INTEREST RATES AND BOND VALUATION

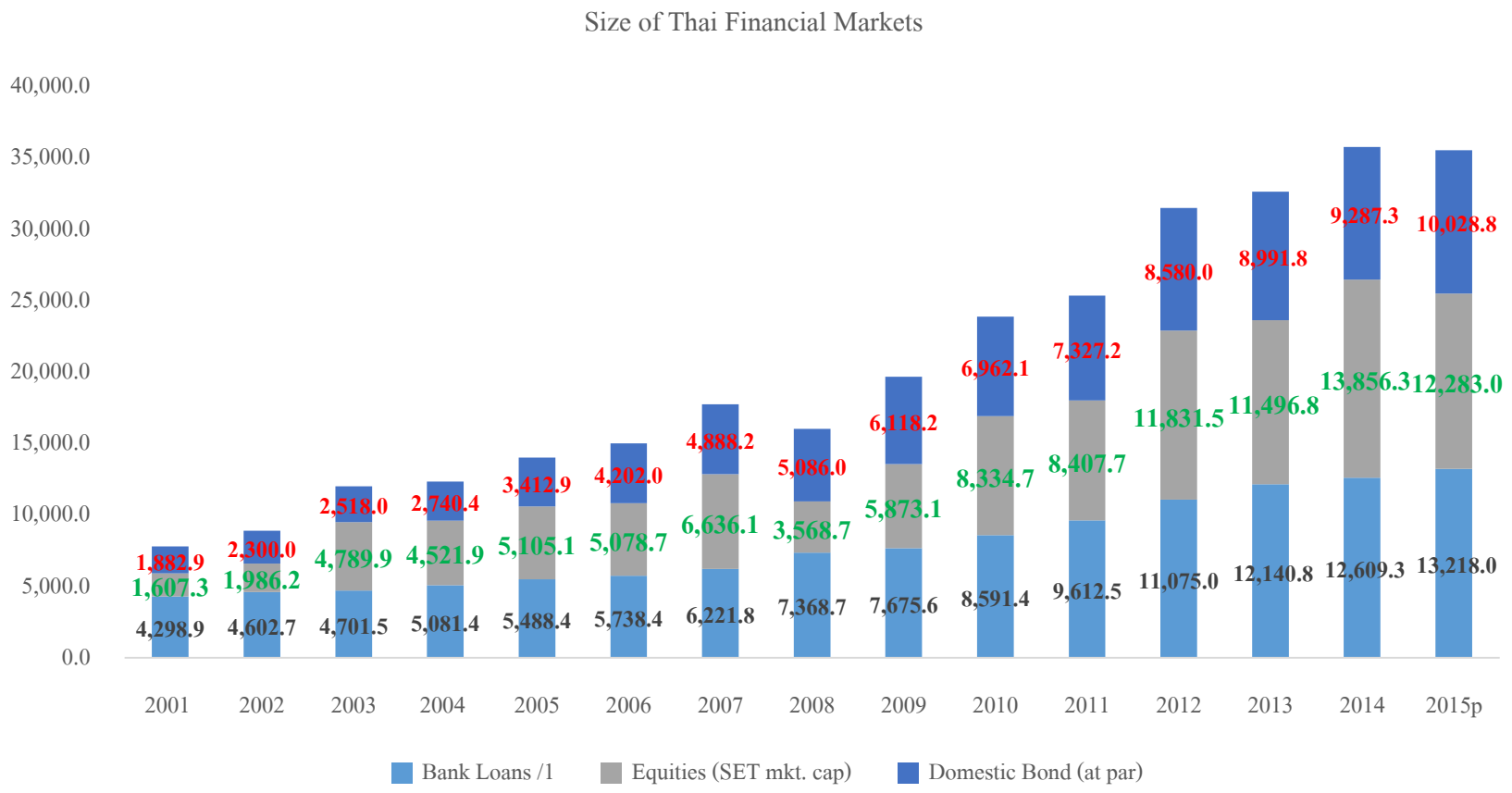
Key Concepts and Skills

- Know the important bond features and bond types
- Understand bond values and why they fluctuate
- Understand bond ratings and what they mean
- Understand the impact of inflation on interest rates
- Understand the term structure of interest rates and the determinants of bond yields

Chapter Outline

- Bonds and Bond Valuation
- More about Bond Features
- Bond Ratings
- Some Different Types of Bonds
- Bond Markets
- Inflation and Interest Rates
- Determinants of Bond Yields

Size of thai financial market



Bond Definitions

- Bond
- Par value (face value)
- Coupon rate
- Coupon payment
- Maturity date
- Yield or Yield to maturity

Present Value of Cash Flows as Rates Change

$$P = \frac{\sum_{t=1}^{n} CF_t}{(1+r)^t}$$

$$\text{A} = C\left[\frac{1-\frac{1}{(1+r)^n}}{r}\right]$$

- Bond Value = PV of coupons + PV of par
- Bond Value = PV of annuity + PV of lump sum
- As interest rates increase, present values decrease
- So, as interest rates increase, bond prices decrease and vice versa

Valuing a Discount Bond with Annual Coupons

- Consider a bond with a coupon rate of 10% and annual coupons.
- The par value is $1,000, and the bond has 5 years to maturity.
- The yield to maturity is 11%. What is the value of the bond?
  - Using the formula:
    - B = PV of annuity + PV of lump sum
    - $B = 100[1 - 1/(1.11)^5] / .11 + 1{,}000 / (1.11)^5$
    - B = 369.59 + 593.45 = 963.04
  - Using the calculator:
    - N = 5; I/Y = 11; PMT = 100; FV = 1,000
    - CPT PV = -963.04

Valuing a Premium Bond with Annual Coupons

- Suppose you are reviewing a bond that has a 10% annual coupon
- Face value of $1000.
- There are 20 years to maturity, and the yield to maturity is 8%.
- What is the price of this bond?
  - Using the formula:
    - B = PV of annuity + PV of lump sum
    - $B = 100[1 - 1/(1.08)^{20}] / .08 + 1000 / (1.08)^{20}$
    - B = 981.81 + 214.55 = 1196.36
  - Using the calculator:
    - N = 20; I/Y = 8; PMT = 100; FV = 1000
    - CPT PV = -1,196.36

The Bond Pricing Equation

$$\text{Bond Value} = C\left[\frac{1 - \frac{1}{(1+r)^t}}{r}\right] + \frac{FV}{(1+r)^t}$$

Example 7.1

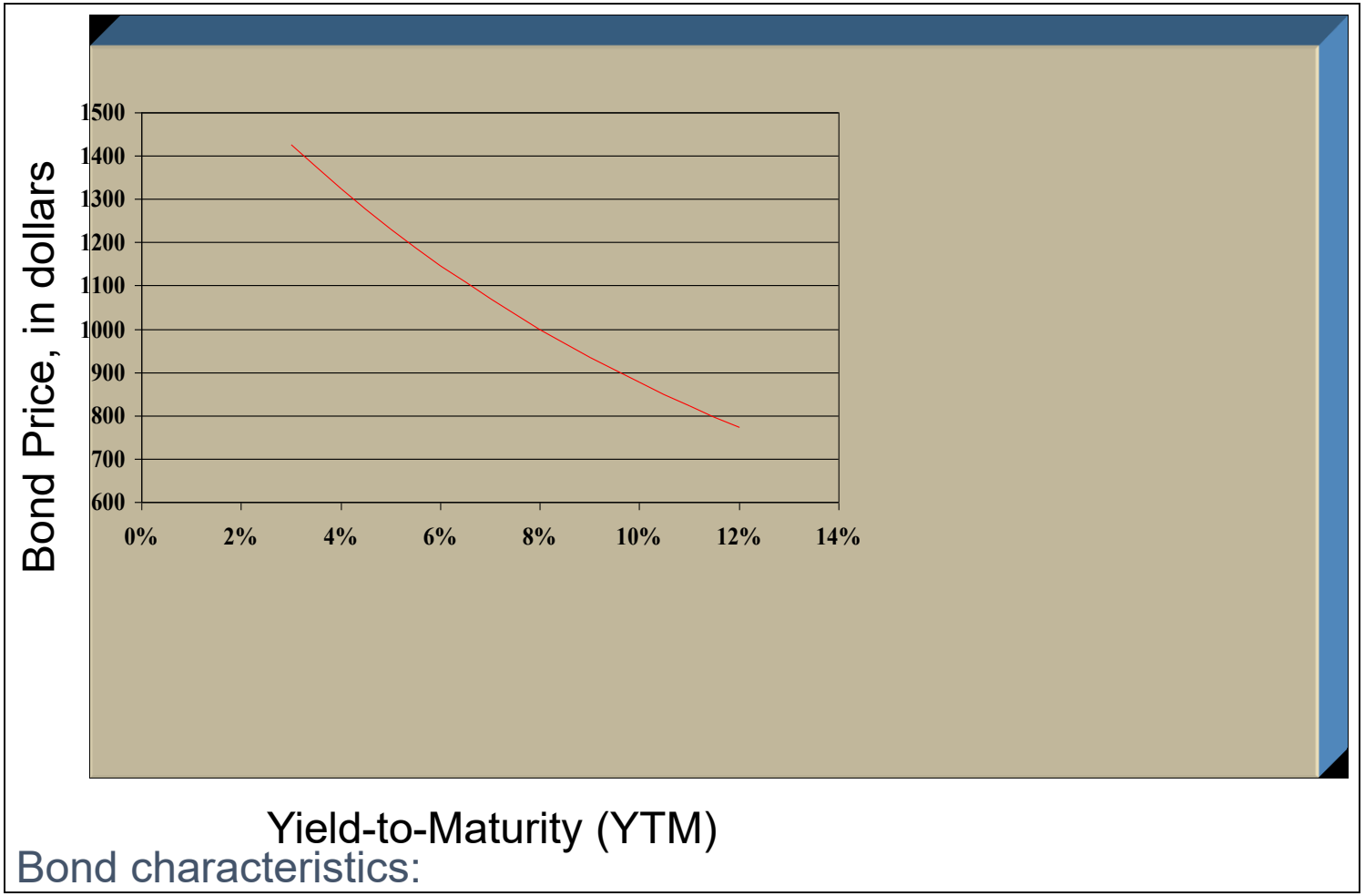
- If an ordinary bond has a coupon rate of 14 percent
- Then the owner will get a total of $140 per year, but this $140 will come in two payments of $70 each.
- The yield to maturity is quoted at 16 percent.
- The bond matures in seven years.

- Note: Bond yields are quoted like APRs; the quoted rate is equal to the actual rate per period multiplied by the number of periods.

Example 7.1

- How many coupon payments are there?
- What is the semiannual coupon payment?
- What is the semiannual yield?
- What is the bond price?
- $B = 70[1 – 1/(1.08)^{14}] / .08 + 1{,}000 / (1.08)^{14} = 917.56$
- Or PMT = 70; N = 14; I/Y = 8; FV = 1,000; CPT PV = -917.56

Graphical Relationship Between Price and Yield-to-maturity (YTM)



Bond characteristics:

10 year maturity, 8% coupon rate, $1,000 par value

Bond Prices: Relationship Between Coupon and Yield

- If YTM = coupon rate, then par value = bond price

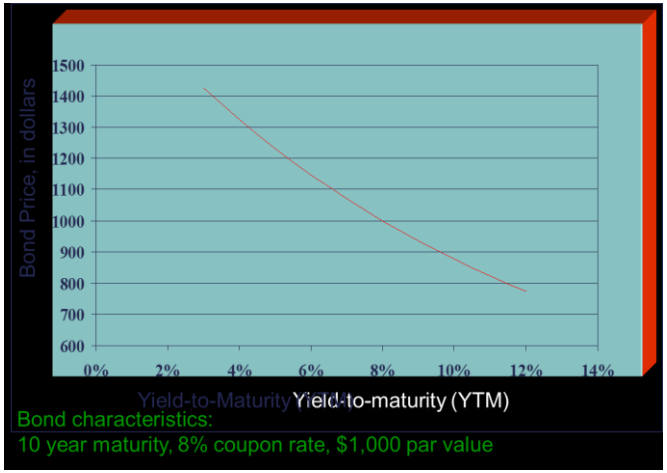
- If YTM > coupon rate, then par value > bond price
  - Why? The discount provides yield above coupon rate
  - Price below par value, called a discount bond

- If YTM < coupon rate, then par value < bond price
  - Why? Higher coupon rate causes value above par
  - Price above par value, called a premium bond

Practice Question1

- Microhard has issued a bond with the following characteristics: Par: $1,000 Time to maturity: 25 years Coupon rate: 7 percent Semiannual payments
- Calculate the price of this bond if the YTM is:
- 1) 7 percent
- 2) 9 percent
- 3) 5 percent

Interest Rate Risk

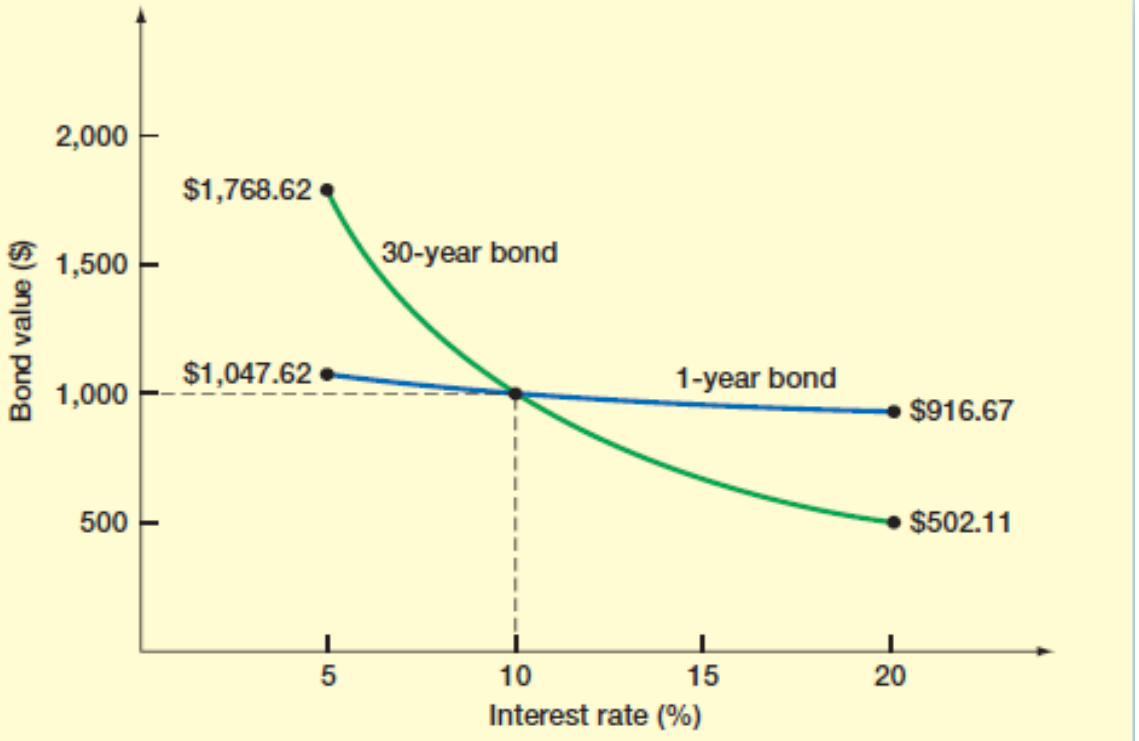


Price Risk

- Change in price due to changes in interest rates
- Long-term bonds have more price risk than short-term bonds
- Low coupon rate bonds have more price risk than high coupon rate bonds

- Reinvestment Rate Risk
  - Uncertainty concerning rates at which cash flows can be reinvested
  - Short-term bonds have more reinvestment rate risk than long-term bonds
  - High coupon rate bonds have more reinvestment rate risk than low coupon rate bonds

Figure 7.2



Value of a Bond with a 10 Percent Coupon Rate for Different Interest Rates and Maturities

	Time to Maturity	
Interest Rate	1 Year	30 Years
5%	$1,047.62	$1,768.62
10	1,000.00	1,000.00
15	956.52	671.70
20	916.67	502.11

Computing Yield to Maturity

- Yield to Maturity (YTM) is the rate implied by the current bond price
- Finding the YTM requires trial and error if you do not have a financial calculator and is similar to the process for finding r with an annuity
- If you have a financial calculator, enter N, PV, PMT, and FV, remembering the sign convention (PMT and FV need to have the same sign, PV the opposite sign)

YTM with Annual Coupons

- Consider a bond with a 10% annual coupon rate, 15 years to maturity and a par value of $1,000. The current price is $928.09.
  - Will the yield be more or less than 10%?
  - N = 15; PV = -928.09; FV = 1,000; PMT = 100; CPT I/Y = 11%

YTM with Semiannual Coupons

- Suppose a bond with a 10% coupon rate and semiannual coupons, has a face value of $1,000, 20 years to maturity and is selling for $1,197.93.
  - Is the YTM more or less than 10%?
  - What is the semiannual coupon payment?
  - How many periods are there?
  - N = 40; PV = -1,197.93; PMT = 50; FV = 1,000; CPT I/Y = 4% (Is this the YTM?)
  - YTM = 4%* 2 = 8%

Practice Question2

- Watters Umbrella Corp. issued 12-year bonds 2 years ago at a coupon rate of 7.8 percent. The bonds make semiannual payments. If these bonds currently sell for 105 percent of par value, what is the YTM?

Practice Question3

- G-Corporation issued 20-year, noncallable, 7.5% annual coupon bonds at their par value of $1,000 one year ago.
- Today, the market interest rate on these bonds is 5.5%.
- What is the current price of the bonds, given that they now have 19 years to maturity?

Challenging Question

- The Morgan Corporation has two different bonds currently outstanding.
  - Bond M has a face value of $20,000 and matures in 20 years. The bond makes no payments for the first six years, then pays $800 every six months over the subsequent eight years, and finally pays $1,000 every six months over the last six years.
  - Bond N also has a face value of $20,000 and a maturity of 20 years; it makes no coupon payments over the life of the bond.
- If the required return on both these bonds is 8 percent compounded semiannually what is the current price of Bond M? Of Bond N?

Current Yield vs. Yield to Maturity

- Current Yield = annual coupon / price
- Yield to maturity = current yield + capital gains yield
- Example: 10% coupon bond, with semiannual coupons, face value of 1,000, 20 years to maturity, $1,197.93 price
  - Find Current Yield, Capital Gain, YTM
  - Current yield = 100 / 1,197.93 = .0835 = 8.35%
  - Price in one year, assuming no change in YTM = 1,193.68
  - Capital gain yield = (1,193.68 – 1,197.93) / 1,197.93 = -.0035 = -.35%
  - YTM = 8.35 - .35 = 8%, which is the same YTM computed earlier

Bond Pricing Theorems

- Bonds of similar risk (and maturity) will be priced to yield about the same return, regardless of the coupon rate
- If you know the price of one bond, you can estimate its YTM and use that to find the price of the second bond
- This is a useful concept that can be transferred to valuing assets other than bonds

Differences Between Debt and Equity

- Debt
  - Not an ownership interest
  - Creditors do not have voting rights
  - Interest is considered a cost of doing business and is tax deductible
  - Creditors have legal recourse if interest or principal payments are missed
  - Excess debt can lead to financial distress and bankruptcy
- Equity
  - Ownership interest
  - Common stockholders vote for the board of directors and other issues
  - Dividends are not considered a cost of doing business and are not tax deductible
  - Dividends are not a liability of the firm, and stockholders have no legal recourse if dividends are not paid
  - An all equity firm can not go bankrupt merely due to debt since it has no debt

The Bond Indenture

- Contract between the company and the bondholders that includes
  - The basic terms of the bonds
  - The total amount of bonds issued
  - A description of property used as security, if applicable
  - Sinking fund provisions
  - Call provisions
  - Details of protective covenants

Example: Callable bond

- Sadik Inc.'s bonds currently sell for $1,180 and have a par value of $1,000. They pay a $105 annual coupon and have a 15-year maturity, but they can be called in 5 years at $1,100. What is their yield to call (YTC)?

-

Bond Classifications

- Registered vs. Bearer Forms
- Security
  - Collateral – secured by financial securities
  - Mortgage – secured by real property, normally land or buildings
  - Debentures – unsecured
  - Notes – unsecured debt with original maturity less than 10 years
- Seniority

Bond Characteristics and Required Returns

- The coupon rate depends on the risk characteristics of the bond when issued

- Which bonds will have the higher coupon, all else equal?
  - Secured debt versus a debenture
  - Subordinated debenture versus senior debt
  - A bond with a sinking fund versus one without
  - A callable bond versus a non-callable bond

Bond Ratings – Investment Quality

- High Grade
  - Moody's Aaa, S&P and Fitch AAA – capacity to pay is extremely strong
  - Moody's Aa, S&P and Fitch AA – capacity to pay is very strong
- Medium Grade
  - Moody's A, S&P and Fitch A – capacity to pay is strong, but more susceptible to changes in circumstances
  - Moody's Baa, S&P and Fitch BBB – capacity to pay is adequate, adverse conditions will have more impact on the firm's ability to pay

Bond Ratings – Speculative Grade

- Low Grade
  - Moody's Ba and B
  - S&P and Fitch BB and B
  - Considered possible that the capacity to pay will degenerate.

- Very Low Grade
  - Moody's C (and below) and S&P and Fitch C (and below)
    - income bonds with no interest being paid, or
    - in default with principal and interest in arrears

Government Bonds

- Treasury Securities
  - Federal government debt
  - T-bills – pure discount bonds with original maturity of one year or less
  - T-notes – coupon debt with original maturity between one and ten years
  - T-bonds – coupon debt with original maturity greater than ten years
- Municipal Securities
  - Debt of state and local governments
  - Varying degrees of default risk, rated similar to corporate debt
  - Interest received is tax-exempt at the federal level

Example 7.4

- A taxable bond has a yield of 8%, and a municipal bond has a yield of 6%.
  - If you are in a 40% tax bracket, which bond do you prefer?
    - 8%(1 - .4) = 4.8%
    - The after-tax return on the corporate bond is 4.8%, compared to a 6% return on the municipal
  - At what tax rate would you be indifferent between the two bonds?
    - 8%(1 – T) = 6%
    - T = 25%

Zero Coupon Bonds

- Make no periodic interest payments (coupon rate = 0%)
- The entire yield-to-maturity comes from the difference between the purchase price and the par value
- Cannot sell for more than par value
- Sometimes called zeroes, deep discount bonds, or original issue discount bonds (OIDs)
- Treasury Bills and principal-only Treasury strips are good examples of zeroes

Floating-Rate Bonds

- Coupon rate floats depending on some index value
- Examples – adjustable rate mortgages and inflation-linked Treasuries
- There is less price risk with floating rate bonds
  - The coupon floats, so it is less likely to differ substantially from the yield-to-maturity
- Coupons may have a “collar” – the rate cannot go above a specified “ceiling” or below a specified “floor”

Other Bond Types

- Disaster bonds
- Income bonds
- Convertible bonds
- Put bonds
- There are many other types of provisions that can be added to a bond and many bonds have several provisions – it is important to recognize how these provisions affect required returns

Sukuk

- Sukuk are bonds have been created to meet a demand for assets that comply with Shariah, or Islamic law
- Shariah does not permit the charging or paying of interest
- Sukuk are typically bought and held to maturity, and are extremely illiquid

Bond Markets

- Primarily over-the-counter transactions with dealers connected electronically
- Extremely large number of bond issues, but generally low daily volume in single issues
- Makes getting up-to-date prices difficult, particularly on small company or municipal issues
- Treasury securities are an exception

Inflation and Interest Rates

- Real rate of interest – change in purchasing power
- Nominal rate of interest – quoted rate of interest, change in actual number of dollars
- The *ex ante* nominal rate of interest includes our desired real rate of return plus an adjustment for expected inflation

The Fisher Effect

- The Fisher Effect defines the relationship between real rates, nominal rates, and inflation

- $(1 + R) = (1 + r)(1 + h)$, where
  - R = nominal rate
  - r = real rate
  - h = expected inflation rate

- Approximation
  - $R = r + h$

Example 7.5

- If we require a 10% real return and we expect inflation to be 8%, what is the nominal rate?
  $(1 + R) = (1 + r)(1 + h)$,
- R = (1.1)(1.08) – 1 = .188 = 18.8%

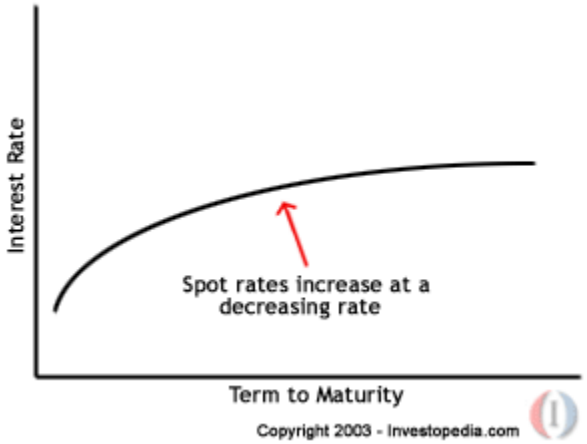
- Approximation: R = 10% + 8% = 18%

- Because the real return and expected inflation are relatively high, there is significant difference between the actual Fisher Effect and the approximation.

Term Structure of Interest Rates

- Term structure is the relationship between time to maturity and yields, all else equal
- It is important to recognize that we pull out the effect of default risk, different coupons, etc.
- Yield curve – graphical representation of the term structure
  - Normal – upward-sloping; long-term yields are higher than short-term yields
  - Inverted – downward-sloping; long-term yields are lower than short-term yields

Yield Curve


Interest Rate
Spot rates increase at a decreasing rate
Term to Maturity
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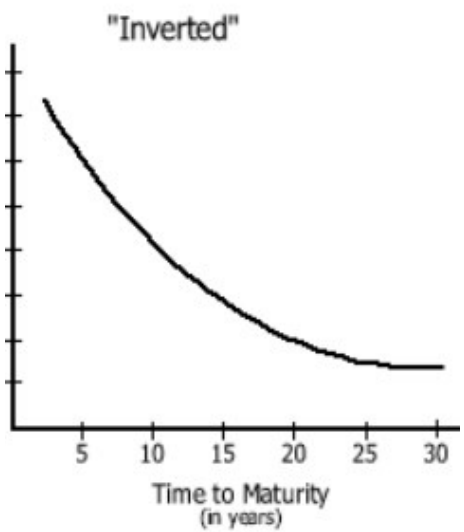
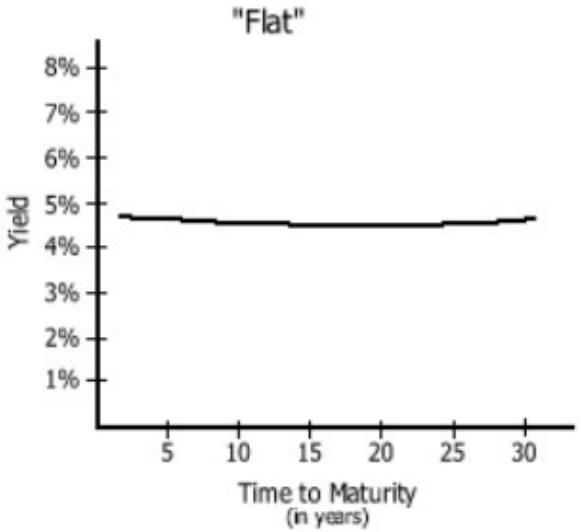

"Inverted"
5
10
15
20
25
30
Time to Maturity
(in years)


"Flat"
Yield
8%
7%
6%
5%
4%
3%
2%
1%
5
10
15
20
25
30
Time to Maturity
(in years)

Factors Affecting Bond Yields

- Real rate of interest
- Expected future inflation premium
- Interest rate risk premium
- Default risk premium
- Taxability premium
- Liquidity premium

Quick Quiz: 15 minutes

- How do you find the value of a bond, and why do bond prices change?
- What is a bond indenture, and what are some of the important features?
- What are bond ratings, and why are they important?
- How does inflation affect interest rates?
- What is the term structure of interest rates?
- What factors determine the required return on bonds?

Comprehensive Problem

- What is the price of a $1,000 par value bond with a 6% coupon rate paid semiannually, if the bond is priced to yield 5% and it has 9 years to maturity?
- What would be the price of the bond if the yield rose to 7%?
- What is the current yield on the bond if the YTM is 7%?

Ethics Issues

- In 1996, allegations were made against Moody's that it was issuing ratings on bonds it had not been hired to rate, in order to pressure issuers to pay for their service.

- The government conducted an inquiry, but charges of antitrust violations were dropped. Even though no legal action was taken, does an ethical issue exist?

Chapter 7

End of Chapter