consumption and Saving

- Choosing consumption: **income effects**
  - Household chooses the time path of consumption—in this case,  $C_1$  and  $C_2$ —to maximize utility, subject to the budget constraint.

# Consumption and Saving

- $$C_1 + C_2/(1+i_1) = (1+i_0) \cdot (B_0/P+K_0) + (w/P)_1 \cdot L + (w/P)_2 \cdot L/(1+i_1) - (B_2/P+K_2)/(1+i_1)$$

*pv of consumption = value of initial assets + pv of wage incomes – pv of assets end year 2*

- $(B_2/P+K_2)/(1+i_1)$  : 财富存量, is going to be carried into the year 3, which cannot be consumed.

# Consumption and Saving

- Choosing consumption: income effects
  - For simplicity, we set a notation

$$V = (1 + i_0) \cdot (B_0/P + K_0) + (w/P)_1 \cdot L + (w/P)_2 \cdot L / (1 + i_1)$$

*p.v. of sources of funds = value of initial assets +  
p.v. of wage incomes*

# Consumption and Saving

- Choosing consumption: income effects
  - $C_1 + C_2/(1+i_1) = V - (B_2/P + K_2)/(1+i_1)$
  - *p.v. of consumption = p.v. of sources of funds*
    - *p.v. of assets end year 2*

# Consumption and Saving

- Choosing consumption: income effects
  - Suppose that  $V$  increases due to a rise in initial assets,  $(B_0/P + K_0)$ , or wage incomes,  $(w/P)_1 \cdot L$ ,  $(w/P)_2 \cdot L$ .
  - Since we are holding fixed the term  $(B_2/P + K_2)/(1 + i_1)$ , the total present value of consumption,  $C_1 + C_2/(1 + i_1)$ , must rise by the same amount as  $V$ .
  - Since households like to consume at similar levels in the two years (smooth consumption assumption), we predict that  $C_1$  and  $C_2$  will rise by similar amounts.
  - These responses of consumption to increases in initial assets or wage incomes are called **income effects**.

# Smooth Consumption

- smooth consumption: 消费平滑性
- permanent income hypothesis: 持久收入假说
- 莫迪利亚尼 (Modigliani) 及弗里德曼 (Friedmann) 提出的生命周期/持久收入假说。
- 认为：个人会将自己一生的财富资源均等地在他生命中的每一期进行分配，即在给定的一个时期里，个人的消费不是由当期收入决定，而是由个人一生的劳动收入和初始财富所决定。
- 如果持久收入假说成立，那么消费支出的变化就完全由消费者劳动收入的变化所决定，相应的增加消费支出就必须从提高居民的（持久）收入水平入手。

# Consumption and Saving

- Choosing consumption: **the intertemporal-substitution effect.**
  - A higher  $i_1$  provides a greater reward for deferring consumption. Therefore, the household responds to an increase in  $i_1$  by lowering  $C_1$  and raising  $C_2$ .
  - This response is called the **intertemporal-substitution effect(跨期替代效用)**.

# Consumption and Saving

- So that this year's consumption,  $C_1$ , falls on the left-hand side in the year 1's budget constraint.

$$C_1 + (B_1/P + K_1) - (B_0/P + K_0) = (w/P)_1 \cdot L + i_0 \cdot (B_0/P + K_0)$$



# Consumption and Saving

- Since year 1's real income,  $(w/P)_1 \cdot L + i_0 \cdot (B_0/P + K_0)$  on the right-hand side is given, the decline in  $C_1$  must be matched by a rise in year 1's real saving,  $(B_1/P + K_1) - (B_0/P + K_0)$ .
- The intertemporal-substitution effect motivates the household to save more when the interest rate rises.

# Consumption and Saving

- A higher  $i_1$  provides also income effect.
- For year 2's budget constraint:

$$C_2 + (B_2/P + K_2) - (B_1/P + K_1) = (w/P)_2 \cdot L + i_1 \cdot (B_1/P + K_1)$$

- The income effect from  $i_1$  in the item:  
[ $i_1 \cdot (B_1/P + K_1)$ ]

# Consumption and Saving

- Combining income & intertemporal substitution effects
  - The effect of an increase in the interest rate,  $i_1$ , on consumption,  $C_1$  and  $C_2$ 
    - The intertemporal substitution effect motivates the household to reduce  $C_1$  and increase  $C_2$
    - An increase in  $i_1$  also has a positive income effect, motivating household to raise  $C_2$

# Consumption and Saving

- Consumption Over Many Years
  - Two-year budget constraint
    - $C_1 + C_2/(1+i_1) = (1+i_0) \cdot (B_0/P + K_0) + (w/P)_1 \cdot L + (w/P)_2 \cdot L/(1+i_1) - (B_2/P + K_2)/(1+i_1)$

# Consumption and Saving

- Consumption and income in future years.
  - overall present value of consumption
$$C_1 + C_2/(1 + i_1) + C_3/[(1 + i_1) \cdot (1 + i_2)] + \dots$$
  - overall present value of wage income
$$(w/P)_1 \cdot L + (w/P)_2 \cdot L/(1 + i_1) + (w/P)_2 \cdot L/[(1 + i_1) \cdot (1 + i_2)] + \dots$$

# Consumption and Saving

– Multiyear budget constraint:

$$\begin{aligned} & \bullet C_1 + C_2/(1 + i_1) + C_3/[(1 + i_1) \cdot (1 + i_2)] + \dots = \\ & (1 + i_0) \cdot (B_0/P + K_0) + \\ & (w/P)_1 \cdot L + (w/P)_2 \cdot L/(1 + i_1) + \\ & (w/P)_3 \cdot L/[(1 + i_1) \cdot (1 + i_2)] + \dots \end{aligned}$$

– Originally the last term in the two-year constraint,  $(B_2/P + K_2)/(1 + i_1)$ , becomes the present value of assets held in the distant future as  $(B_n/P + K_n)/[(1 + i_1) \cdot (1 + i_2) \cdot \dots \cdot (1 + i_n)]$ . Because of the discounting used to calculate the PV, we can neglect this trivial term

# Consumption and Saving

- Consumption Over Many Years
  - Multi-Year budget constraint allows the **comparison** of the effects of **temporary** and **permanent changes in income**.

# Consumption and Saving

- Temporary change in income
  - We predict that the household would respond to a rise in  $(w/P)_1 \cdot L$  by raising consumption by similar amounts in each year:  $C_1$ ,  $C_2$ ,  $C_3$ , and so on.
  - This response means, however, that consumption in any particular year, such as year 1, cannot increase very much.
  - Therefore, if  $(w/P)_1 \cdot L$  rises by one unit, we predict that  $C_1$  increases by much less than one unit. To put it another way, the propensity to consume in year 1 out of an extra unit of year 1's income tends to be small when the extra income is temporary.



# Consumption and Saving

- Year 1's real saving,  $(B_1/P + K_1) - (B_0/P + K_0)$ , must rise by nearly one unit on the left-hand side.
- The **propensity to save** in year 1 out of an extra unit of year 1's income is nearly one when the extra income is temporary, since additional assets are needed to provide for the planned increases in consumption in future years,  $C_1$ ,  $C_2$ ,  $C_3$ , and so on.

# Consumption and Saving

- Permanent increase in wage income
  - $(w/P)_1 \cdot L$ ,  $(w/P)_2 \cdot L$ ,  $(w/P)_3 \cdot L$ , and so on, each rise by one unit.
  - It would be possible for the household to respond by increasing consumption by one unit in each year.

# Consumption and Saving

- The prediction is that the propensity to consume out of an extra unit of year 1's income would be high—close to one—when the extra income is permanent.
- The propensity to save in year 1 out of an extra unit of year 1's income is small when the extra income is permanent.
- **permanent income hypothesis: 持久收入假说:** Consumption depends on a long-term average of incomes—which Milton Friedman called permanent income—rather than current income.

# Consumption, Saving and Investment in Equilibrium

- Determine the aggregate quantities of consumption and saving.
- Determine the aggregate quantity of investment.

# Consumption, Saving and Investment in Equilibrium

- Budget Constraint

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

Where,  $i = (R/P - \delta)$ , so

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

- **$B = 0$  and  $\Delta B = 0$** : when the bond market clears, households in the aggregate hold at a zero quantity of bonds. （实际上假定没有金融市场了）

# Consumption, Saving and Investment in Equilibrium

- Budget Constraint

- $C + \Delta K = (w/P) \cdot L + (R/P) \cdot K - \delta K$

Where, in equilibrium as in the last lecture,  
 $(w/P) \cdot L + (R/P) \cdot K = Y$  (Real GDP), so

- $C + \Delta K = Y - \delta K$

*Consumption + net investment*  
*= real GDP – depreciation*  
*= real net domestic product*

# Consumption, Saving and Investment in Equilibrium

- The left-hand side of the equation implies that the economy's net investment,  $\Delta K$ , is determined by households' choices of consumption,  $C$ .
- Given the real net domestic product, one unit more of consumption,  $C$ , means one unit less of net investment,  $\Delta K$ .
- This choice of  $C$  determines  $\Delta K$