Chapter 7

A Real Intertemporal Model with **Investment**

Already Done

- Consumer Behavior:
  - Work-Leisure choices (CHAPTER 4)
  - Intertemporal Consumption-Savings choices (CHAPTER 6)
- Production Side:
  - Firms' Production Technology and Labor Demand (CHAPTER 4)
  - Changes in Productivity affect c, E and y. (CHAPTER 5)
- Government Side:
  - Government expenditure and the timing of taxes.

To do: REAL Model

- **REAL INTERTEMPORAL MODEL**: show how real aggregate output, real consumption, real investment, employment, real wage and the real interest rate are determined.
- CHAPTER 7: Investment behavior.

Investment Behavior

- Determinants of Investment:
  Study the microeconomic investment behavior of the firm, which makes an intertemporal decision regarding investment in the current period.
- Forgoes current profits to have higher capital stock and higher profits in the future.

Determinants of **high Investment**

- Lower capital stock.
- Higher expected future total factor productivity.
- Lower real interest rate.

KEY:
opportunity cost
of Investment

STUDY

- Effects of:
  - Government Spending Shock.
  - Total Factor Productivity Shock.
  - Capital Stock Shock.

MODEL

- Representative Consumer:
  - Supply labor and demand goods.
- Representative Firm:
  - Demand labor, supply goods and demand investment goods.
- Government:
  - Demand goods for purchases.

Consumer Budget

- CURRENT $c + s = w\,(h-l) + \pi - T$
- FUTURE $c' = w'\,(h-l') + \pi' - T' + (1+r)\,s$

- **LIFETIME**

$$c + c'/1+r = w(h-l) + \pi - T + (w'(h-l')+\pi'-T')/1+r$$

Consumer Problem

- Choose c, c', *l* and *l'*
- Given w, w', r, T and T'
- Cannot depict this on a single graph,
- Solution: describe consumer decision in terms of THREE marginal conditions (Chapter 4 and 6)

Three Marginal (Optimal) Decisions

- Work-leisure decision (CHAPTER 4):
  $MRS_{l,c} = w$

Substitution between *l* and c is determined by w

Remember: Income/Substitution effects of a change in w

- Same in the future:
  $MRS_{l',c'} = w'$
- Consumption-Savings decision (CHAPTER 6):
  $MRS_{c,c'} = 1 + r$

NOTE

w
price of current leisure (labor) in terms of current c

w'
price of future leisure in terms of future c'

1+r
price of current consumption in terms of future consumption

w(1+r)/w'
current price of leisure relative to the future price of leisure

CONSUMER
The Labor Supply

Figure 7-1 The Representative Consumer's Current Labor Supply Curve

Why?

We care for the Short-Run. In the Long-Run, both effects cancel out

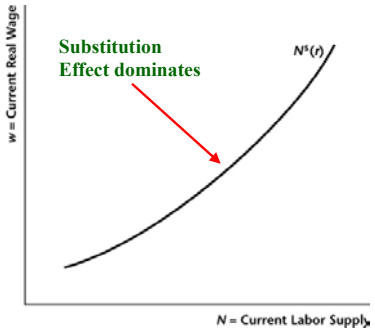

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Figure 7-2 An Increase in the Real Interest Rate Shifts the Current Labor Supply Curve to the Right

↑ r → ↑ price of current leisure relative to future leisure

Intertemporal Substitution of leisure

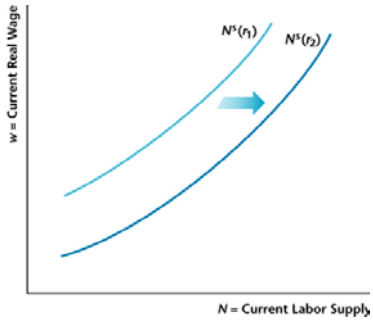

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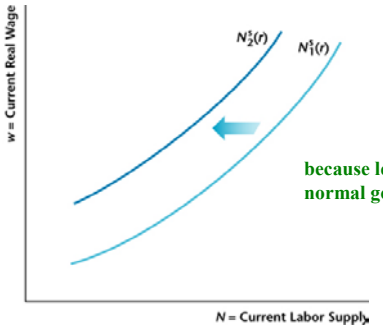
Figure 7-3 Effects of an Increase in Lifetime Wealth



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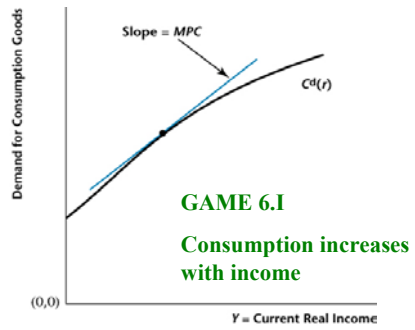
CONSUMER
The Demand for Goods

Remember the FOUR games in chapter 6.

Figure 7-4 The Representative Consumer's Current Demand for Consumption Goods Increases with Income



GAME 6.I

Consumption increases with income

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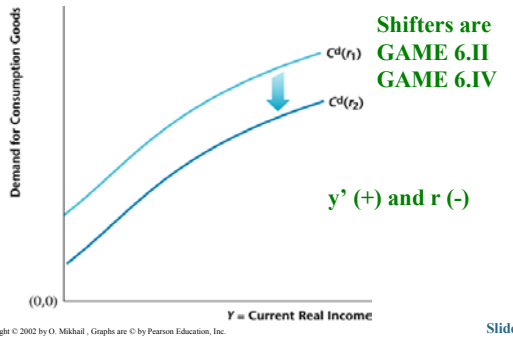
Figure 7-5 An Increase in the Real Interest Rate from r_1 to r_2 Shifts the Demand for Consumption Goods Down



Shifters are
GAME 6.II
GAME 6.IV

y' (+) and r (-)

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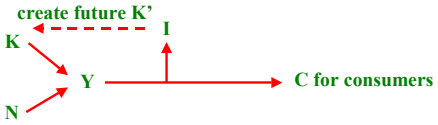
THE FIRM
THE DEMAND FOR LABOR
THE INVESTMENT DECISION

The Firm Production and Investment

- Production Function $Y = z\ F(K,N)$
- Gross Investment $I = K' - K + d\ K$
- Net Investment $I^N = K' - K$
- Note that $K' = (1 - d)\ K + I$



The Firm's Decision

- Maximize the Present Value of π by choosing N, N' and I.
- i.e., max V = max [$\pi + \pi'/1+r$]
- Note that
  - $\pi = Y - wN - I$
  - $\pi' = Y' - w'N' + (1 - d)\ K'$

THE FIRM
The Labor DEMAND

Figure 7-7 The Demand Curve for Current Labor Is the Representative Firm's Marginal Product of Labor Schedule

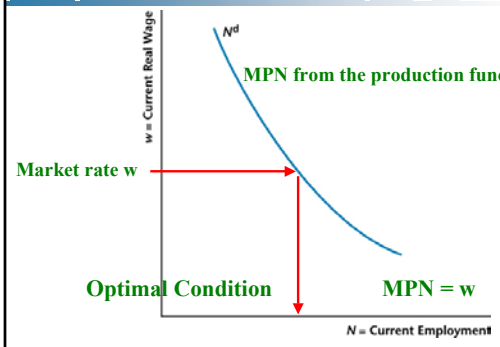


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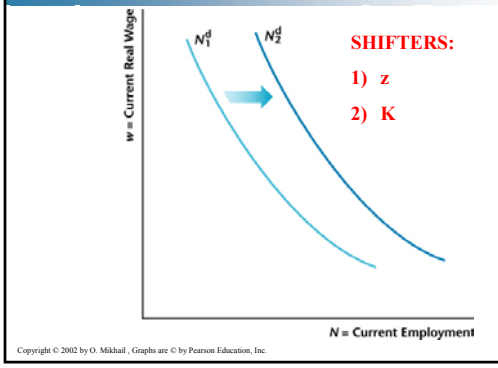
Figure 7-8 The Current Demand Curve for Labor Shifts Due to Changes in Current Total Factor Productivity *z* and in the Current Capital Stock *K*



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THE FIRM
The Investment Decision

The Investment Decision

- Marginal Cost = Marginal Benefit
- Marginal Cost = 1, an extra unit of Investment, reduces current profits by 1 unit, which reduces PV(profits) by 1.
- Marginal Benefit = (MPK'+1–d) / 1+r where MPK is the extra output from the extra unit of K and (1-d) is the left over K, all are discounted to the present.

Continue

Solve it

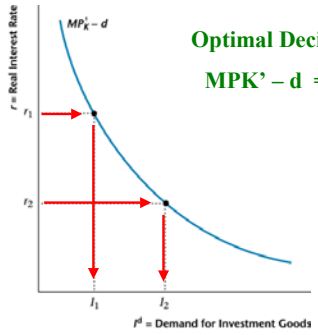
MC = MB →

OPTIMAL INVESTMENT RULE

MPK' – d = r

Net Marginal Product K = real interest rate

Figure 7-9 Optimal Investment Schedule for the Representative Firm



Optimal Decision

MPK' – d = r

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Remember

For Labor Demand → relevant price is w
Condition: MPN = w

For Investment Demand → relevant price is r
Condition: MPK' – d = r

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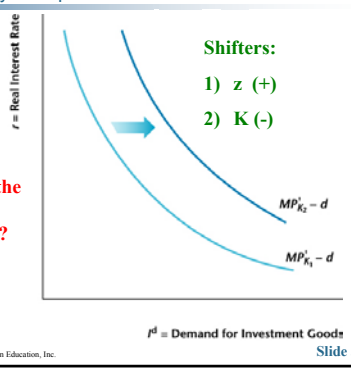
Figure 7-10 The Optimal Investment Schedule Shifts to the Right if Current Capital Decreases or Future Total Factor Productivity Is Expected to Increase



Shifters:

1) z (+)
2) K (-)

Extra:

What will happen to the Optimal Investment Schedule if d changes?

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Table 7-1:
Optimal Investment: A Numerical Example

K = 10 trees, Y = 100 bushels of apples, d = 0.2, r = 5%

The seeds of 1 bushel of apples yield 1 tree in the future

Table 7.1 Data for Paula's Orchard

K' = Trees in Future	I	Y'	V	$MP_K - d$
8	0	95	197.5	—
9	1	98	199.5	2.8
10	2	100	201.2	1.8
11	3	101	202.0	0.8
12	4	101.5	202.3	0.3
13	5	101.65	202.2	−0.05
14	6	101.75	202.1	−0.1
15	7	101.77	201.9	−0.18

3 – 0.2

Find the Optimal number of trees in the future K'

GOVERNMENT

Government

Finances purchases through taxation and issuing bonds.

The Present Value Budget

$$G + G'/1+r = T + T'/1+r$$

Competitive Equilibrium

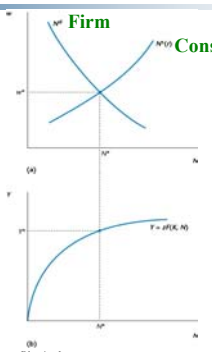
BUILD THE MODEL

- The goods Market
- The labor Market

THE GOODS MARKET

CONSTRUCT
THE OUTPUT SUPPLY CURVE

Figure 7-11 Determination of Equilibrium in the Labor Market Given the Real Interest Rate *r*



L market clears

→ N*

→ Y

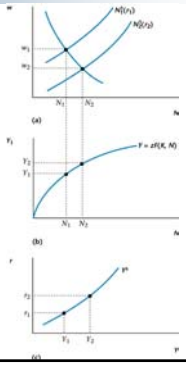
r is constant

Figure 7-12
Construction of the Output Supply Curve

If r changes → N^s shifts → N^*

Track the changes to r and Y

Graph r and Y



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