# Consumption, Saving, and Investment

*ECON202 Macroeconomics — UG-I, 2025: Semester III*

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## Sections Covered

| § | Topic |
|---|---|
| 4-1 | Consumption and Saving |
| 4-2 | Investment |
| 4-3 | Goods Market Equilibrium |



## Learning Objectives

1. Describe the factors that affect consumption and saving decisions (Sec. 4.1: Consumption and Saving)
2. Discuss the factors that affect the investment of firms (Sec. 4.2: Investment)
3. Explain the factors affecting goods market equilibrium (Sec. 4.3: Goods Market Equilibrium)

## How to Use Your Guided Notes

**The idea.** These are *skeleton notes* — equations, data, and numeric examples are already printed; the blanks are the **reasoning** (↑/↓, "less than", "crowded out"). You fill them in **as we go**, just like normal note-taking.

**Why.** It keeps you **proactive in class** — you think along and predict the answer instead of just copying.

**How to work along**




- **4-1 · Consumption and Saving**
- 4-2 · Investment
- 4-3 · Goods Market Equilibrium




## The Importance of Consumption and Saving



- **Desired consumption** ⇒ what households *plan* to consume (not actual)
- **Desired national saving** ⇒ national saving when $C$ is at its desired level

$$S^d = Y - C^d - G \quad (4.1)$$



## The Consumption and Saving Decision of an Individual



- Consume **less** than income ⇒ saving **positive**
- Consume **more** than income ⇒ saving **negative** (dissaving)

## Current versus Future Consumption



**Current ⇄ future consumption: a trade-off**

- Price of 1 unit today ⇒ $1 + r$ units of future consumption ($r$ = real interest rate)
- **Consumption-smoothing motive** ⇒ prefer an *even* consumption path over time



## Effect of Changes in Current Income



- Current income ↑ ⇒ consumption **and** saving both ↑ (↓ ⇒ both fall)
- **MPC** = share of extra income consumed ⇒ $0 < MPC < 1$
- Aggregate: income ↑ ⇒ $C^d$ ↑ (by less than $Y$) ⇒ $S^d$ ↑
- **Expected future income** ↑ ⇒ consumption ↑ today ⇒ saving ↓



## The Keynesian Consumption Function



**The Keynesian consumption function is given by:**

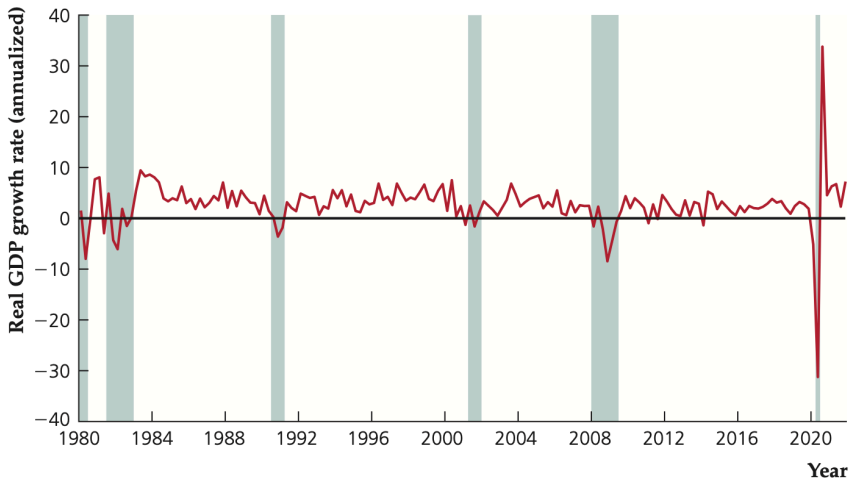
$$C^d = c_0 + c_y Y$$

- $C^d$ = total consumption spending
- $c_0$ = autonomous consumption (consumption when income is zero)
- $c_y$ = marginal propensity to consume (MPC), where $0 < c_y < 1$
- $Y$ = disposable income



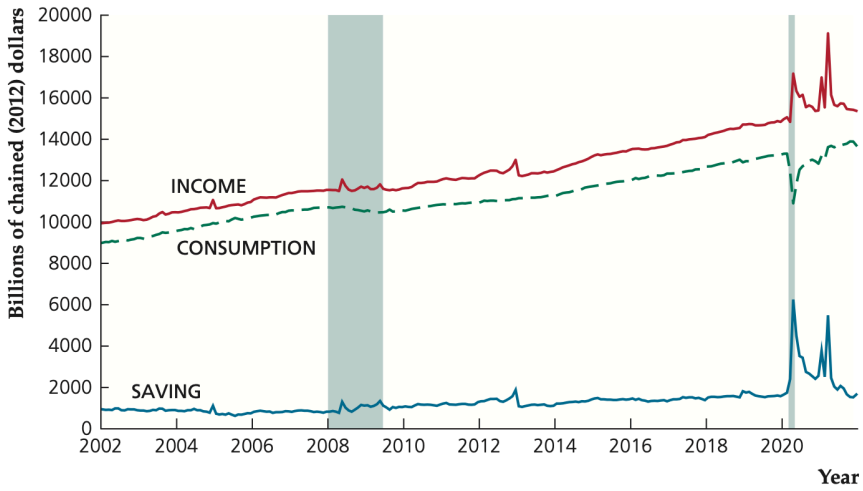
## Application: The Pandemic Recession and Consumption





## Application: Income, Consumption, and Saving








## Effect of Changes in Wealth



- Wealth ↑ ⇒ current consumption ↑ ⇒ current saving ↓



## Effect of Changes in the Real Interest Rate



**Real interest rate ↑ ⇒ two opposing effects**

- **Substitution effect** ⇒ bigger reward for waiting ⇒ saving ↑
- **Income effect:**
  - Saver ⇒ reach target with less ⇒ saving ↓
  - Borrower ⇒ wealth loss ⇒ saving ↑
- Empirics: mixed ⇒ probably a *slight* ↑ in aggregate saving



## Worked Example: A Rate Rise — Saver vs Borrower



**Saver** — targeting ₹110 next year

- At $r = 10\%$: save ₹100 today
- At $r = 20\%$: need only ≈ ₹92
- Income effect ⇒ saves **less**

**Borrower** — owes at the old rate

- Rate rises after borrowing
- Locked in on worse terms ⇒ poorer
- Wealth loss ⇒ saves **more**

## Taxes and the Real Return to Saving



**Effect of changes in the real interest rate: taxes**

- Expected after-tax real interest rate:

$$r_{a-t} = (1-t)i - \pi^e \qquad (4.2)$$

- **Calculating after-tax rates** — with $i = 5\%$ and $\pi^e = 2\%$:
  - $t = 30\%$: after-tax nominal $= (1 - 0.30)\,5\% = 3.5\%$, real $= 1.5\%$
  - $t = 20\%$: after-tax nominal $= (1 - 0.20)\,5\% = 4\%$, real $= 2\%$



## In Touch with Data and Research: Interest Rates

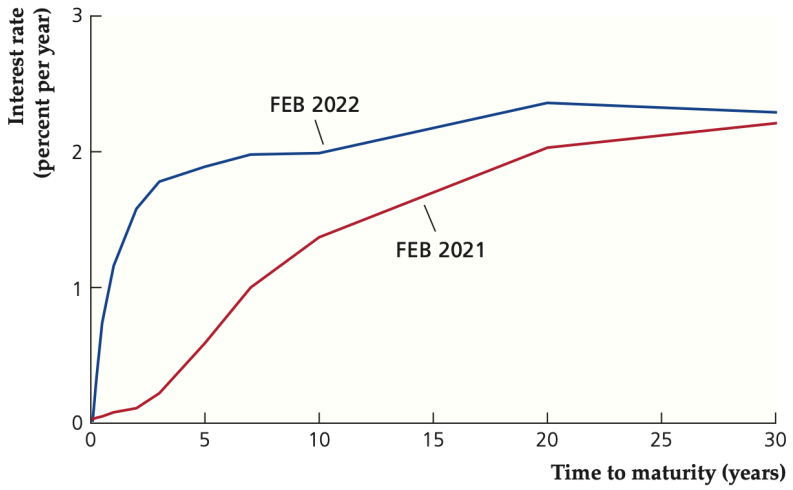


- Rates differ by ⇒ **default risk**, **term** (yield curve), **tax status**
- Rates co-move ⇒ we say "**the**" interest rate
- **Yield curve** ⇒ bond's term (life) vs. the rate it pays



## The Yield Curve








## Recap · Lecture 1 — The Consumption–Saving Decision



- Saving $= Y - C$ ⇒ consuming and saving are **one** decision; we save to move consumption to the **future**
- Price of 1 unit today $= 1 + r$ ⇒ the consumption-smoothing motive keeps the path **even**
- Current income ↑ ⇒ $C^d$ **and** $S^d$ both ↑ (MPC between 0 and 1)
- Expected future income ↑ or wealth ↑ ⇒ $C^d$ ↑, $S^d$ ↓

## Recap · Lecture 1 — Interest Rates & Saving



- Real interest rate ↑ ⇒ substitution effect raises saving, income effect offsets it for savers ⇒ **small** net rise
- The relevant rate is the **after-tax real** rate: $r_{a\text{-}t} = (1 - t)i - \pi^e$ ⇒ higher $t$ or $\pi^e$ lowers it
- Market rates differ by **default risk**, **term** (yield curve), **tax status** ⇒ but co-move ⇒ we say "the" interest rate



Lecture 2 — placeholder



## Fiscal Policy



**Fiscal policy**

- Affects $C^d$ ⇒ via current & expected future income
- Affects $S^d$ **directly** ⇒ the $-G$ term in $S^d = Y - C^d - G$



## Government Purchases (Temporary Increase)



- $G$ ↑ + current taxes ↑ ⇒ after-tax income ↓ ⇒ $C^d$ ↓
- Same if financed by *future* taxes ⇒ provided people foresee them
- $C^d$ falls *less* than $G$ rises ⇒ both $C^d$ **and** $S^d$ ↓

## Taxes



- Lump-sum tax cut now ⇒ financed by higher *future* taxes
- Future income ↓ offsets current income ↑ ⇒ $C^d$ could rise **or** fall



## Ricardian Equivalence



**Ricardian equivalence proposition**

- Future loss = current gain (exact) ⇒ **no change** in consumption
- Tax change ⇒ only *timing*, not total (same present value)
- In practice: future taxes *not foreseen* ⇒ cut feels like income ⇒ $C^d$ ↑, $S^d$ ↓



## Worked Example: A Tax Cut Today, Higher Taxes Tomorrow



**₹100 lump-sum tax cut now, repaid via higher taxes next year ($r = 10\%$)**

- Future tax bill: $₹100 \times 1.10 = ₹110$ next year
- Present value of that bill: $₹110/1.10 = ₹100$
- Change in lifetime resources: $₹100 - ₹100 = 0$

⇒ **A forward-looking household saves the whole cut; $C$ and $S^d$ unchanged**



## Summary 5: Determinants of Desired National Saving



| An increase in | Causes desired national saving to | Reason |
|---|---|---|
| Current output, *Y* | Rise | Part of the extra income is saved to provide for future consumption. |
| Expected future output | Fall | Anticipation of future income raises current desired consumption, lowering current desired saving. |
| Wealth | Fall | Some of the extra wealth is consumed, which reduces saving for given income. |
| Expected real interest rate, *r* | Probably rise | An increased return makes saving more attractive, probably outweighing the fact that less must be saved to reach a specific savings target. |
| Government purchases, *G* | Fall | Higher government purchases directly lower desired national saving. |
| Taxes, *T* | Remain unchanged or rise | 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. |

✓ 4-1 · Consumption and Saving

▸ **4-2 · Investment**

4-3 · Goods Market Equilibrium



## Why Is Investment Important?



- The **most volatile** component of GDP ⇒ drives the business cycle
  - investment is only about **one-sixth of GDP**,
  - in a typical recession **half or more** of the total ↓ in spending is falling investment
- Builds the capital stock ⇒ drives long-run growth



## The Desired Capital Stock



- **Desired capital stock** $K^*$ ⇒ capital that *maximises* expected profit
- Set by ⇒ marginal **benefit** vs marginal **cost** of more capital
- Investing pays off with a *lag* ⇒ benefit = **future** $MPK$ ($MPK^f$)



## Example: Kyle's Bakery



- **Kyle's Bakery** ⇒ buys a **solar-powered oven**, choosing its size
- Price ⇒ **$100 per cubic foot** (real, any size, treated as continuously divisible)
- Depreciation ⇒ **10% fewer cookies/yr** → real value falls **10%/yr** (→ $90)
- Finance ⇒ borrow or lend at real rate **8% per year**

## The User Cost of Capital



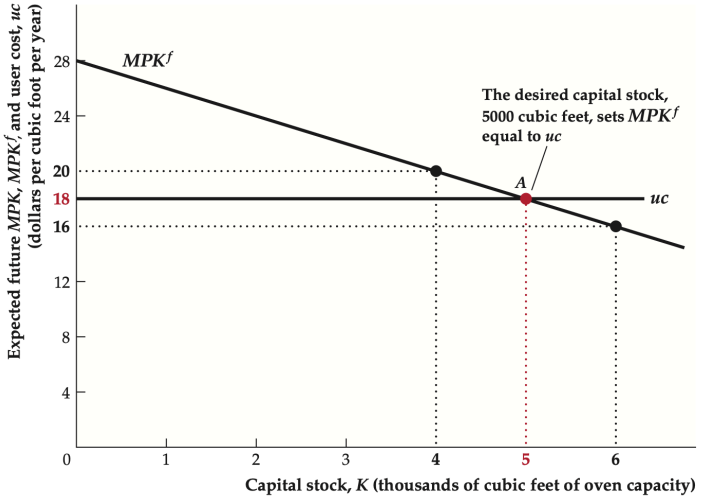
- Kyle's Bakery ⇒ price $p_K$, depreciation $d$, real rate $r$
- **User cost** = cost of using 1 unit for a period ⇒ interest cost + depreciation

$$uc = r p_k + d p_k = (r + d) p_k \qquad (4.3)$$



## Determination of the Desired Capital Stock

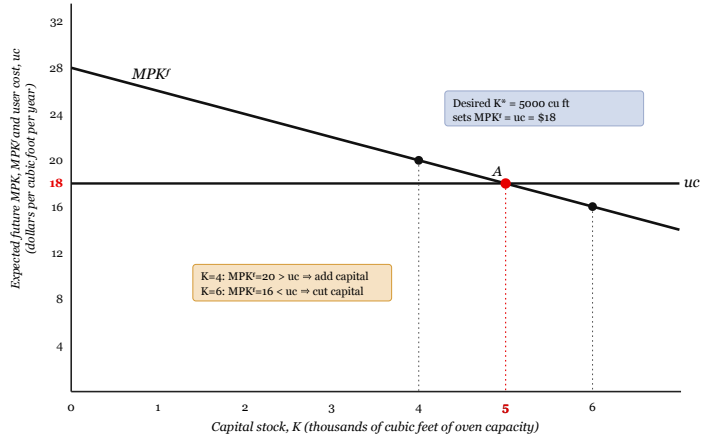







## Build-Up · Determination of Desired Capital








## Factors That Change the Desired Capital Stock

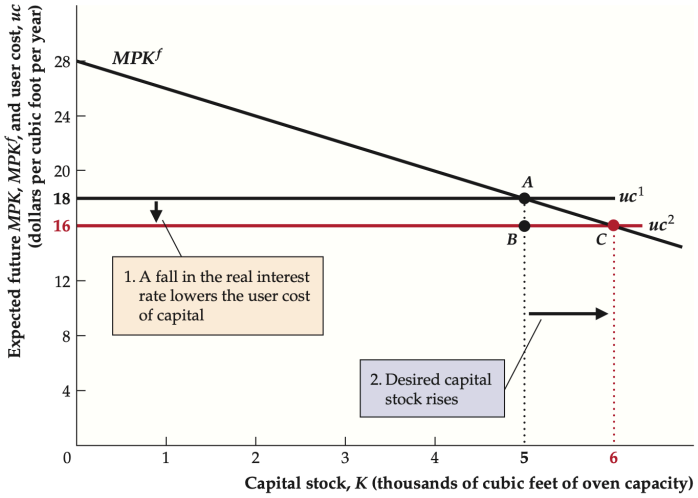


Desired capital sits where $MPK^f = uc$ ⇒ it moves only when **one side moves**:

- **User cost $uc$ changes** ⇒ via $r$, depreciation $d$, or price $p_K$
- $MPK^f$ **curve shifts** ⇒ via technology (capital more/less productive)

# A Decline in the Real Interest Rate Raises the Desired Capital Stock

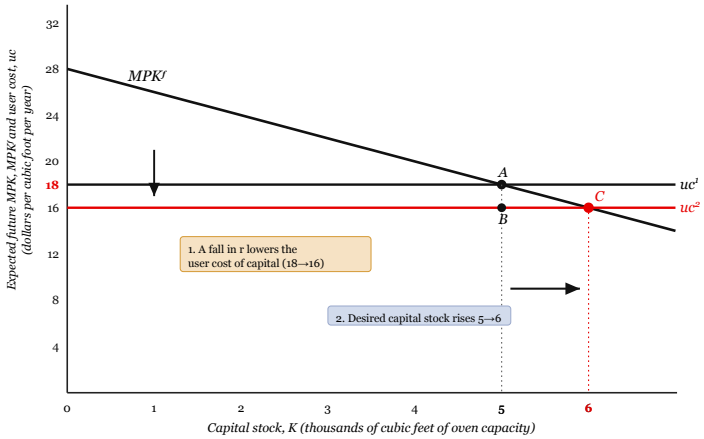







# Build-Up · A Fall in r Raises Desired K

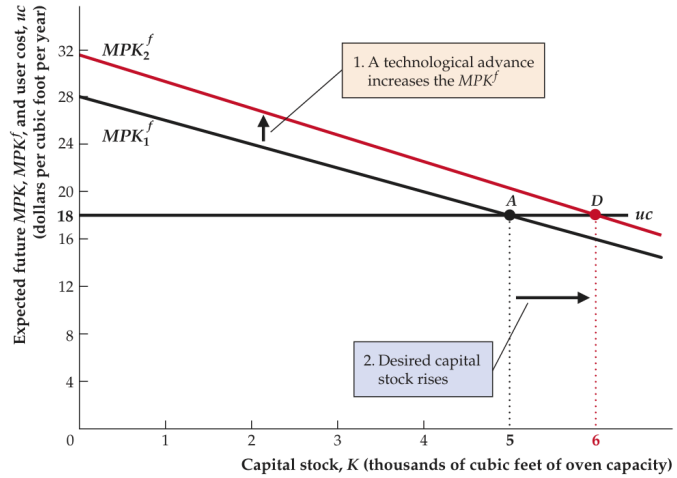







# An Increase in the Expected MPK$^f$ Raises the Desired Capital Stock

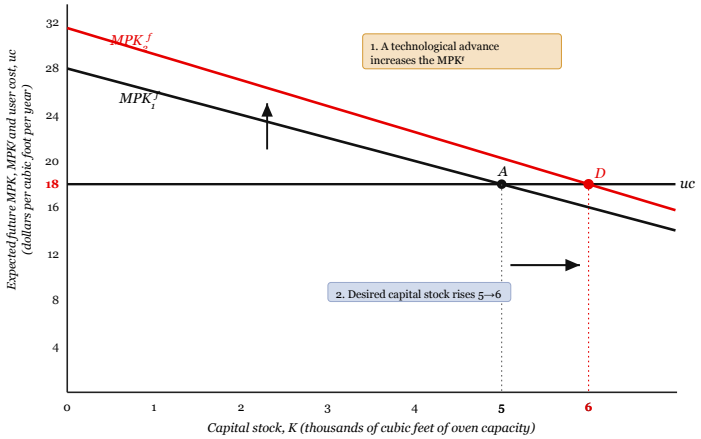







# Build-Up · Higher MPK$^f$ Raises Desired K





## Taxes and the Desired Capital Stock



- With taxes ⇒ firm keeps only $(1-\tau)MPK^f$
- Set after-tax return = user cost ⇒ $(1-\tau)MPK^f = uc$ ⇒

$$MPK^f = \frac{uc}{1-\tau} = \frac{(r+d)p_K}{1-\tau} \qquad (4.4)$$

- **Gist** ⇒ the tax is a **wedge** on the return: the firm must earn a higher *pre-tax* $MPK^f$ to clear the same user cost (since $\frac{1}{1-\tau} > 1$) ⇒ desired $K$ **falls**



## Recap · Lecture 2 — Fiscal Policy & Saving



- Fiscal policy shifts $C^d$ (via current & future income) and $S^d$ **directly** (the $-G$ term)
- Temporary $G$ ↑ ⇒ $C^d$ ↓ (by less than $\Delta G$) ⇒ national saving $S^d$ ↓
- **Ricardian equivalence:** a lump-sum tax cut is only a **timing** shift (same present value) ⇒ $C$, $S^d$ unchanged — unless future taxes go unforeseen ⇒ $C^d$ ↑, $S^d$ ↓



## Recap · Lecture 2 — The Desired Capital Stock



- Investment matters ⇒ the most **volatile** part of GDP **and** the engine of long-run growth
- **Desired capital** sits where $MPK^f = uc$, with user cost $uc = (r+d)p_K$ (interest + depreciation)
- User cost ↓ (lower $r$, $d$, $p_K$) or $MPK^f$ ↑ ⇒ desired $K$ ↑; a higher tax $\tau$ ↑ ⇒ $uc/(1-\tau)$ ↑ ⇒ desired $K$ ↓



Lecture 3 — placeholder

## Taxes and the Desired Capital Stock (continued)



- **Tax-adjusted user cost** ⇒ $\dfrac{uc}{1-\tau}$
- $\tau$ ↑ ⇒ tax-adjusted user cost ↑ ⇒ desired $K$ ↓



## From the Desired Capital Stock to Investment



Capital stock ⇒ changes through **two opposing channels**

- New capital ⇒ **gross investment** (adds to the stock)
- Depreciation ⇒ wears the stock **down**



## Net Investment



- **Net investment** = gross $I$ **–** depreciation ⇒

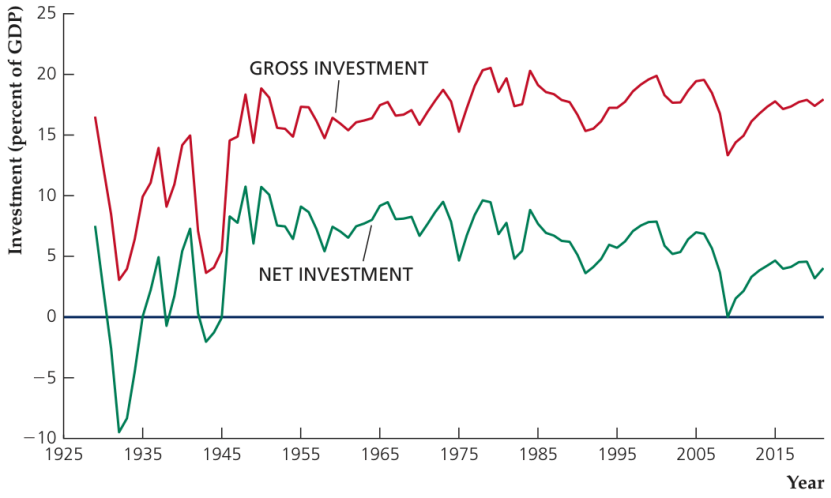
$$K_{t+1} - K_t = I_t - dK_t \qquad (4.5)$$

- Net investment = **change** in capital stock ⇒ $I >$ dep. ⇒ stock grows



## Gross and Net Investment, 1929–2021





## From the Desired Capital Stock to Investment (continued)



- Rewriting (4.5) gives $I_t = K_{t+1} - K_t + dK_t$
- Assume adjust in one period ⇒ $K^* = K_{t+1}$
  - With all avaialble information, firms can determine the and **reach the desired stock** in one period (at the end of t and starting of t+1)
- So $I_t = K^* - K_t + dK_t \quad (4.6)$



## Investment Has Two Parts



- **Net increase** ⇒ reach desired stock ($K^* - K_t$)
- **Replacement** ⇒ cover depreciation ($dK_t$)



## Lags and Investment



- Some capital installs fast ⇒ other capital takes *years*
- So adjustment to $K^*$ ⇒ **spread over several years**



## Investment and the Stock Market: Tobin's $q$



- $q = \dfrac{\text{market value of capital}}{\text{replacement cost of capital}}$
  - $q > 1$ ⇒ capital worth **more** than it costs ⇒ **invest**
  - $q < 1$ ⇒ **do not** invest

## Summary 6



| Determinants of Desired Investment | | |
|---|---|---|
| **An increase in** | **Causes desired investment to** | **Reason** |
| Real interest rate, $r$ | Fall | The user cost increases, which reduces desired capital stock. |
| Effective tax rate, $\tau$ | Fall | The tax-adjusted user cost increases, which reduces desired capital stock. |
| Expected future *MPK* | Rise | The desired capital stock increases. |



✓ 4-1 · Consumption and Saving
✓ 4-2 · Investment
▸ **4-3 · Goods Market Equilibrium**



## The Goods Market Equilibrium Condition

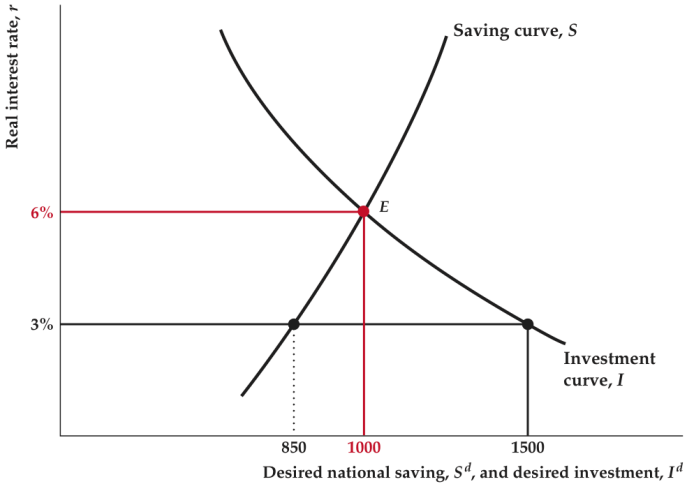


- $Y = C^d + I^d + G \quad (4.7)$
- Unlike the *identity* ⇒ this condition **need not** always hold
- Undesired output produced ⇒ unsold goods ⇒ **not** in equilibrium
- Equivalently ⇒ $S^d = I^d$:
  - $S^d = Y - C^d - G$
  - $S^d = I^d \quad (4.8)$



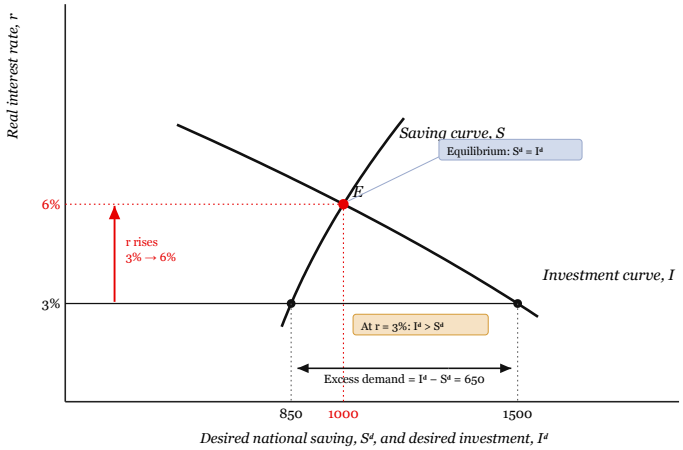
## Goods Market Equilibrium: Plotting $S^d$ vs. $I^d$





# Build-Up · Goods-Market Equilibrium (S–I)








# Components of Aggregate Demand for Goods (An Example)

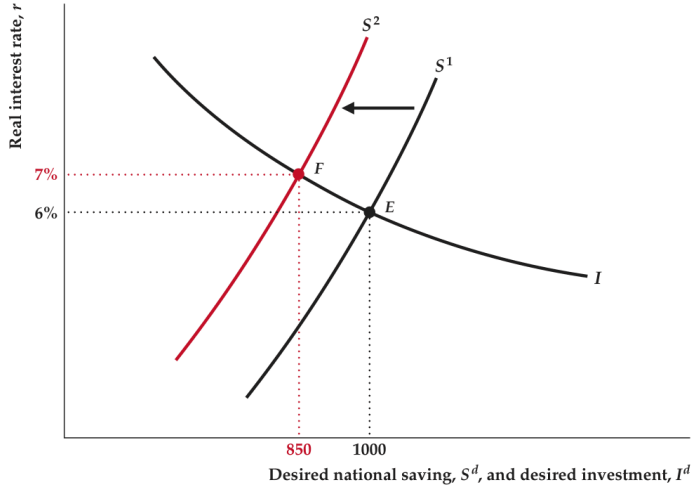


| Variable | $r = 3\%$ | $r = 6\%$ |
|---|---|---|
| Output, $Y$ | 4500 | 4500 |
| Desired consumption, $C^d$ | 2150 | 2000 |
| Desired investment, $I^d$ | **1500** | **1000** |
| Government purchases, $G$ | 1500 | 1500 |
| Desired national saving, $S^d = Y - C^d - G$ | **850** | **1000** |
| Aggregate demand, $C^d + I^d + G$ | **5150** | **4500** |



# A Decline in Desired Saving

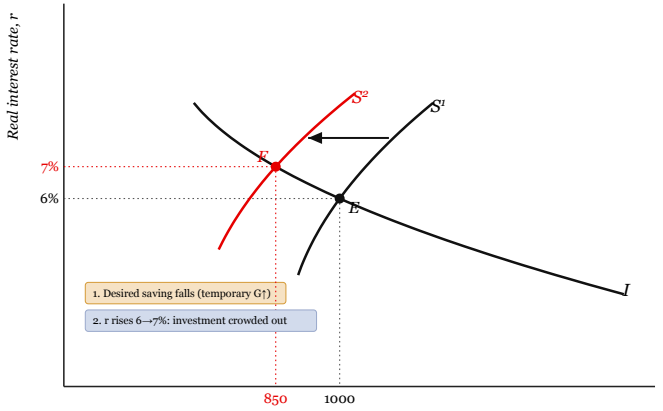






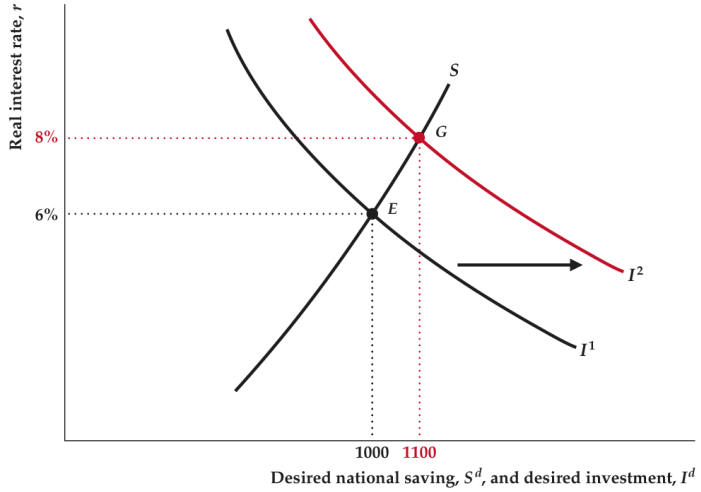

# Build-Up · A Decline in Desired Saving





## An Increase in Desired Investment

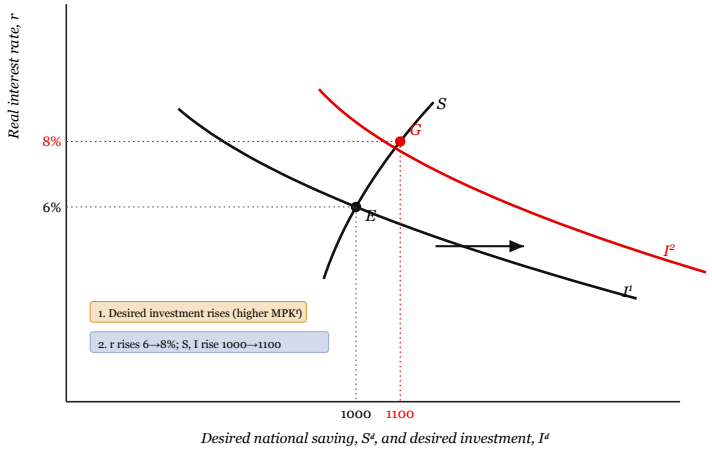







## Build-Up · An Increase in Desired Investment








## Recap · Lecture 3 — From Capital to Investment



- The **effective tax rate** (not the statutory rate) summarises the tax code ⇒ what actually matters for investment
- **Net investment** = gross $I$ **–** depreciation = $\Delta K$; so $I_t = K^* - K_t + dK_t$ ⇒ close the gap to $K^*$ **+** replace wear
- Build **lags** ⇒ investment responds to $r$ slowly; Tobin's $q > 1$ ⇒ invest more



## Recap · Lecture 3 — Goods Market Equilibrium



- Equilibrium: $Y = C^d + I^d + G$, equivalently $S^d = I^d$ ⇒ the **real interest rate** clears the market
- Saving slopes **up** and investment slopes **down** in $r$ ⇒ they cross at the equilibrium rate
- Desired saving ↓ (e.g. temporary $G$ ↑) ⇒ $r$ ↑ ⇒ investment **crowded out**; desired investment ↑ ⇒ $r$ ↑, with $S$ & $I$ ↑

- Summary



## Summary I · Consumption and Saving



- Saving $= Y - C \Rightarrow$ consuming & saving are **one** decision $\Rightarrow$ save to shift consumption to the **future**
- Current income ↑ $\Rightarrow C^d$ & $S^d$ both ↑; expected future income or wealth ↑ $\Rightarrow C^d$ ↑, $S^d$ ↓
- $r$ ↑ $\Rightarrow$ subst. effect: $S^d$ ↑; income effect: borrowers ↑ / savers ↓ $\Rightarrow$ **small** net rise; relevant rate = **expected real after-tax**
- Temporary $G$ ↑ $\Rightarrow C^d$ ↓ (by $< \Delta G$) $\Rightarrow S^d$ ↓
- **Ricardian equivalence:** lump-sum tax cut $\Rightarrow C, S$ **unchanged** — unless future taxes ignored $\Rightarrow C^d$ ↑, $S^d$ ↓



## Summary II · Investment and Goods Market Equilibrium



- **Desired capital** where $MPK^f = uc \Rightarrow uc = (r + d)p_K$ (interest + depreciation)
- $uc$ ↓, $MPK^f$ ↑, or **effective tax rate** ↓ $\Rightarrow$ desired $K$ ↑
- **Net investment** = gross $I$ − depreciation $= \Delta K \Rightarrow$ invest to reach $K^*$
- Equilibrium: $Y = C^d + I^d + G \Leftrightarrow S^d = I^d \Rightarrow$ **real interest rate** clears the market
- $S$–$I$ **diagram:** $S$ **up**, $I$ **down** in $r \Rightarrow$ shift either curve $\Rightarrow$ new equilibrium $r$



# Numerical Problems

Lecture 5 · Worked problems — consumption & saving, investment, goods-market equilibrium

## Problem 1 · Julia's Two-Period Savings Plan



**Julia is making saving plans for this year and next:**

- Real income after taxes: \$50,000 in both years
- Real interest rate: 10%
- Currently no wealth (no assets, no debts)
- Needs \$16,800 for college tuition next year
- Wants equal consumption in both years
- No assets or debts at the end of next year



## Problem 1a · Base Case



**How much should Julia save this year, and how much should she consume?**

Given:

- $Y_1 = Y_2 = \$50,000$
- Interest rate: $r = 10\%$
- Tuition payment: $T = \$16,800$
- Equal consumption: $C_1 = C_2 = C$



## Problem 1a · Solution — Setting Up the Equation



Julia wants equal consumption ($C_1 = C_2 = C$). Resources accumulated by year 2 must cover tuition:

$$(Y_1 - C)(1 + r) + (Y_2 - C) = T$$

Substituting values:

$$(\$50,000 - C) \times 1.1 + (\$50,000 - C) = \$16,800$$



## Problem 1a · Solution — Solving for Consumption



Factor out $(\$50,000 - C)$:

$$(\$50,000 - C)(1.1 + 1) = \$16,800$$

$$(\$50,000 - C) \times 2.1 = \$16,800$$

$$\$50,000 - C = \frac{\$16,800}{2.1} = \$8,000$$

## Problem 1a · Solution — Final Answer



- Consumption: $C = \$50,000 - \$8,000 = \boxed{\$42,000}$
- Savings: $S = Y_1 - C = \$50,000 - \$42,000 = \boxed{\$8,000}$



## Problem 1b · Current Income Increase



**How are savings and consumption affected if current income rises from $50,000 to $54,200?**

New given: $Y_1 = \$54,200$ (increased by $4,200)



## Problem 1b · Solution — Part 1



Modified equation:

$$(\$54,200 - C) \times 1.1 + (\$50,000 - C) = \$16,800$$

Expanding:

$$\$59,620 + \$50,000 - C \times 2.1 = \$16,800$$



## Problem 1b · Solution — Part 2



$$\$109,620 - \$16,800 = C \times 2.1$$

$$\$92,820 = C \times 2.1 \;\Rightarrow\; C = \frac{\$92,820}{2.1} = \$44,200$$

**Results:**

- Consumption: $C = \boxed{\$44,200}$ (up $2,200)
- Savings: $S = \$54,200 - \$44,200 = \boxed{\$10,000}$ (up $2,000)

## Problem 1c · Future Income Increase



**How are savings and consumption affected if next year's income rises from $50,000 to $54,200?**

New given: $Y_2 = \$54,200$ (increased by $4,200)



## Problem 1c · Solution



$$(\$50,000 - C) \times 1.1 + (\$54,200 - C) = \$16,800$$

Solving: $C = \$44,000$

**Results and comparison:**

- Consumption: $C = \boxed{\$44,000}$ (up $2,000)
- Savings: $S = \boxed{\$6,000}$ (down $2,000)



## Problem 1d · Inheritance Effect



**How are savings affected if Julia receives a $1,050 inheritance this year?**

New element: initial wealth $W = \$1,050$



## Problem 1d · Solution



Modified budget constraint:

$$(W + Y_1 - C)(1 + r) + (Y_2 - C) = T$$

$$(\$1,050 + \$50,000 - C) \times 1.1 + (\$50,000 - C) = \$16,800$$

**Results:**

- Consumption: $C = \boxed{\$42,550}$ (up $550)
- Savings: $S = \boxed{\$7,450}$ (down $550)

## Problem 1e · Higher Tuition



**What if tuition rises from $16,800 to $18,900?**

**Impact:**

- Consumption: $C = \boxed{\$41,000}$ (down $1,000)
- Savings: $S = \boxed{\$9,000}$ (up $1,000)



## Problem 1f · Interest Rate Change



**What if the interest rate rises from 10% to 24%?**

**Surprising result:**

- Consumption: $C = \boxed{\$42,500}$ (up $500)
- Savings: $S = \boxed{\$7,500}$ (down $500)



## Problem 1 · Summary of Results



| Scenario | Consumption | Savings |
|---|---|---|
| Base case | $42,000 | $8,000 |
| ↑ Current income (+$4,200) | $44,200 | $10,000 |
| ↑ Future income (+$4,200) | $44,000 | $6,000 |
| + Wealth ($1,050) | $42,550 | $7,450 |
| ↑ Tuition (+$2,100) | $41,000 | $9,000 |
| ↑ Interest (10% → 24%) | $42,500 | $7,500 |



## Problem 2 · Buy vs. Rent Decision



**Deciding whether to buy or rent a house:**

- House price: $300,000
- Nominal mortgage rate: 10% per year; savings earn: 10% per year
- Tax bracket: 30%; expected inflation: 5% per year
- Maintenance cost: 6% of house value
- Mortgage interest is tax deductible; interest earnings are taxable

## Problem 2a · Real After-Tax Interest Rate



**What is the expected real after-tax interest rate on the home mortgage?**



## Problem 2a · Solution — After-Tax Nominal Rate



Since mortgage interest is tax deductible:

$$i_{\text{after-tax}} = i \times (1 - \tau)$$

$$= 0.10 \times (1 - 0.30) = 0.10 \times 0.70 = 0.07$$



## Problem 2a · Solution — Convert to Real Rate



Using the Fisher equation:

$$r_{\text{after-tax}} = i_{\text{after-tax}} - \pi$$

$$= 0.07 - 0.05 = 0.02 = 2\%$$

The expected real after-tax mortgage rate is $\boxed{2\%}$.



## Problem 2b · User Cost of the House



**What is the user cost of the house?**

User cost includes:

- Opportunity cost of equity
- Mortgage interest cost
- Maintenance expenses
- Less: capital gains from appreciation

## Problem 2b · Solution — Components



1. **After-tax opportunity cost** (interest on savings is taxable):

$$0.10 \times (1 - 0.30) = 0.07 \text{ nominal}$$

2. **Real after-tax opportunity cost:**

$$0.07 - 0.05 = 0.02 = 2\%$$

3. **Maintenance:** 6% of house value



## Problem 2b · Solution — Total User Cost



$$\text{User cost rate} = r_{\text{after-tax}} + \text{maintenance}$$

$$= 0.02 + 0.06 = 0.08 = 8\%$$

In dollar terms:

$$\text{Annual user cost} = 0.08 \times \$300{,}000 = \boxed{\$24{,}000}$$



## Problem 2c · Break-Even Rent



**At what annual rent would you be indifferent between buying and renting?**

You are indifferent when:

$$\text{Annual rent} = \text{Annual user cost} = \boxed{\$24{,}000}$$



## Problem 3 · Goods Market Equilibrium



**Economy with** full-employment output $Y = 9000$ and government purchases $G = 2000$; consumption and investment depend on the real interest rate:

| Real interest rate (%) | Desired consumption | Desired investment |
|---|---|---|
| 2 | 6100 | 1500 |
| 3 | 6000 | 1400 |
| 4 | 5900 | 1300 |
| 5 | 5800 | 1200 |
| 6 | 5700 | 1100 |

## Problem 3a · Economic Intuition



**Why do desired consumption and investment fall as the real interest rate rises?**

- **Consumption:** higher returns to saving encourage households to save more and consume less now
- **Investment:** a higher cost of capital makes projects less attractive, reducing the desired capital stock



## Problem 3b · National Saving



**Find desired national saving at each real interest rate.**

$$S_d = Y - C_d - G = 9000 - C_d - 2000 = 7000 - C_d$$



## Problem 3b · Solution



| $r$ (%) | $C_d$ | $I_d$ | $S_d = 7000 - C_d$ |
|---|---|---|---|
| 2 | 6100 | 1500 | 900 |
| 3 | 6000 | 1400 | 1000 |
| 4 | 5900 | 1300 | 1100 |
| 5 | 5800 | 1200 | 1200 |
| 6 | 5700 | 1100 | 1300 |



## Problem 3c · Finding Equilibrium



**Find the equilibrium real interest rate, national saving, and investment.**

Equilibrium conditions:

1. Goods market: $Y = C_d + I_d + G$
2. Saving–investment: $S_d = I_d$

## Problem 3c · Solution



| $r$ (%) | $C_d$ | $I_d$ | $C_d + I_d + G$ | $S_d$ |
|---|---|---|---|---|
| 2 | 6100 | 1500 | 9600 | 900 |
| 3 | 6000 | 1400 | 9400 | 1000 |
| 4 | 5900 | 1300 | 9200 | 1100 |
| **5** | **5800** | **1200** | **9000** | **1200** |
| 6 | 5700 | 1100 | 8800 | 1300 |

Equilibrium at $r = 5\%$: $Y = 9000 = C_d + I_d + G$ and $S_d = I_d = 1200$ ✓



## Problem 3d · Fiscal Policy Effect



**What happens if government purchases fall from 2000 to 1600?**

New equilibrium:

- Interest rate: $r = 3\%$ (down from 5%)
- Saving and investment: $S_d = I_d = 1400$ (up from 1200)



## Problem 4 · Investment Decision



**Given:**

- Future MPK: $\text{MPK}_f = 20 - 0.02K$
- Depreciation rate: $d = 0.20$; current capital stock: $K = 900$ units
- Price of capital: 1 unit of output; tax rate on output: 15%
- Consumption: $C = 100 + 0.5Y - 200r$
- Government purchases: $G = 200$; full-employment output: $Y = 1000$



## Problem 4a · Investment at $r = 10\%$



At $r = 10\%$, find:

1. Tax-adjusted user cost of capital
2. Desired future capital stock
3. Desired investment

## Problem 4a · Solution — Tax-Adjusted User Cost



$$\frac{uc}{1-\tau} = \frac{(r+d)\,p_k}{1-\tau}$$

$$= \frac{(0.1+0.2)\times 1}{1-0.15} = \frac{0.3}{0.85} = 0.353$$



## Problem 4a · Solution — Capital Stock & Investment



Set the user cost equal to the MPK:

$$20 - 0.02K = 0.353 \;\Rightarrow\; 0.02K = 19.647 \;\Rightarrow\; K = 982.35$$

Investment:

$$I = K_{t+1} - K_t + dK_t = 982.35 - 900 + 0.2(900) = 262.35$$



## Problem 4b(i) · Investment as a Function of $r$



Equate the tax-adjusted user cost to the marginal product of capital:

$$20 - 0.02K = 0.235 + 1.176\,r$$

$$0.02K = 19.765 - 1.176\,r \;\Rightarrow\; K = 988.25 - 58.8\,r$$



## Problem 4b(ii) · Goods Market Clearing



Use the investment function from part (i), together with the consumption function and government purchases, to find the real interest rate that clears the goods market.

What are the market-clearing values of consumption, saving, and investment? What are the tax-adjusted user cost and the desired capital stock in this equilibrium?

## Problem 4b(ii) · Equilibrium Interest Rate



$$Y = C + I + G$$

$$1000 = \left(100 + 0.5(1000) - 200r\right) + \left(268.25 - 58.8r\right) + 200$$

$$1000 = 1068.25 - 258.8r \;\Rightarrow\; r = 26.4\%$$



## Problem 4b(ii) · Equilibrium Values



Consumption:

$$C = 100 + 0.5 \times 1000 - 200 \times 0.264 = 547.2$$

Investment:

$$I = 268.25 - 58.8 \times 0.264 = 252.7$$

Saving:

$$S = 1000 - 547.2 - 200 = 252.8$$

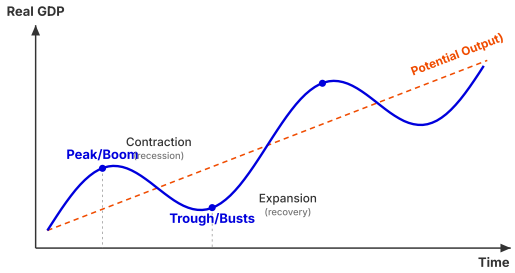
Tax-adjusted user cost and capital stock:

$$\frac{uc}{1-\tau} = 0.235 + 1.176 \times 0.264 = 0.545, \qquad K = 988.25 - 58.8 \times 0.264$$



## Appendix · The Business Cycle

**Business cycle** ⇒ recurring **expansions** and **contractions** of real GDP around its long-run **trend** (potential output).




↩ Back to *Why Is Investment Important?*