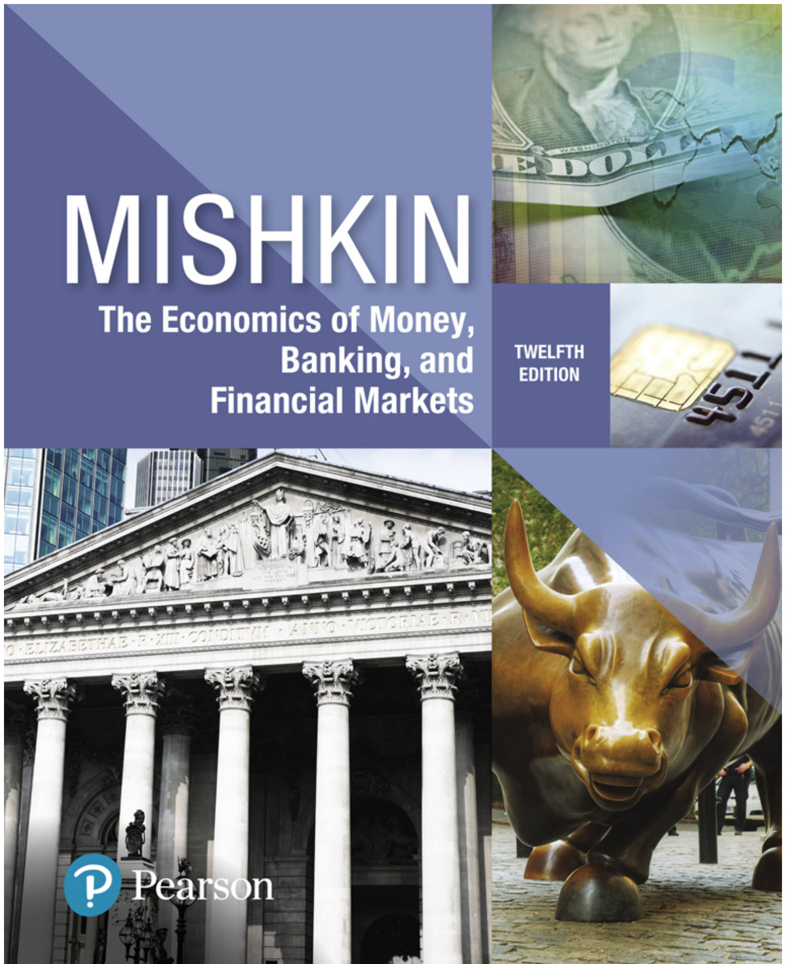
The Economics of Money, Banking, and Financial Markets

Twelfth Edition



Chapter 4

The Meaning of Interest Rates

Preview

- Before we can go on with the study of money, banking, and financial markets, we must understand exactly what the phrase interest rates means. In this chapter, we see that a concept known as the yield to maturity is the most accurate measure of interest rate.

Learning Objectives

- Calculate the present value of future cash flows and the yield to maturity on the four types of credit market instruments.
- Recognize the distinctions among yield to maturity, current yield, rate of return, and rate of capital gain.
- Interpret the distinction between real and nominal 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 $\$1 \times (1+i)$ one year from today.
  – To understand the importance of this notion, consider the value of a $20 million lottery payout today versus a payment of $1 million per year for each of the next 20 years. Are these two values the same?

Present Value

Let $i = .10$

In one year: $\$100 \times (1 + 0.10) = \$110$

In two years: $\$110 \times (1 + 0.10) = \$121$

or $\$100 \times (1 + 0.10)^2$

In three years: $\$121 \times (1 + 0.10) = \$133$

or $\$100 \times (1 + 0.10)^3$

In n years

$\$100 \times (1 + i)^n$

Simple Present Value (1 of 2)

PV = today's (present) value

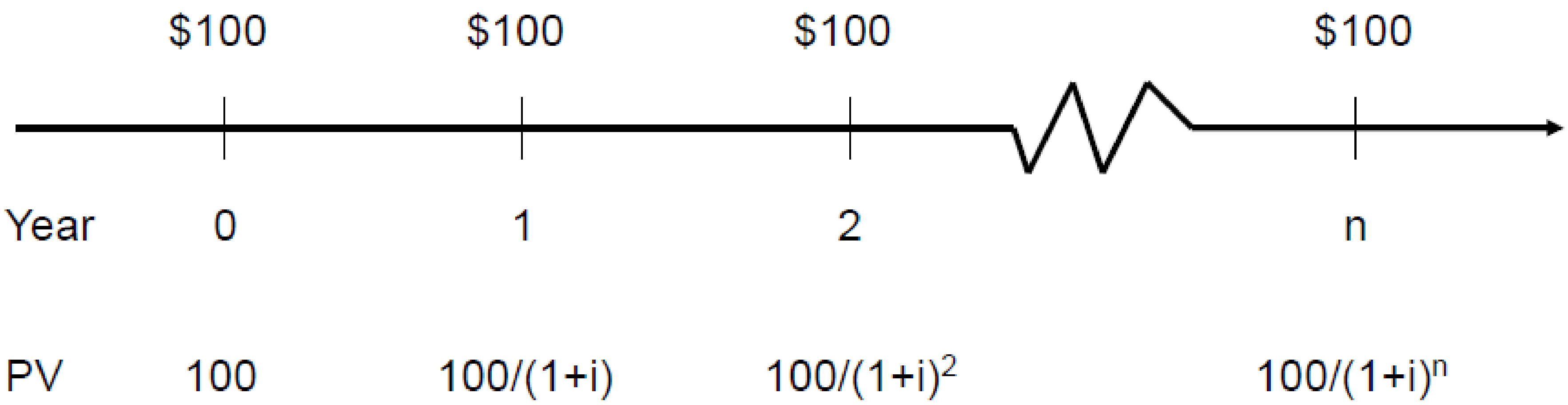
CF = future cash flow (payment)

i = the interest rate

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

Simple Present Value (2 of 2)

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



Four Types of Credit Market Instruments

- Simple Loan
- Fixed Payment Loan
- Coupon Bond
- Discount Bond

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

Yield to Maturity on a Simple Loan

$$\text{PV} = \text{amount borrowed} = \$100$$

$$\text{CF} = \text{cash flow in one year} = \$110$$

$$n = \text{number of years} = 1$$

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

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

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

$$i = 0.10 = 10\%$$

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

Pearson

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

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

Coupon Bond (1 of 4)

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 (2 of 4)

- 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.

Coupon Bond (3 of 4)

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 (4 of 4)

- **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 = price of the consol

C = yearly interest payment

I_c = yield to maturity of the consol

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

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 (1 of 4)

- Rate of Return:

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

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

$$\text{RET} = \text{return from holding the bond from time } t \text{ to time } t+1$$

$$P_t = \text{price of bond at time } t$$

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

$$C = \text{coupon payment}$$

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

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

The Distinction Between Interest Rates and Returns (2 of 4)

- 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.
- Interest rates do not always have to be positive as evidenced by recent experience in Japan and several European states.

The Distinction Between Interest Rates and Returns (3 of 4)

- 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.

The Distinction Between Interest Rates and Returns (4 of 4)

Table 2 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 [col (2) + col (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.

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

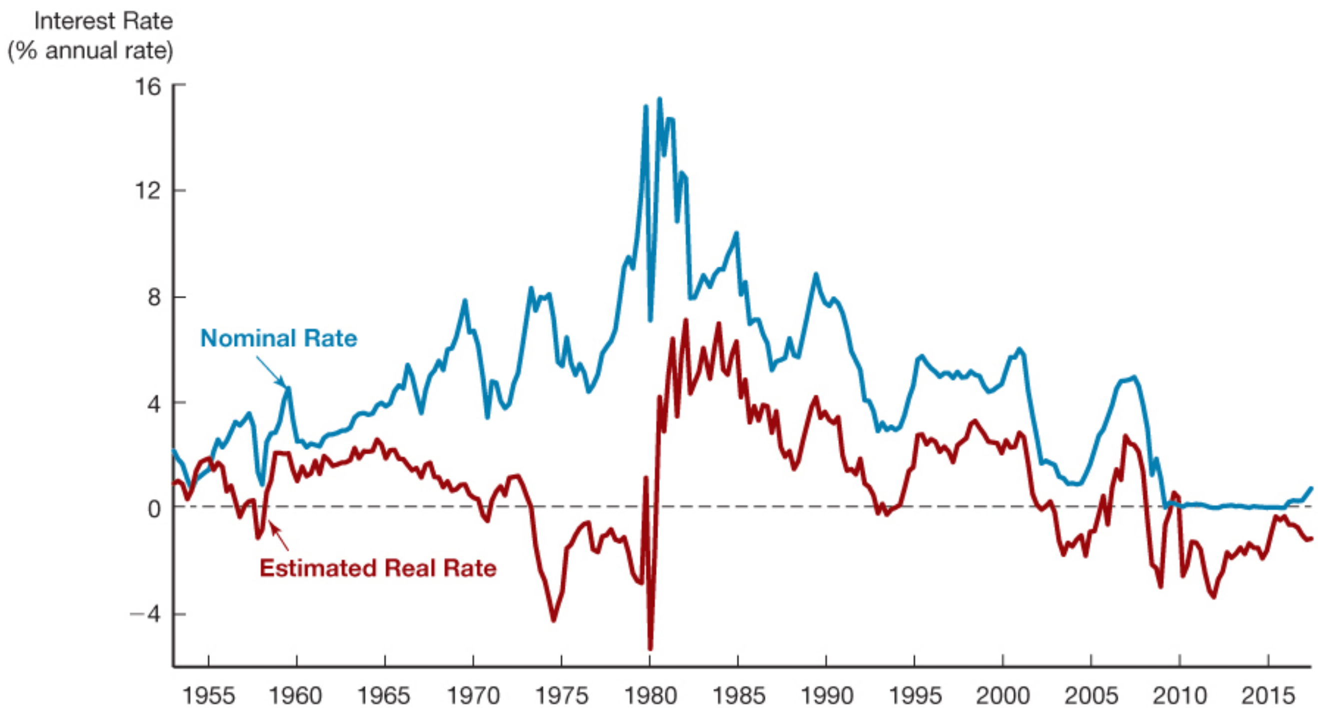
π^e = expected inflation rate

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), 1953–2017



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.

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