Chapter 3: Money & The Interest Rate

Financial Markets

Yeganeh Forouheshfar

International Affairs Department

2nd Semester 2019-2020

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

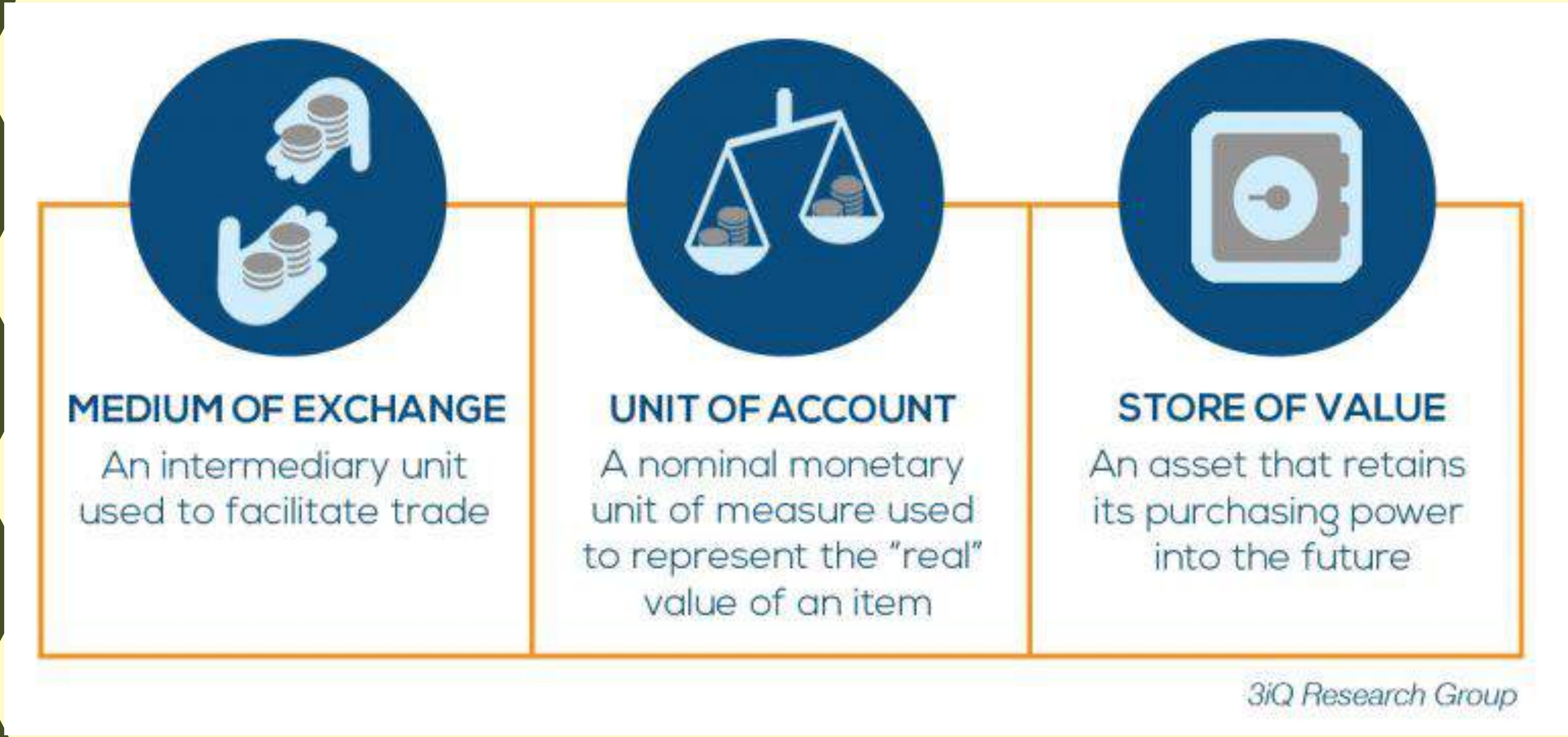
- Money (a stock concept) is different from:
  - **Wealth**: the total collection of pieces of property that serve to store value (includes money but also other assets: bonds, property …)
  - **Income**: flow of earnings per unit of time (a flow concept)
  - Currency: paper money and coins

FUNCTIONS OF MONEY

1. Medium of Exchange

2. Unit of Account

3. Store of Value


MEDIUM OF EXCHANGE
An intermediary unit used to facilitate trade
UNIT OF ACCOUNT
A nominal monetary unit of measure used to represent the "real" value of an item
STORE OF VALUE
An asset that retains its purchasing power into the future
3iQ Research Group

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 according to the inflation rate.

- 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 CRYPTO-CURRENCY BECOME THE MONEY OF THE FUTURE?

Discussion

WILL CRYPTO-CURRENCY 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

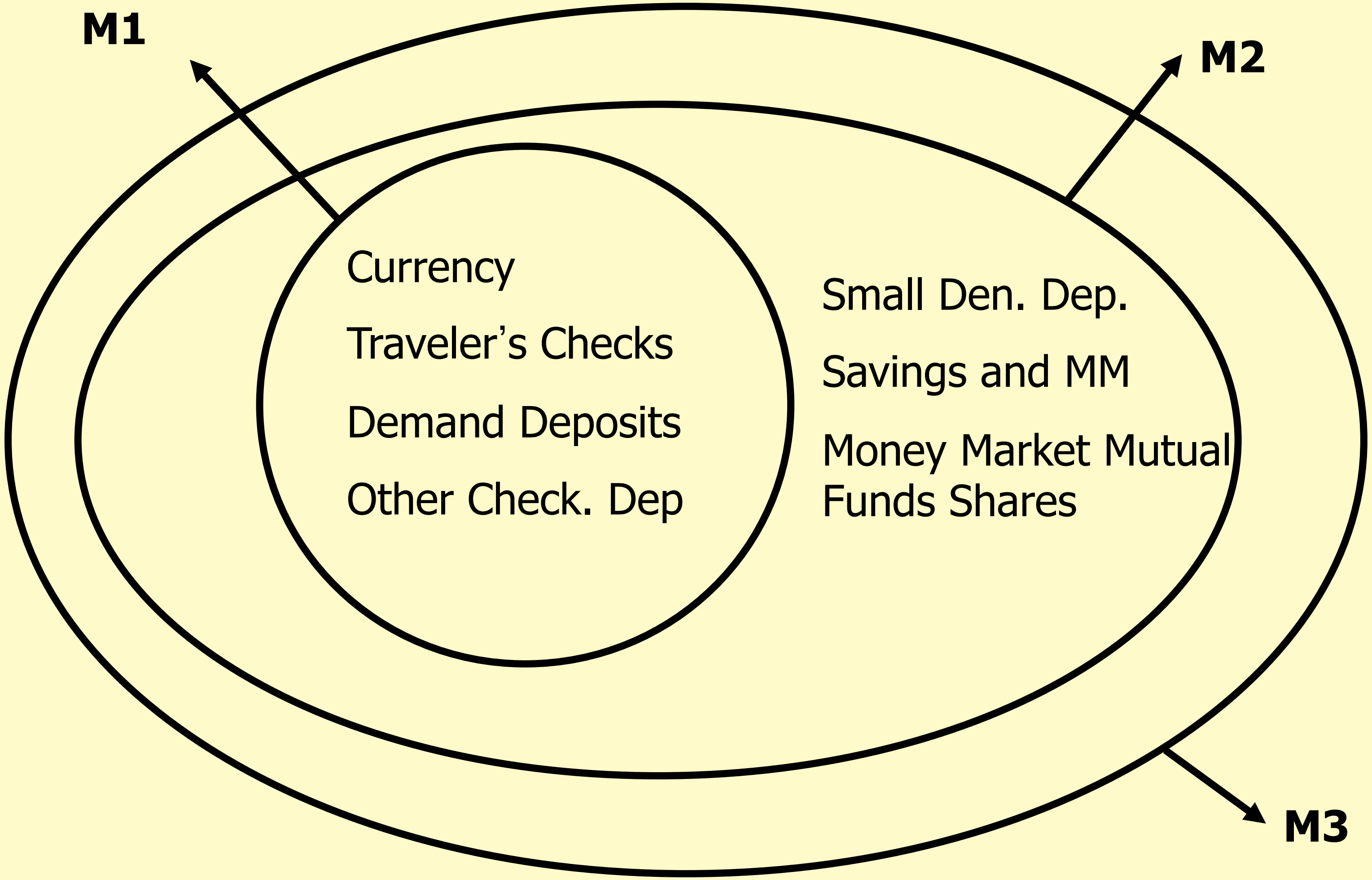


TABLE 3-1 Measures of Monetary Aggregates

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

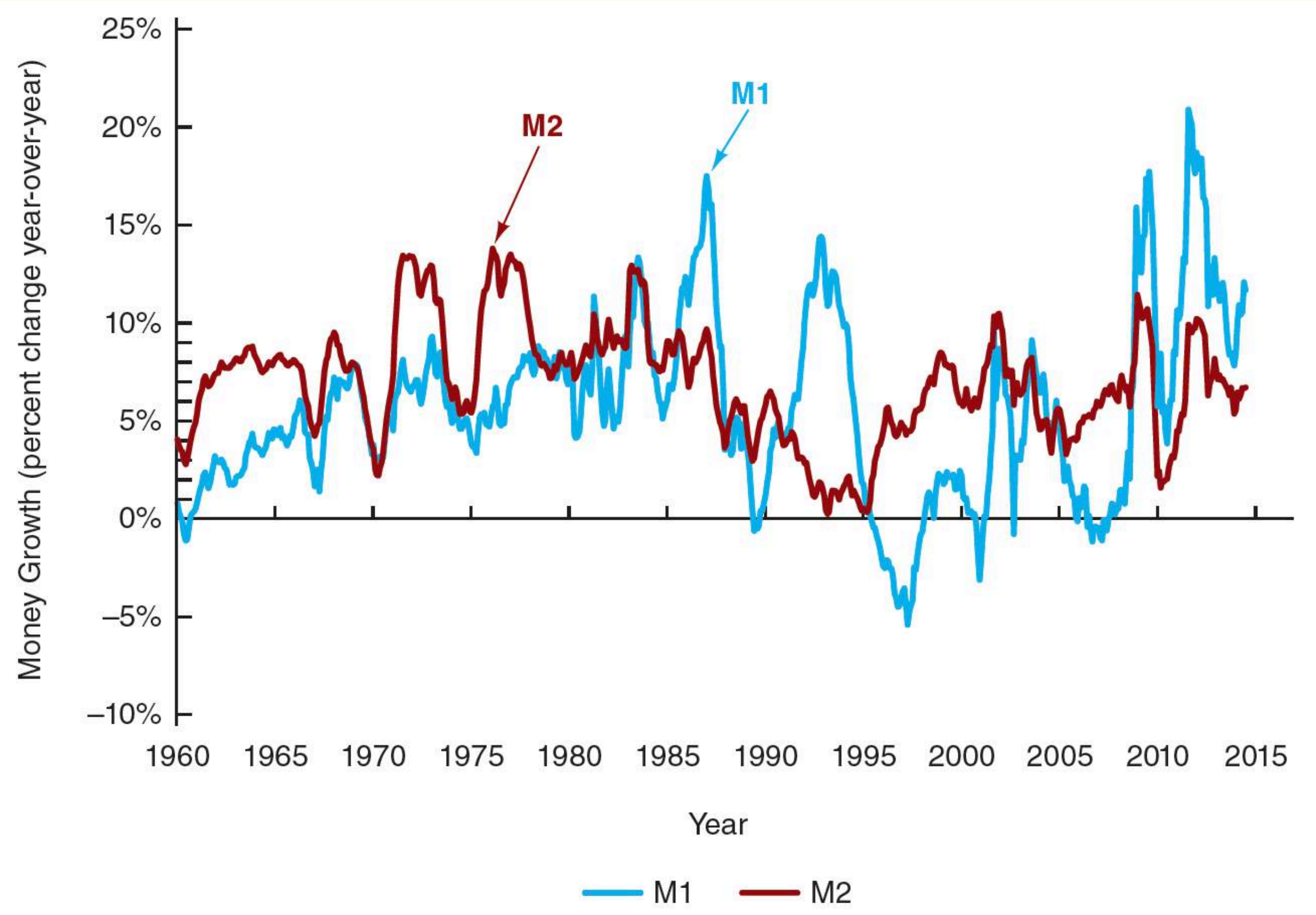
M1++ (gross) = M1+ (gross) plus the following:
All non-chequable deposits at chartered banks, TMLs, and CUCPs.

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

- $M = x_1 + x_2 + \ldots + x_n$

- 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

	\$100	\$100	\$100	\$100
Year	0	1	2	n
PV	100	100/(1+i)	$100/(1+i)^2$	$100/(1+i)^n$

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

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

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

$$\begin{aligned}
C &= \text{coupon payment} = \$1000 \times 0.08 = \$80 \\
P_{t+1} &= \text{price of the bond one year later} = \$800 \\
P_t &= \text{price of the bond today} = \$1000
\end{aligned}$$

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

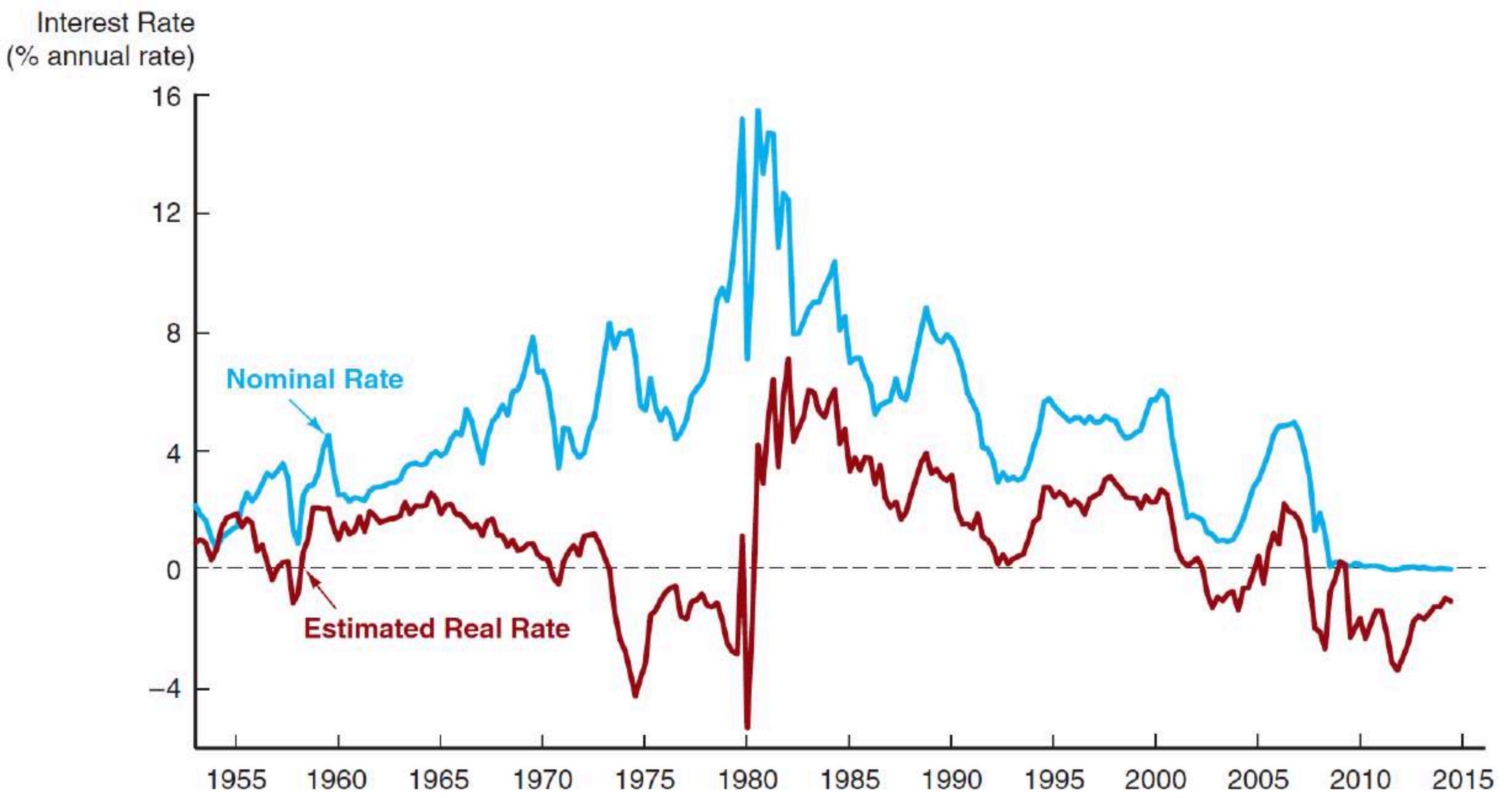
π^e = expected inflation rate

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)