# Chapter 6 : Money and interest rate

Financial Markets, Money and Banking

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# Outline

- **Meaning of Money**
- Functions of Money
- Evolution of the Payments System
- Are We Headed for a Cashless Society?
- Measuring Money
- **The Meaning of Interest Rates**
- Present value
- Yield to maturity
- Credit market instruments
- Distinction between the interest rate and returns

# Definition of Money

- Money (or the “money supply”): anything that is generally accepted as payment for goods or services or in the repayment of debts.
- A rather broad definition

# Meaning of Money

- Money (a stock concept) is different from:
  - **Wealth**: the total collection of pieces of property that serve to store value (includes money but also other assets: bonds, property …)
  - **Income**: flow of earnings per unit of time (a flow concept)
  - Currency: paper money and coins

# Functions of Money

1. Medium of Exchange
2. Unit of Account
3. Store of Value

# Functions of Money

- **<u>Medium of Exchange</u>**:
  - Promotes economic efficiency
  - Eliminates the trouble of finding a double coincidence of needs (reduces transaction costs)
  - Promotes specialization
- A medium of exchange must:
  - be easily standardized
  - be widely accepted
  - be divisible
  - be easy to carry
  - not deteriorate quickly

What is the situation in a **Barter Economy**?

- The need for money is strong in almost every society

- Ex:
  - Tabocco and Whiskey used by the early American colonists
  - Cigarettes in prisoner-of-war camps in WWII

# Functions of Money

- **Unit of Account**:
  - Used to measure value in the economy
  - Reduces transaction costs

What is the situation in a **Barter Economy**?

# Functions of Money

- **Store of Value**:
  - Used to save purchasing power over time
  - Other assets also serve this function.
  - Money is the most **liquid** of all assets but loses value during inflation.

- Quality of storing value and inflation?
  Ex. hyperinflation in Germany after WWI

**Liquidity:** the relative ease and speed with which an asset can be converted into a medium of exchange.

- Liquidity is highly desirable
- Money is the most liquid asset of all; it does not have to be converted into anything else in order to make purchases. Other assets involve transaction costs when they are converted into money

# Evolution of the Payments System

- **Commodity Money**: valuable, easily standardized and divisible commodities (e.g. precious metals, cigarettes)

- **Fiat Money**: paper money decreed by governments as legal tender

  - Drawbacks: can be easily stolen, expensive to transport

# Evolution of the Payments System

- **Checks/cheques**: an instruction to your bank to transfer money from your account

  Major innovation to improve efficiency of payment system
  - Advantages:
    - reduces the transportation costs,
    - can be written for any amount,
    - loss from theft is greatly reduced
    - convenient receipts for purchases
  - Disadvantages:
    - it takes time to get cheques from one place to another
    - it usually takes several business days before a bank will allow you to make use of the funds from a cheque you have deposited

- **Electronic Payment** (e.g. online bill pay)

# Evolution of the Payments System

- **E-Money** (electronic money):
  - Debit card
  - Stored-value card (**smart card**)
  - **E-cash**

# Are We Headed for a Cashless Society?

- Predictions of a cashless society have been around for decades, but they have not come to fruition.
- Although e-money might be more convenient and efficient than a payments system based on paper, several factors work against the disappearance of the paper system.
- However, the use of e-money will likely still increase in the future.

# Factors working against disappearance of paper money

- Very costly to set up: computers, card reader, telecommunication network

- Security and privacy concerns: hackers …

- Concern that the use of electronic means of payment leaves an electronic trail that contains a large amount of personal data on buying habits

# Will Bitcoin Become the Money of the Future?

Presentation

Discussion

# Will Bitcoin Become the Money of the Future?

- Bitcoin is type of electronic money created in 2009.
- By "mining," Bitcoin is created by decentralized users when they use their computing power to verify and process transactions.
- Although Bitcoin functions as a medium of exchange it is unlikely to become the money of the future because it performs less well as a unit of account and a store of value

# Measuring Money

- How do we measure money? Which particular assets can be called “money”?
- Construct **monetary aggregates** using the concept of liquidity:
  - **M1** (most liquid assets) = currency + traveler’s checks + demand deposits + other checkable deposits

# Measuring Money

- **M2** (adds to M1 other assets that are not so liquid) = M1 + small denomination time deposits + savings deposits and money market deposit accounts + money market mutual fund shares

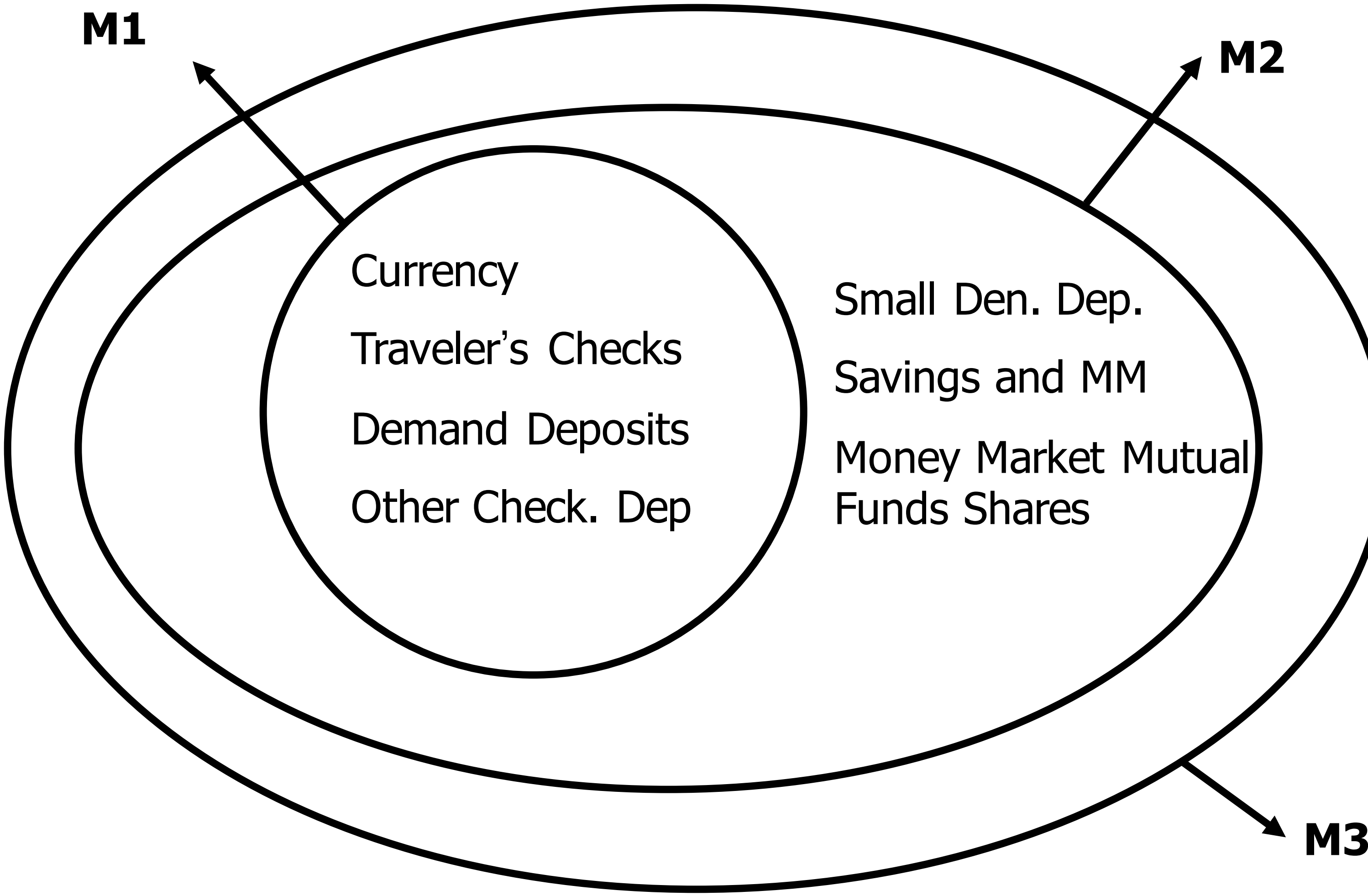
# The Federal Reserve's Monetary Aggregates

**TABLE 1** Measures of the Monetary Aggregates

| | Value as of August 18, 2014, ($ billions) |
|---|---|
| M1 = Currency | 1,206.1 |
| + Traveler's checks | 3.3 |
| + Demand deposits | 1,089.9 |
| + Other checkable deposits | 477.4 |
| Total M1 | 2,776.7 |
| M2 = M1 | |
| + Small-denomination time deposits | 533.0 |
| + Savings deposits and money market deposit accounts | 7,338.2 |
| + Money market mutual fund shares (retail) | 642.5 |
| Total M2 | 11,290.4 |

Source: http://www.federalreserve.gov/releases/h6/hist.

# The Federal Reserve's Monetary Aggregates



## TABLE 3-1 Measures of Monetary Aggregates

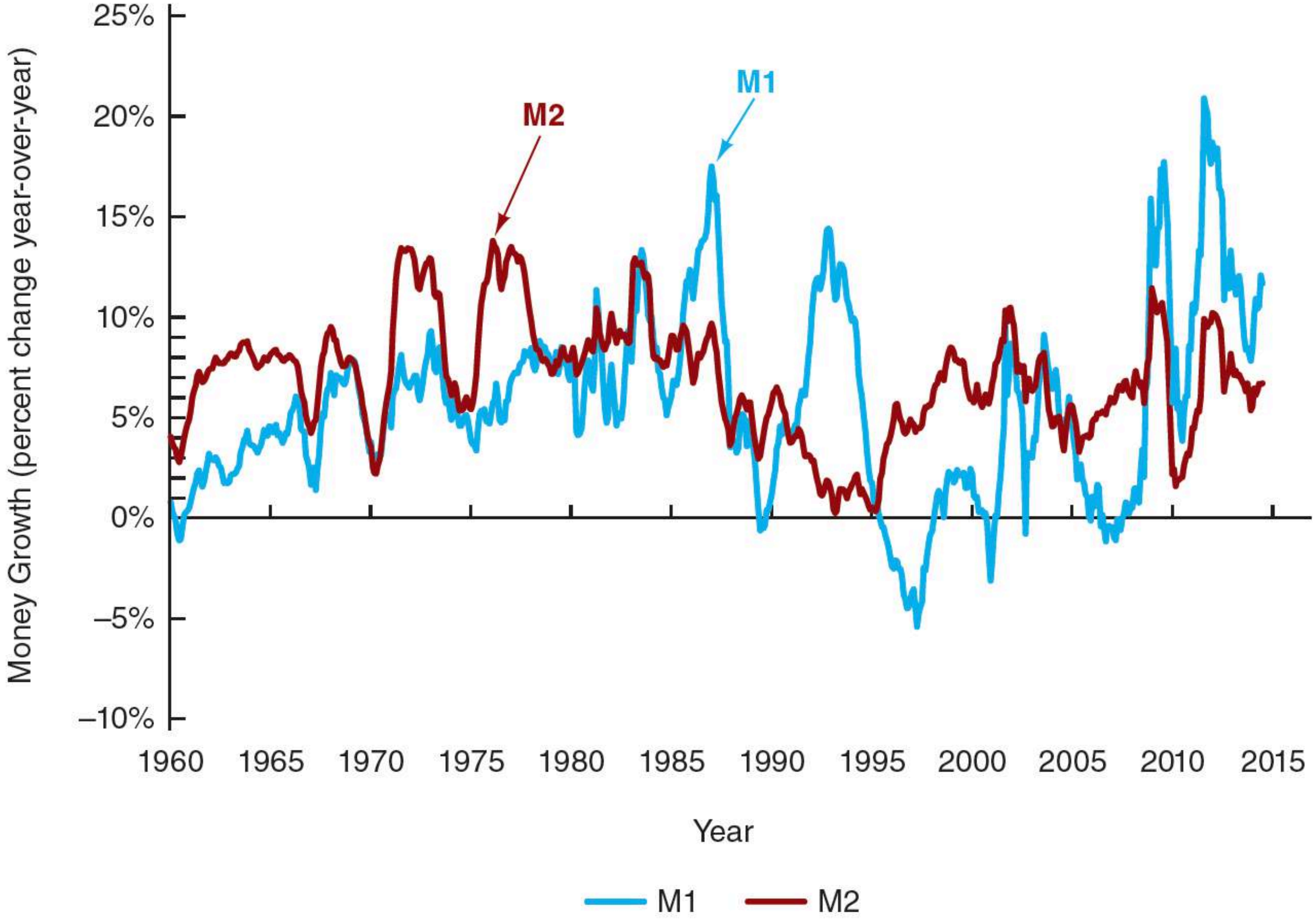
| |
|---|
| **M2 (gross)** |
| Currency outside banks |
| Personal deposits at chartered banks |
| Non-personal demand and notice deposits at chartered banks |
| **M3 (gross) = M2 (gross) plus the following:** |
| Non-personal term deposits at chartered banks |
| Foreign currency deposits of residents at chartered banks |
| **M2+ (gross) = M2 (gross) plus the following:** |
| Deposits at trust and mortgage loan companies (TMLs) |
| Deposits at credit unions and *caisses populaires* (CUCPs) |
| Life insurance company individual annuities |
| Personal deposits at government-owned savings institutions |
| Money market mutual funds |
| **M2++ (gross) = M2+ (gross) plus the following:** |
| Canada Savings Bonds and other retail instruments |
| Non–money market mutual funds |
| **M1+ (gross)** |
| Currency outside banks |
| All chequable deposits at chartered banks, TMLs, and CUCPs |
| **M1++ (gross) = M1+ (gross) plus the following:** |
| All non-chequable deposits at chartered banks, TMLs, and CUCPs. |

*Notes:* Monetary aggregates exclude inter-bank deposits and include continuity adjustments. In January 2007, the monetary aggregates were redefined to reflect: (i) the elimination of demand deposits and (ii) the inclusion of private-sector float.

# The Federal Reserve's Monetary Aggregates

- M1 versus M2: Does it matter which measure of money is considered?

# Figure 1 Growth Rates of the M1 and M2 Aggregates, 1960–2014




Source: Federal Reserve Bank of St. Louis, FRED database: http://research.stlouisfed.org/fred2

- M1 and M2 can move in different directions in the short run (see figure).
- The growth rates of the aggregates do tend to move together

- Conclusion: the choice of monetary aggregate is important for policymakers.

# Money as a weighted aggregate

- M=x1 +x2 + ... +xn

- New approach: construction of weighted monetary aggregates.

- Recent research indicates that these new measures of money seem to predict inflation and the business cycle somewhat better than more conventional measures

# Where Are All the U.S. Dollars?

- The more than $4,000 of U.S. currency held per person in the United States is a surprisingly large number.
- Where are all these dollars and who is holding them?
  - Criminals
  - Foreigners
  - Businesses (avoid declaring income & pay tax)

# The Meaning of Interest Rates

# Measuring Interest Rates

- **Present value**:

  a dollar paid to you one year from now is less valuable than a dollar paid to you today.

  – Why?
    a dollar deposited today can earn interest and become \$1 x (1+i) one year from today.

# Present Value

Let $i = .10$

In one year: $\$100 \text{ X } (1 + 0.10) = \$110$

In two years: $\$110 \text{ X } (1 + 0.10) = \$121$

or $\$100 \text{ X } (1 + 0.10)^2$

In three years: $\$121 \text{ X } (1 + 0.10) = \$133$

or $\$100 \text{ X } (1 + 0.10)^3$

In $n$ years

$\$100 \text{ X } (1 + i)^n$

# Simple Present Value

$$PV = \text{today's (present) value}$$

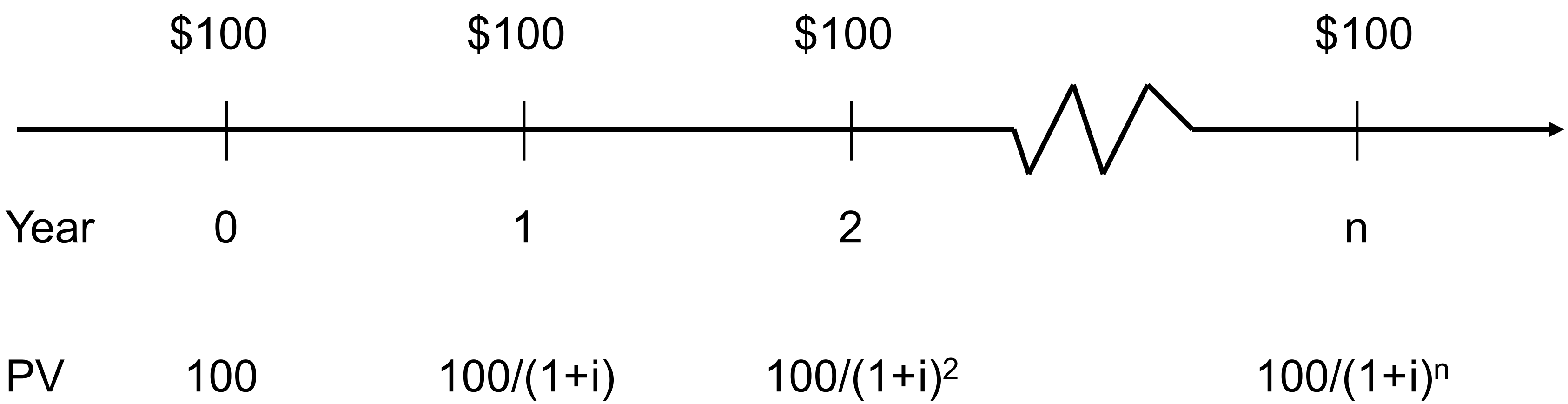
$$CF = \text{future cash flow (payment)}$$

$$i = \text{the interest rate}$$

$$PV = \frac{CF}{(1+i)^n}$$

# Simple Present Value

•Cannot directly compare payments scheduled in different points in the time line



# Yield to Maturity

- **Yield to maturity**: the interest rate that equates the present value of cash flow payments received from a debt instrument with its value today

# Credit Market Instruments

1. Simple Loan
2. Fixed Payment Loan
3. Coupon Bond
4. Discount Bond

# Yield to Maturity on a Simple Loan

PV = amount borrowed = $100

CF = cash flow in one year = $110

$n$ = number of years = 1

$$\$100 = \frac{\$110}{(1+i)^1}$$

$$(1+i)\,\$100 = \$110$$

$$(1+i) = \frac{\$110}{\$100}$$

$$i = 0.10 = 10\%$$

For simple loans, the simple interest rate equals the yield to maturity

# Fixed-Payment Loan or fully amortized loan

The same cash flow payment every period throughout the life of the loan

LV = loan value

FP = fixed yearly payment

$n$ = number of years until maturity

$$\text{LV} = \frac{\text{FP}}{1+i} + \frac{\text{FP}}{(1+i)^2} + \frac{\text{FP}}{(1+i)^3} + \ldots + \frac{\text{FP}}{(1+i)^n}$$

# Exercise

You decide to purchase a new home and need a $100 000 mortgage. You take out a loan from the bank that has an interest rate of 7%. What is the yearly payment to the bank to pay off the loan in 20 years?

You decide to purchase a new home and need a $100 000 mortgage. You take out a loan from the bank that has an interest rate of 7%. What is the yearly payment to the bank to pay off the loan in 20 years?

The yearly payment to the bank is $9439.29.

$$LV = \frac{FP}{1+i} + \frac{FP}{(1+i)^2} + \frac{FP}{(1+i)^3} + \cdots + \frac{FP}{(1+i)^n}$$

where

$LV$ = loan value amount = $100 000

$i$ = annual interest rate = 0.07

$n$ = number of years = 20

Thus

$$\$100\,000 = \frac{FP}{1+0.07} + \frac{FP}{(1+0.07)^2} + \frac{FP}{(1+0.07)^3} + \cdots + \frac{FP}{(1+0.07)^{20}}$$

# Coupon Bond

Using the same strategy used for the fixed-payment loan:

P = price of coupon bond

C = yearly coupon payment

F = face value of the bond

$n$ = years to maturity date

$$P = \frac{C}{1+i} + \frac{C}{(1+i)^2} + \frac{C}{(1+i)^3} + \ldots + \frac{C}{(1+i)^n} + \frac{F}{(1+i)^n}$$

# Coupon Bond

- When the coupon bond is priced at its face value, the yield to maturity equals the coupon rate.
- The price of a coupon bond and the yield to maturity are negatively related.
- The yield to maturity is greater than the coupon rate when the bond price is below its face value.

**TABLE 1** Yields to Maturity on a 10%-Coupon-Rate Bond Maturing in Ten Years (Face Value = $1,000)

| Price of Bond ($) | Yield to Maturity (%) |
|---|---|
| 1,200 | 7.13 |
| 1,100 | 8.48 |
| 1,000 | 10.00 |
| 900 | 11.75 |
| 800 | 13.81 |

# Coupon Bond

- **Consol** or **perpetuity**: a bond with no maturity date that does not repay principal but pays fixed coupon payments forever

$$P = C / i_c$$

$$P_c = \text{price of the consol}$$

$$C = \text{yearly interest payment}$$

$$i_c = \text{yield to maturity of the consol}$$

$$\text{can rewrite above equation as this}: i_c = C / P_c$$

For coupon bonds, this equation gives the current yield, an easy to calculate approximation to the yield to maturity

# Discount Bond
# or zero-coupon bond

For any one year discount bond

$$i = \frac{F - P}{P}$$

F = Face value of the discount bond

P = current price of the discount bond

The yield to maturity equals the increase in price over the year divided by the initial price.

As with a coupon bond, the yield to maturity is negatively related to the current bond price.

# The Distinction Between Interest Rates and Returns

- Rate of Return:

The payments to the owner plus the change in value expressed as a fraction of the purchase price

$$\text{RET} = \frac{C}{P_t} + \frac{P_{t+1} - P_t}{P_t}$$

RET = return from holding the bond from time $t$ to time $t + 1$

$P_t$ = price of bond at time $t$

$P_{t+1}$ = price of the bond at time $t + 1$

C = coupon payment

$$\frac{C}{P_t} = \text{current yield} = i_c$$

$$\frac{P_{t+1} - P_t}{P_t} = \text{rate of capital gain} = g$$

# Example

## Calculating the Rate of Return

What would the rate of return be on a bond bought for \$1000 and sold one year later for \$800? The bond has a face value of \$1000 and a coupon rate of 8%.

What would the rate of return be on a bond bought for $1000 and sold one year later for $800? The bond has a face value of $1000 and a coupon rate of 8%.

The rate of return on the bond for holding it one year is −12%.

$$RET = \frac{C + P_{t+1} - P_t}{P_t}$$

where

$C$ = coupon payment = $1000 × 0.08 = $80

$P_{t+1}$ = price of the bond one year later = $800

$P_t$ = price of the bond today = $1000

Thus

$$RET = \frac{\$80 + (\$800 - \$1000)}{\$1000} = \frac{-\$120}{\$1000} = -0.12 = -12\%$$

# The Distinction Between Interest Rates and Returns

- The return equals the yield to maturity only if the holding period equals the time to maturity.
- A rise in interest rates is associated with a fall in bond prices, resulting in a capital loss if time to maturity is longer than the holding period.
- The more distant a bond's maturity, the greater the size of the percentage price change associated with an interest-rate change.

# The Distinction Between Interest Rates and Returns

- The more distant a bond's maturity, the lower the rate of return the occurs as a result of an increase in the interest rate.
- Even if a bond has a substantial initial interest rate, its return can be negative if interest rates rise.

# Example

## Calculating the Rate of Capital Gain

Calculate the rate of capital gain or loss on a ten-year zero-coupon bond for which the interest rate has increased from 10% to 20%. The bond has a face value of $1000.

Calculate the rate of capital gain or loss on a ten-year zero-coupon bond for which the interest rate has increased from 10% to 20%. The bond has a face value of $1000.

The rate of capital gain or loss is −49.7%.

$$g = \frac{P_{t+1} - P_t}{P_t}$$

where

$P_{t+1}$ = price of the bond one year from now $= \dfrac{\$1000}{(1 + 0.20)^9} = \$193.81$

$P_t$ = price of the bond today $= \dfrac{\$1000}{(1 + 0.10)^{10}} = \$385.54$

Thus

$$g = \frac{\$193.81 - \$385.54}{\$385.54}$$

$$g = -0.497 = -49.7\%$$

# Maturity and the Volatility of Bond Returns: Interest-Rate Risk

- Prices and returns for long-term bonds are more volatile than those for shorter-term bonds.
- There is no interest-rate risk for any bond whose time to maturity matches the holding period.

# The Distinction Between Real and Nominal Interest Rates

- **Nominal interest rate** makes no allowance for inflation.
- **Real interest rate** is adjusted for changes in price level so it more accurately reflects the cost of borrowing.
  - *Ex ante real interest rate* is adjusted for expected changes in the price level
  - *Ex post real interest rate* is adjusted for actual changes in the price level

# Fisher Equation

$$i = i_r + \pi^e$$

$i$ = nominal interest rate

$i_r$ = real interest rate

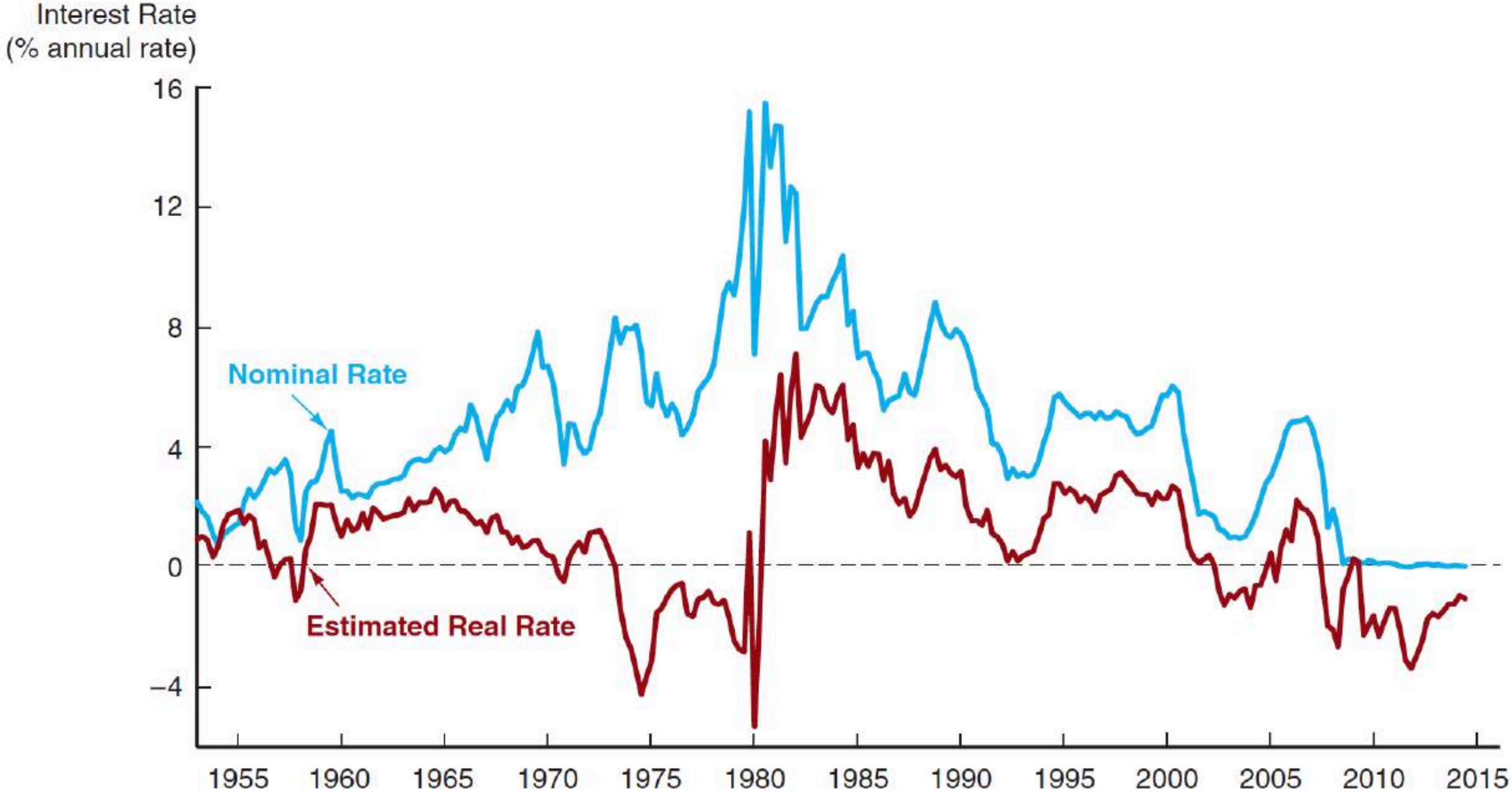
$\pi^e$ = expected inflation rate

When the real interest rate is low,

there are greater incentives to borrow and fewer incentives to lend.

The real interest rate is a better indicator of the incentives to borrow and lend.

# Figure 1 Real and Nominal Interest Rates (Three-Month Treasury Bill), 1953–2014




Sources: Nominal rates from Federal Reserve Bank of St. Louis FRED database: http://research.stlouisfed.org/fred2/. The real rate is constructed using the procedure outlined in Frederic S. Mishkin, "The Real Interest Rate: An Empirical Investigation," Carnegie-Rochester Conference Series on Public Policy 15 (1981): 151–200. This procedure involves estimating expected inflation as a function of past interest rates, inflation, and time trends, and then subtracting the expected inflation measure from the nominal interest rate.

# References

- The Economics of Money, Banking and Financial Markets (8th edition, 2015) Frederic S. Mishkin (Chapter 3 & 4)