Money and Banking

ZHANG, Guoxiong

guoxiong@sjtu.edu.cn

Lecture 3 Understanding Interest Rate

- Measuring Interest Rate
  - Present value
  - Four types of credit market instruments
    - simple loan
    - fixed-payment loan
    - coupon bond
    - discount bond
  - Yield to maturity

- The distinction between interest rates and return.
  - Maturity and the volatility of bond returns: interest-rate risk

- The distinction between real and nominal interest rates

Present Value

- Different *debt instrument* has different streams of cash payment **(cash flows)** with very different timing
- The concept of **present value** (present discounted value) is based on the common notion that a dollar one year from now is less than one dollar.
- **simple loan**: a loan where the lender provide the borrower with an amount of funds(principle) that must be paid back at the maturity date with an interest payment.

Discounting the Future:

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

PV: the present value

CF: the amount of cash flow

i: nominal interest rate

n: number of years of the cash flow from now

Credit Market Instruments

- Four types of credit markets instruments:
  - **simple loan**
  - **fixed-payment loan(fully amortized loan)**: a loan that must be repaid by making the same payment every period
  - **coupon bond:** pays the owner a fixed interest payment every year and the face value(par value) at the maturity
    - **coupon rate**: yearly coupon payment/face value
  - **discounted coupon**: coupon sold at a price lower than the face value and paid in face value at maturity

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

Fixed-Payment 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

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

We need financial calculators to solve for the yield to maturity i.

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

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

We need financial calculators to solve for the yield to maturity i.

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

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

- 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

Console 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 for long term bonds.

Discount 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

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

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

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

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

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

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 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

Table 2 One-Year Returns on Different-Maturity 10%-Coupon-Rate Bonds

One-Year Returns on Different-Maturity 10%-Coupon-Rate Bonds When Interest Rates Rise from 10% to 20%

(1) Years to Maturity When Bond Is Purchased	(2) Initial Current Yield (%)	(3) Initial Price ($)	(4) Price Next Year* ($)	(5) Rate of Capital Gain (%)	(6) Rate of Return (2 + 5) (%)
30	10	1,000	503	−49.7	−39.7
20	10	1,000	516	−48.4	−38.4
10	10	1,000	597	−40.3	−30.3
5	10	1,000	741	−25.9	−15.9
2	10	1,000	917	−8.3	+1.7
1	10	1,000	1,000	0.0	+10.0

*Calculated with a financial calculator using Equation 3.

The Distinction between Interest Rates and Returns

- 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

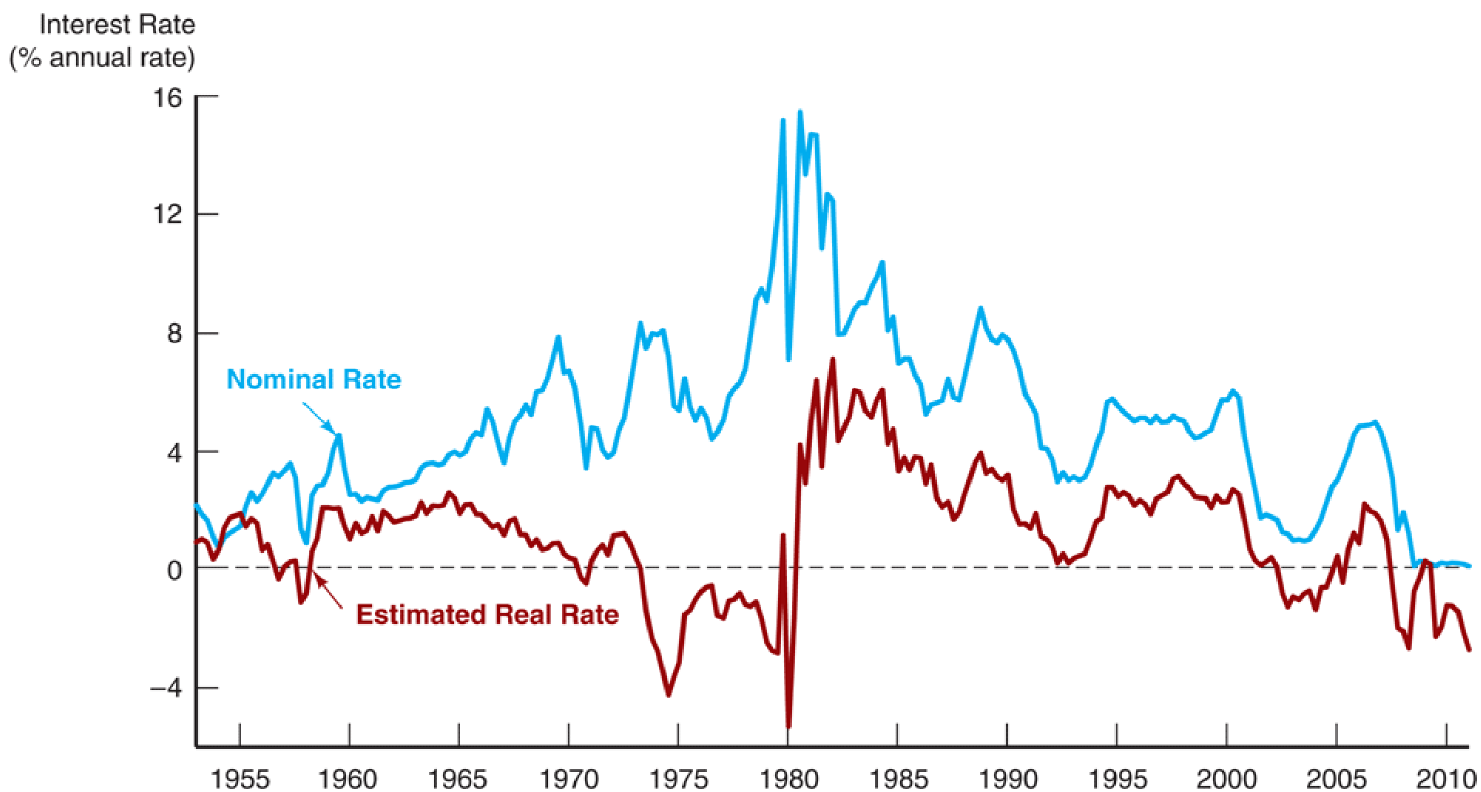
When the real interest rate is low,

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), 1953–2011



Quiz 1: calculate the M1 and M2 growth rate for 2010

	2009	2010
Currency	900	920
Money Market Mutual Fund shares	680	681
Saving account deposit	5,500	5,780
Money market deposit accounts	1,214	1,245
Demand and checkable deposits	1,000	972
Small denomination time deposits	830	861
Traveler’s check	4	4
3-month treasury bill	1,986	2,374