Chapter 4

Consumption, Saving, and Investment
Chapter Outline

• Consumption and Saving
• Investment
• Goods Market Equilibrium
Consumption and Saving

• The importance of consumption and saving
  – Desired consumption: consumption amount desired by households
  – Desired national saving: level of national saving when consumption is at its desired level:

\[ S^d = Y - C^d - G \]  

(4.1)
Consumption and Saving

• The consumption and saving decision of an individual
  – A person can consume less than current income (saving is positive)
  – A person can consume more than current income (saving is negative)
Consumption and Saving

• The consumption and saving decision of an individual
  – Trade-off between current consumption and future consumption
    • The price of 1 unit of current consumption is 1 + r units of future consumption, where r is the real interest rate
    • Consumption-smoothing motive: the desire to have a relatively even pattern of consumption over time
Consumption and Saving

- Effect of changes in current income
  - Increase in current income: both consumption and saving increase (vice versa for decrease in current income)
  - Marginal propensity to consume \((MPC)\) = fraction of additional current income consumed in current period; between 0 and 1
  - Aggregate level: When current income \((Y)\) rises, \(C^d\) rises, but not by as much as \(Y\), so \(S^d\) rises
Consumption and Saving

• Effect of changes in expected future income
  – Higher expected future income leads to more consumption today, so saving falls
Consumption and Saving

• Application: consumer sentiment and forecasts of consumer spending
  – Do consumer sentiment indexes help economists forecast consumer spending?
  – Data do not seem to give much warning before recessions (Fig. 4.1)
Figure 4.1 University of Michigan Index of Consumer Sentiment, January 1978—December 2005
Consumption and Saving

• Application: consumer sentiment and forecasts of consumer spending
  – Data on consumer spending are correlated with data on consumer confidence (Fig. 4.2)
Figure 4.2 University of Michigan Index of Consumer Sentiment and Consumption Spending January 1978—December 2005
Consumption and Saving

• Application: consumer sentiment and forecasts of consumer spending
  – Data on consumer spending are correlated with data on consumer confidence (Fig. 4.2)
  – But formal statistical analysis shows that data on consumer confidence do not improve forecasts of consumer spending based on other macro data
Consumption and Saving

• Effect of changes in wealth
  – Increase in wealth raises current consumption, so lowers current saving
Consumption and Saving

• Effect of changes in real interest rate
  – Increased real interest rate has two opposing effects
    • Substitution effect: Positive effect on saving, since rate of return is higher; greater reward for saving elicits more saving
    • Income effect
      – For a saver: Negative effect on saving, since it takes less saving to obtain a given amount in the future (target saving)
      – For a borrower: Positive effect on saving, since the higher real interest rate means a loss of wealth
  • Empirical studies have mixed results; probably a slight increase in aggregate saving
Consumption and Saving

- Effect of changes in real interest rate
  - Taxes and the real return to saving
    - Expected after-tax real interest rate:
      \[ r_{a-t} = (1 - t)i - \pi^e \]  
(4.2)
Table 4.1 Calculating After-Tax Interest Rates

\[ i = \text{nominal interest rate} = 5\% \text{ per year} \]
\[ \pi^e = \text{expected inflation rate} = 2\% \text{ per year} \]

Example 1
\[ t = \text{tax rate on interest income} = 30\% \]
After-tax nominal interest rate \[= (1 - t)i = (1 - 0.30)5\% = 3.5\% \]
Expected after-tax real interest rate \[= (1 - t)i - \pi^e = (1 - 0.30)5\% - 2\% = 1.5\% \]

Example 2
\[ t = \text{tax rate on interest income} = 20\% \]
After-tax nominal interest rate \[= (1 - t)i = (1 - 0.20)5\% = 4\% \]
Expected after-tax real interest rate \[= (1 - t)i - \pi^e = (1 - 0.20)5\% - 2\% = 2\% \]
Consumption and Saving

• In touch with the macroeconomy: interest rates
  – Discusses different interest rates, default risk, term structure (yield curve), and tax status
  – Since interest rates often move together, we frequently refer to “the” interest rate
  – Yield curve: relationship between life of a bond and the interest rate it pays
In Touch Yield Curve

![Graph showing yield curve comparison between current and a year earlier.](image)

- **CURRENT**
- **YEAR EARLIER**

Interest rate (percent per year) vs. Maturity (3 months, 6 months, 10 years, 20 years)

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Consumption and Saving

• Fiscal policy
  – Affects desired consumption through changes in current and expected future income
  – Directly affects desired national saving,
    \[ S^d = Y - C^d - G \]
Consumption and Saving

• Fiscal policy
  – Government purchases (temporary increase)
    • Higher $G$ financed by higher current taxes reduces after-tax income, lowering desired consumption
    • Even true if financed by higher future taxes, if people realize how future incomes are affected
    • Since $C^d$ declines less than $G$ rises, national saving ($S^d = Y - C^d - G$) declines
    • So government purchases reduce both desired consumption and desired national saving
Consumption and Saving

• Fiscal policy
  – Taxes
    • Lump-sum tax cut today, financed by higher future taxes
    • Decline in future income may offset increase in current income; desired consumption could rise or fall
Consumption and Saving

• Fiscal policy
  – Taxes
    • Ricardian equivalence proposition
      – If future income loss exactly offsets current income gain, no change in consumption
      – Tax change affects only the timing of taxes, not their ultimate amount (present value)
      – In practice, people may not see that future taxes will rise if taxes are cut today; then a tax cut leads to increased desired consumption and reduced desired national saving
Consumption and Saving

• Application: a Ricardian tax cut?
  – The Economic Growth and Tax Relief Reconstruction Act (EGTRRA) of 2001 gave rebate checks to taxpayers and cut tax rates substantially
  – From the first quarter to the third quarter, government saving fell $277 billion (at an annual rate) but private saving increased $180 billion, so national saving declined only $97 billion, so about 2/3 of the tax cut was saved
Consumption and Saving

• Application: a Ricardian tax cut?
  – Most consumers saved their tax rebates and did not spend them
  – As a result, the tax rebate and tax cut did not stimulate much additional spending by households
### Summary 5

#### Determinants of Desired National Saving

<table>
<thead>
<tr>
<th>An increase in</th>
<th>Causes desired national saving to</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current output, $Y$</td>
<td>Rise</td>
<td>Part of the extra income is saved to provide for future consumption.</td>
</tr>
<tr>
<td>Expected future output</td>
<td>Fall</td>
<td>Anticipation of future income raises current desired consumption, lowering current desired saving.</td>
</tr>
<tr>
<td>Wealth</td>
<td>Fall</td>
<td>Some of the extra wealth is consumed, which reduces saving for given income.</td>
</tr>
<tr>
<td>Expected real interest rate, $r$</td>
<td>Probably rise</td>
<td>An increased return makes saving more attractive, probably outweighing the fact that less must be saved to reach a specific savings target.</td>
</tr>
<tr>
<td>Government purchases, $G$</td>
<td>Fall</td>
<td>Higher government purchases directly lower desired national saving.</td>
</tr>
<tr>
<td>Taxes, $T$</td>
<td>Remain unchanged or rise</td>
<td>Saving doesn’t change if consumers take into account an offsetting future tax cut; saving rises if consumers don’t take into account a future tax cut and thus reduce current consumption.</td>
</tr>
</tbody>
</table>
Investment

• Why is investment important?
  – Investment fluctuates sharply over the business cycle, so we need to understand investment to understand the business cycle
  – Investment plays a crucial role in economic growth
Investment

• The desired capital stock
  – Desired capital stock is the amount of capital that allows firms to earn the largest expected profit
  – Desired capital stock depends on costs and benefits of additional capital
  – Since investment becomes capital stock with a lag, the benefit of investment is the future marginal product of capital ($MPK^f$)
Investment

• The desired capital stock
  – The user cost of capital
    • Example of Kyle’s Bakery: cost of capital, depreciation rate, and expected real interest rate
    • User cost of capital = real cost of using a unit of capital for a specified period of time = real interest cost + depreciation

\[ uc = rp_K + dp_K = (r + d)p_K \] (4.3)
Investment

• The desired capital stock
  – Determining the desired capital stock (Fig. 4.3)
Figure 4.3 Determination of the desired capital stock

The desired capital stock, 5000 cubic feet, sets $MPK^f$ equal to $uc$. 

$MPK^f$ 

Expected future $MPK$, $MPK^f$, and user cost, $uc$ (dollars per cubic foot per year) 

Capital stock, $K$ (thousands of cubic feet of oven capacity)
Investment

- The desired capital stock
  - Desired capital stock is the level of capital stock at which $MPK_f = uc$
  - $MPK_f$ falls as $K$ rises due to diminishing marginal productivity
  - $uc$ doesn’t vary with $K$, so is a horizontal line
Investment

- The desired capital stock
  - If $MPK^f > uc$, profits rise as $K$ is added (marginal benefits > marginal costs)
  - If $MPK^f < uc$, profits rise as $K$ is reduced (marginal benefits < marginal costs)
  - Profits are maximized where $MPK^f = uc$
Investment

• Changes in the desired capital stock
  – Factors that shift the $MPK^f$ curve or change the user cost of capital cause the desired capital stock to change
  – These factors are changes in the real interest rate, depreciation rate, price of capital, or technological changes that affect the $MPK^f$ (Fig. 4.4 shows effect of change in $uc$; Fig. 4.5 shows effect of change in $MPK^f$)
Figure 4.4 A decline in the real interest rate raises the desired capital stock
Figure 4.5 An increase in the expected future MPK raises the desired capital stock.
Investment

• Changes in the desired capital stock
  – Taxes and the desired capital stock
    • With taxes, the return to capital is only \((1 - \tau) MPK_f\)
    • A firm chooses its desired capital stock so that the return equals the user cost, so
      \[(1 - \tau)MPK_f = uc\], which means:

\[
MPK_f^t = uc/(1 - \tau) = (r + d)p_K/(1 - \tau) \quad (4.4)
\]
Investment

• Changes in the desired capital stock
  – Taxes and the desired capital stock
    • Tax-adjusted user cost of capital is $uc/(1 – \tau)$
    • An increase in $\tau$ raises the tax-adjusted user cost and reduces the desired capital stock
Investment

• Changes in the desired capital stock
  – Taxes and the desired capital stock
    • In reality, there are complications to the tax-adjusted user cost
      – We assumed that firm revenues were taxed
        » In reality, profits, not revenues, are taxed
        » So depreciation allowances reduce the tax paid by firms, because they reduce profits
      – Investment tax credits reduce taxes when firms make new investments
Investment

- Changes in the desired capital stock
  - Taxes and the desired capital stock
    - In reality, there are complications to the tax-adjusted user cost
      - Summary measure: the effective tax rate—the tax rate on firm revenue that would have the same effect on the desired capital stock as do the actual provisions of the tax code
      - Table 4.2 shows effective tax rates for many different countries
Table 4.2 Effective Tax Rate on Capital, 2005

<table>
<thead>
<tr>
<th></th>
<th>ETR</th>
<th>I/GDP</th>
<th></th>
<th>ETR</th>
<th>I/GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia*</td>
<td>24.1</td>
<td>25.7</td>
<td>Korea (Rep. of)</td>
<td>30.8</td>
<td>30.1</td>
</tr>
<tr>
<td>Austria</td>
<td>19.4</td>
<td>21.2</td>
<td>Luxembourg</td>
<td>21.9</td>
<td>21.4</td>
</tr>
<tr>
<td>Belgium</td>
<td>21.4</td>
<td>21.4</td>
<td>Mexico*</td>
<td>16.7</td>
<td>22.0</td>
</tr>
<tr>
<td>Canada*</td>
<td>39.0</td>
<td>21.0</td>
<td>Netherlands</td>
<td>25.0</td>
<td>19.2</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>17.7</td>
<td>26.4</td>
<td>New Zealand*</td>
<td>29.3</td>
<td>24.6</td>
</tr>
<tr>
<td>Denmark</td>
<td>19.8</td>
<td>20.9</td>
<td>Norway</td>
<td>25.1</td>
<td>20.6</td>
</tr>
<tr>
<td>Finland</td>
<td>22.9</td>
<td>20.2</td>
<td>Poland*</td>
<td>20.2</td>
<td>20.0</td>
</tr>
<tr>
<td>France</td>
<td>33.3</td>
<td>20.2</td>
<td>Portugal</td>
<td>13.5</td>
<td>22.3</td>
</tr>
<tr>
<td>Germany</td>
<td>36.9</td>
<td>17.2</td>
<td>Slovak Republic*</td>
<td>9.1</td>
<td>25.3</td>
</tr>
<tr>
<td>Greece</td>
<td>29.3</td>
<td>23.8</td>
<td>Spain</td>
<td>27.3</td>
<td>29.7</td>
</tr>
<tr>
<td>Hungary</td>
<td>18.2</td>
<td>23.7</td>
<td>Sweden</td>
<td>12.1</td>
<td>17.1</td>
</tr>
<tr>
<td>Iceland</td>
<td>12.1</td>
<td>28.6</td>
<td>Switzerland*</td>
<td>17.0</td>
<td>20.4</td>
</tr>
<tr>
<td>Ireland*</td>
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<td>25.0</td>
<td>Turkey</td>
<td>6.4</td>
<td>24.8</td>
</tr>
<tr>
<td>Italy</td>
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<td>United Kingdom</td>
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<td>16.8</td>
</tr>
<tr>
<td>Japan*</td>
<td>33.6</td>
<td>22.7</td>
<td>United States*</td>
<td>37.7</td>
<td>19.2</td>
</tr>
</tbody>
</table>

Note: ETR is effective tax rate on capital in 2005, in percent. I/GDP is the ratio of gross capital formation to GDP, in percent, for 2005.
*For countries with an asterisk, the I/GDP is for 2004 because the OECD did not report 2005 data.
Investment

• Application: measuring the effects of taxes on investment
  – Do changes in the tax rate have a significant effect on investment?
  – A 1994 study by Cummins, Hubbard, and Hassett found that after major tax reforms, investment responded strongly; elasticity about −0.66 (of investment to user cost of capital)
Investment

- Box 4.1: investment and the stock market
  - Firms change investment in the same direction as the stock market: Tobin’s $q$ theory of investment
  - If market value > replacement cost, then firm should invest more
  - Tobin’s $q = \text{capital’s market value divided by its replacement cost}$
    - If $q < 1$, don’t invest
    - If $q > 1$, invest more
Investment

• Box 4.1: investment and the stock market
  – Stock price times number of shares equals firm’s market value, which equals value of firm’s capital
    • Formula: \( q = \frac{V}{p_K K} \), where \( V \) is stock market value of firm, \( K \) is firm’s capital, \( p_K \) is price of new capital
    • So \( p_K K \) is the replacement cost of firm’s capital stock
    • Stock market boom raises \( V \), causing \( q \) to rise, increasing investment
Investment

• Box 4.1: investment and the stock market
  – Data show general tendency of investment to rise when stock market rises; but relationship isn’t strong because many other things change at the same time
  – This theory is similar to text discussion
    • Higher $MPK^f$ increases future earnings of firm, so $V$ rises
    • A falling real interest rate also raises $V$ as people buy stocks instead of bonds
    • A decrease in the cost of capital, $p_K$, raises $q$
Investment

• From the desired capital stock to investment
  – The capital stock changes from two opposing channels
    • New capital increases the capital stock; this is gross investment
    • The capital stock depreciates, which reduces the capital stock
Investment

• From the desired capital stock to investment
  – Net investment = gross investment ($I$) minus depreciation:
    \[ K_{t+1} - K_t = I_t - dK_t \]  \hspace{1cm} (4.5)
    where net investment equals the change in the capital stock
  – Fig. 4.6 shows gross and net investment for the United States
Figure 4.6 Gross and net investment, 1929-2005
Investment

• From the desired capital stock to investment
  – Rewriting (4.5) gives \( I_t = K_{t+1} - K_t + dK_t \)
  – If firms can change their capital stocks in one period, then the desired capital stock (\( K^* \)) = \( K_{t+1} \)
  – So \( I_t = K^* - K_t + dK_t \) \( (4.6) \)
Investment

• From the desired capital stock to investment
  – Thus investment has two parts
    • Desired net increase in the capital stock over the year \((K^* - K_t)\)
    • Investment needed to replace depreciated capital \((dK_t)\)
Investment

• From the desired capital stock to investment
  – Lags and investment
    • Some capital can be constructed easily, but other capital may take years to put in place
    • So investment needed to reach the desired capital stock may be spread out over several years
Investment

• Investment in inventories and housing
  – Marginal product of capital and user cost also apply, as with equipment and structures
## Summary 6

### Determinants of Desired Investment

<table>
<thead>
<tr>
<th>An increase in</th>
<th>Causes desired investment to</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real interest rate, $r$</td>
<td>Fall</td>
<td>The user cost increases, which reduces desired capital stock.</td>
</tr>
<tr>
<td>Effective tax rate, $\tau$</td>
<td>Fall</td>
<td>The tax-adjusted user cost increases, which reduces desired capital stock.</td>
</tr>
<tr>
<td>Expected future $MPK$</td>
<td>Rise</td>
<td>The desired capital stock increases.</td>
</tr>
</tbody>
</table>
Goods Market Equilibrium

• The real interest rate adjusts to bring the goods market into equilibrium
  – \( Y = C^d + I^d + G \) (4.7)
    goods market equilibrium condition
  – Differs from income-expenditure identity, as goods market equilibrium condition need not hold; undesired goods may be produced, so goods market won’t be in equilibrium
Goods Market Equilibrium

• Alternative representation: since
• $S^d = Y - C^d - G,$
• $S^d = I^d$  \hspace{1cm} (4.8)
Goods Market Equilibrium

- The saving-investment diagram
- Plot $S^d$ vs. $I^d$ (Key Diagram 3; text Fig. 4.7)
Figure 4.7 Goods market equilibrium
Goods Market Equilibrium

- The saving-investment diagram
  - Equilibrium where $S^d = I^d$
  - How to reach equilibrium? Adjustment of $r$
  - See text example (Table 4.3)
Table 4.3 Components of Aggregate Demand for Goods (An Example)

<table>
<thead>
<tr>
<th>Real Interest Rate, $r$</th>
<th>Output, $Y$</th>
<th>Desired Consumption, $C^d$</th>
<th>Desired Investment, $I^d$</th>
<th>Government Purchases, $G$</th>
<th>Desired National Saving, $S^d = Y - C^d - G$</th>
<th>Aggregate Demand for Goods, $C^d + I^d + G$</th>
</tr>
</thead>
<tbody>
<tr>
<td>3%</td>
<td>4500</td>
<td>2150</td>
<td>1500</td>
<td>1500</td>
<td>850</td>
<td>5150</td>
</tr>
<tr>
<td>6%</td>
<td>4500</td>
<td>2000</td>
<td>1000</td>
<td>1500</td>
<td>1000</td>
<td>4500</td>
</tr>
</tbody>
</table>
Goods Market Equilibrium

• Shifts of the saving curve
  – Saving curve shifts right due to a rise in current output, a fall in expected future output, a fall in wealth, a fall in government purchases, a rise in taxes (unless Ricardian equivalence holds, in which case tax changes have no effect)
  – Example: Temporary increase in government purchases shifts S left
  – Result of lower savings: higher $r$, causing crowding out of $I$ (Fig. 4.8)
Figure 4.8 A decline in desired saving

Desired national saving, $S^d$, and desired investment, $I^d$
Goods Market Equilibrium

• Shifts of the investment curve
  – Investment curve shifts right due to a fall in the effective tax rate or a rise in expected future marginal productivity of capital
  – Result of increased investment: higher $r$, higher $S$ and $I$ (Fig. 4.9)
Figure 4.9 An increase in desired investment
Goods Market Equilibrium

- Application: Macroeconomic consequences of the boom and bust in stock prices
  - Sharp changes in stock prices affect consumption spending (a wealth effect) and capital investment (via Tobin’s q)
  - Data in Fig. 4.10
Figure 4.10 Real U.S. stock prices and the ratio of consumption to GDP, 1987-2005
Goods Market Equilibrium

• The boom and bust in stock prices
  – Consumption and the 1987 crash
    • When the stock market crashed in 1987, wealth declined by about $1 trillion
    • Consumption fell somewhat less than might be expected, and it wasn’t enough to cause a recession
    • There was a temporary decline in confidence about the future, but it was quickly reversed
    • The small response may have been because there had been a large run-up in stock prices between December 1986 and August 1987, so the crash mostly erased this run-up
Goods Market Equilibrium

• The boom and bust in stock prices
  – Consumption and the rise in stock market wealth in the 1990s
    • Stock prices more than tripled in real terms
    • But consumption was not strongly affected by the runup in stock prices
Goods Market Equilibrium

• The boom and bust in stock prices
  – Consumption and the decline in stock prices in the early 2000s
    • In the early 2000s, wealth in stocks declined by about $5 trillion
    • But consumption spending increased as a share of GDP in that period
Goods Market Equilibrium

• The boom and bust in stock prices
  – Investment and Tobin’s $q$
    • Investment and Tobin’s $q$ were not closely correlated following the 1987 crash in stock prices
    • But the relationship has been tighter in the 1990s and early 2000s, as theory suggests (Fig. 4.11)
Figure 4.11 Investment and Tobin’s $q$, 1987-2005

The graph shows the investment in trillions of chained 2000 dollars and Tobin’s $q$ over the years 1987 to 2005. The investment and Tobin’s $q$ fluctuate over the years, with investment generally increasing and Tobin’s $q$ showing more variation.
Key Diagram 3 The saving–investment diagram