Bonds – Chapter 7

- Introduction, definitions and terminology.
- Valuation: Bond Prices
- Interest Rate Risk and Bond Price Sensitivity
- Yield to Maturity and Current Yield
- More about Bond Features
- Bond Rating
- Government Bonds
- Zero coupon bonds, Floating rate bonds
- Other types of Bonds:
- Bond Markets
- Inflation and Interest Rates. The Fisher Effect
- Term Structure of Interest Rates and the Yield Curve

Introduction

- Bonds, to corporations, are a valuable vehicle for borrowing long term funds to finance long term investments. They are generally fixed income, long-term securities (level coupon bonds)
- They are recorded as debt on the borrower's balance sheet (the firm) and assets on the lender's balance sheet (the investor).
- The yield to maturity is the required market interest rate on the bond, which typically differ from coupon rate.
- Who issues bonds?
  - Federal Governments
  - Municipalities (local governments)
  - Corporations

Bond Features and Prices

When a corporation or government wishes to borrow money from the public on a long-term basis, it usually does so by issuing or selling debt securities that are generically called bonds

Suppose the Beck Corporation wants to borrow $1,000 for 30 years. The interest rate on similar debt issued by similar corporations is 12%. Beck will thus pay .12 × $1,000 = $120 in interest every year for 30 years. At the end of 30 years, Beck will repay the $1,000.

- **Coupon** is the stated interest payment made on a bond (That is, $120).
- **Face value**, or par value, is the principal amount of a bond that is repair at the end of the term (That is, $1,000).
- **Coupon rate** is the annual coupon divided by the face value of the bond (That is, $120÷$1,000 = .12, or 12%).
- **Maturity** is the specified date on which the principal amount of a bond is paid (That is, 30 years).

Bond Values and Yields

Over time, interest rates change in the marketplace, but the cash flows from a bond remain the same; as a result, the value of the bond will fluctuate.

- When interest rates rise, the present value of the bond's remaining cash flows declines, and the bond is worth less.
- When interest rates fall, the bond is worth more.

To find the value of a bond at a particular point in time, we need the following pieces of information:

- Number of periods remaining until maturity.
- Face value.
- Coupon.
- **Yield to maturity (YTM)**, or yield, which is the rate required in the market on a bond.

Valuation Fundamentals

- Valuation is the process that links risk and return to determine the value of an asset.
- The time value of money techniques we discussed earlier is used for valuation.
- The value of any asset depends on the cash flow(s) it is expected to generate over the ownership period (size, time and riskiness or the cash flows)
- Greater risk is incorporated into the valuation by using a higher required return or discount rate (Yield to maturity for bonds)

Basic Valuation Model

- The value of an asset is the present value of all future cash flows it is expected to generate over the relevant time period.
- The value of an asset is determined by discounting the expected cash flows back to their present value using the appropriate required rate of return to the riskiness of the asset.

$$PV = \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3} + \cdots + \frac{C_T}{(1+r)^T}$$

- There is an inverse relationship between the asset's value and the asset's required rate of return (r)

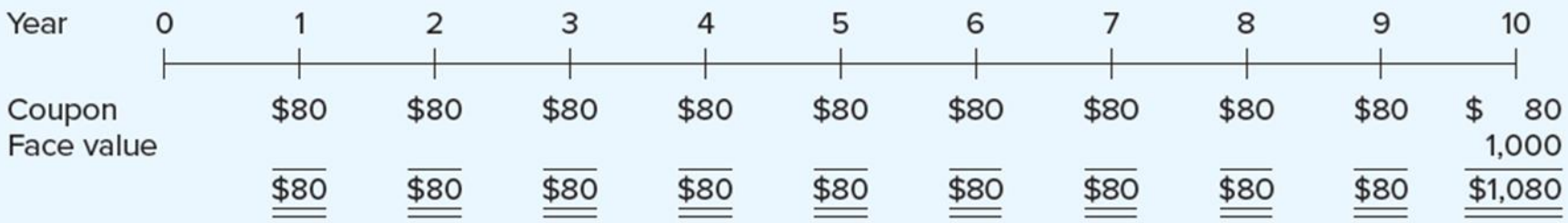
Example: Bond Values and Yields - (**Par Value Bond**)

Suppose Xanth Co. were to issue a bond with 10 years to maturity. The Xanth bond has an annual coupon of $80. Similar bonds have a yield to maturity of 8%. What would this bond sell for?

- Bond will pay $80 per year for the next 10 years in coupon interest. In 10 years, Xanth will pay $1,000 to the bond owner.

- Cash flows for the bond have an annuity component (the coupons) and a lump sum (the face value paid at maturity).
- Cash flows for the bond are shown below:

Cash flows



As shown, the Xanth bond has an annual coupon of $80 and a face, or par, value of $1,000 paid at maturity in 10 years.

At the going rate of 8%, the **PV of the $1,000 face paid in 10 years is**:

$$PV = \frac{C_T}{(1+r)^T} = 1000\ x\ 1/(1+.08)^{10} = 463.19$$

Bond offers $80 per year for 10 years**; PV of this annuity stream is:**

$$\mathrm{PV} = \mathrm{C} \times \left\{ 1 - \left[1 \Big/ (1+r)^{t} \right] \right\} \Big/ r$$

$$\begin{aligned} \text{Annuity present value} &= \$80 \times \left(1 - 1/1.08^{10}\right)/.08 \\ &= \$80 \times \left(1 - 1/2.1589\right)/.08 \\ &= \$80 \times 6.7101 \\ &= \mathbf{\$536.81.} \end{aligned}$$

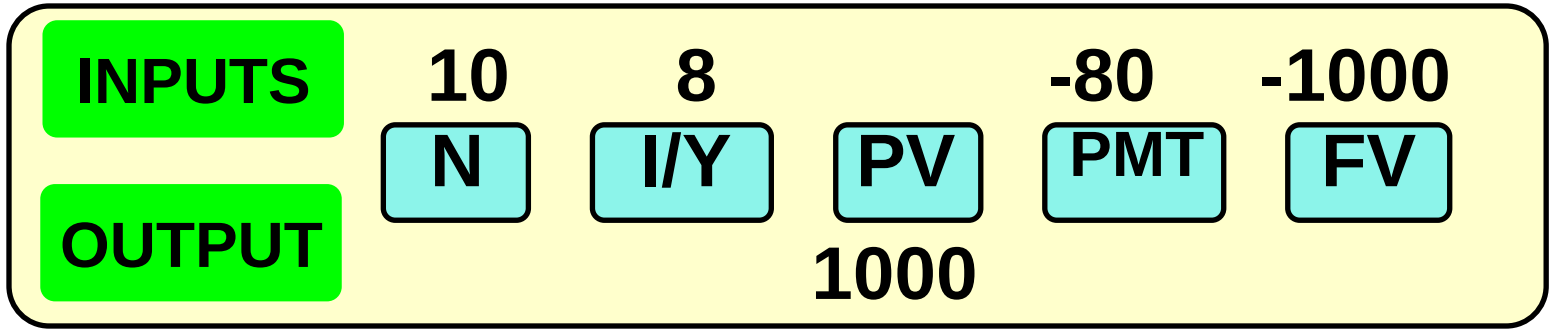
Add the values for the two parts together to get the bond's value:

Total bond value = $463.19 + 536.81 = **$1,000.**

- This bond sells for exactly the face value, so it is a ***par value bond***.

8% annual coupon, 10 years to maturity, $1000 face value, 8% yield to maturity

- **Financial calculator solution**



- **Excel =PV(Rate,Nper,Pmt,FV,Type)**
  =PV(.08,10,-80,-1000,0) = $1000

Example: Bond Values and Yields – (Discount Bond)

Suppose a year has gone by. The Xanth bond now has nine years to maturity. If the interest rate in the market has risen to 10%, what will the bond be worth?

Present value of the $1,000 face paid in nine years at 10% is:

$$PV = \frac{F}{(1+r)^T} = 1000\ x\ 1/(1+.1)^9 = 424.10$$

$$\text{Present value} = \$1{,}000/1.10^9 = \$1{,}000/2.3579 \ \mathbf{= \$424.10.}$$

Bond now offers $80 per year for nine years; the **present value of this annuity stream at 10% is:**

$$\text{PV} = \text{C} \times \left\{1 - \left[1/(1+r)^t\right]\right\} / r$$

$$\text{Annuity present value} = \$80 \times \left(1 - 1/1.10^9\right)/.10$$

$$= \$80 \times \left(1 - 1/2.3579\right)/.10$$

$$= \$80 \times 5.7590$$

$$\mathbf{= \$460.70.}$$

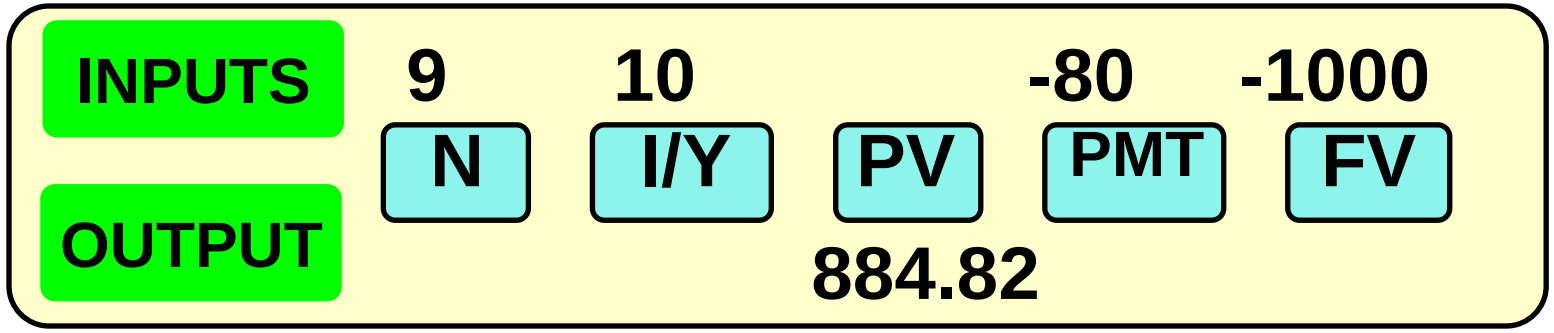
Add the values for the two parts together to get the bond's value:

- **Total bond value** = $424.10 + 460.72 = **$884.82.**

- This bond sells for less than face value, so it is a ***discount bond***.

8% annual coupon,9 years to maturity, $1000 face value, 10% Yield to maturity

- **Financial calculator solution**



- **Excel =PV(Rate,Nper,Pmt,FV,Type)**
  =PV(.1,9,-80,-1000,0) = $884.82

Example: Bond Values and Yields: (Premium Bond)

What would the Xanth bond sell for if interest rates had dropped by 2% instead of rising by 2%? In other words, assume the bond has a coupon rate of 8% when the market rate is now only 6%. (9 years left to maturity)

The present value of the $1,000 face amount is:

$$PV = \frac{C_T}{(1+r)^T} = 1000\ x\ \frac{1}{(1+.06)9} = 591.90$$

The present value of the coupon annuity stream is:

$$\text{Annuity present value} = \$80 \times \left(1 - 1/1.06^{9}\right)/.06$$
$$= \$80 \times \left(1 - 1/1.6895\right)/.06$$
$$= \$80 \times 6.8017$$
$$\mathbf{= \$544.14.}$$

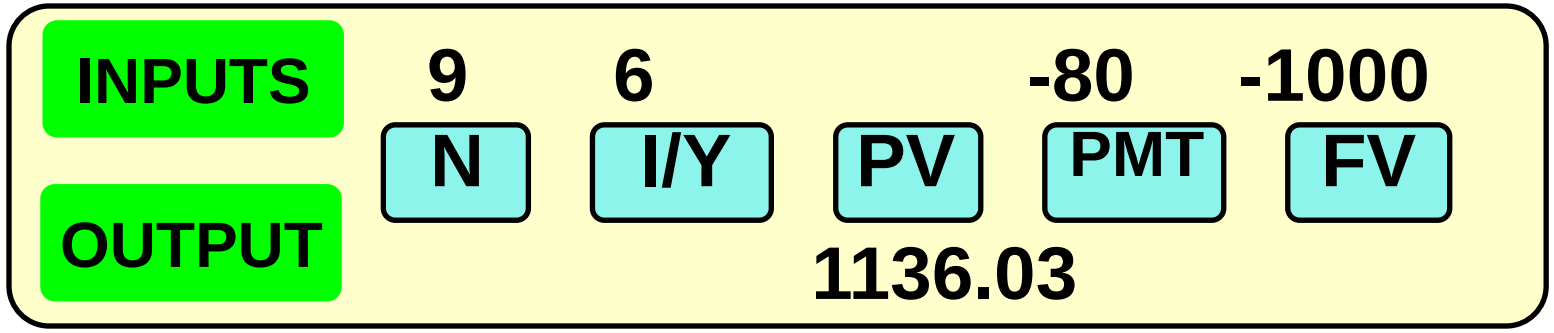
Add the values for the two parts together to get the bond's value:

- **Total bond value** = $591.90 + 544.14 = **$1,136.03.**

- This bond sells for more than face value, so it is a ***premium bond.***

8% annual coupon, 9 years to maturity, $1000 face value, 6% Yield to maturity

- **Financial calculator solution**



- **Excel =PV(Rate,Nper,Pmt,FV,Type)**
  =PV(.06,9,-80,-1000,0) = $1,136.03

Bond Valuation – Level coupon bond

- The basic valuation equation can be customized for use in valuating specific securities such as bonds.
- For a level coupon bond this can be rewritten as:

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

$$\text{Bond value} = \begin{matrix}\text{Present value} \\ \text{of the coupons}\end{matrix} + \begin{matrix}\text{Present value} \\ \text{of the face amount}\end{matrix}$$

C : Bond annual coupon
r : Bond required rate of return (Yield to maturity)
T=t : number of years to maturity
F: Bond face Value

For semiannual bonds: you divide C and r by 2, and multiply T by 2

Relationship between YTM and bond Value

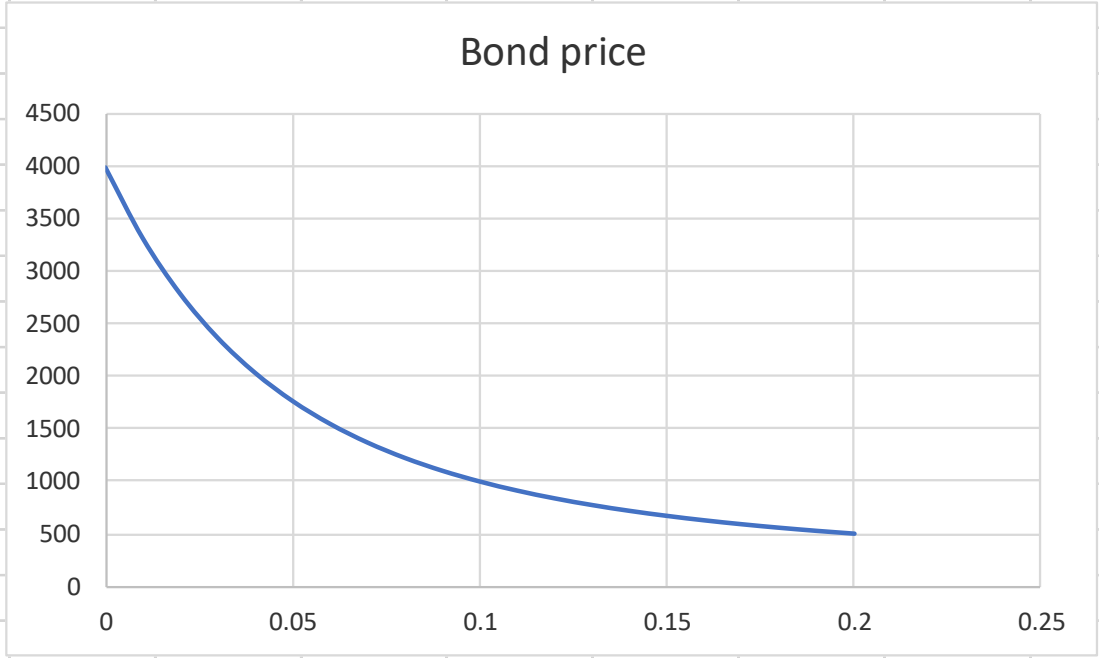
- As interest rates increase, present values decrease
- So, as interest rates increase, bond prices decrease and vice versa
- When the required rate of return on a bond (YTM) is equal to the bond's coupon rate, the bond's value is equal to par (it sells at par)
- Whenever the required return on a bond (YTM) differs from the bond's coupon rate, the bond's value will differ from its face value
- **If YTM = coupon rate, then par value = bond price (Par Bond)**
- **If YTM > coupon rate, then par value > bond price (Discount Bond)**
- **If YTM < coupon rate, then par value < bond price (Premium Bond)**

- At maturity the value of any bond must equal its Par

Relationship between yield to maturity and bond prices

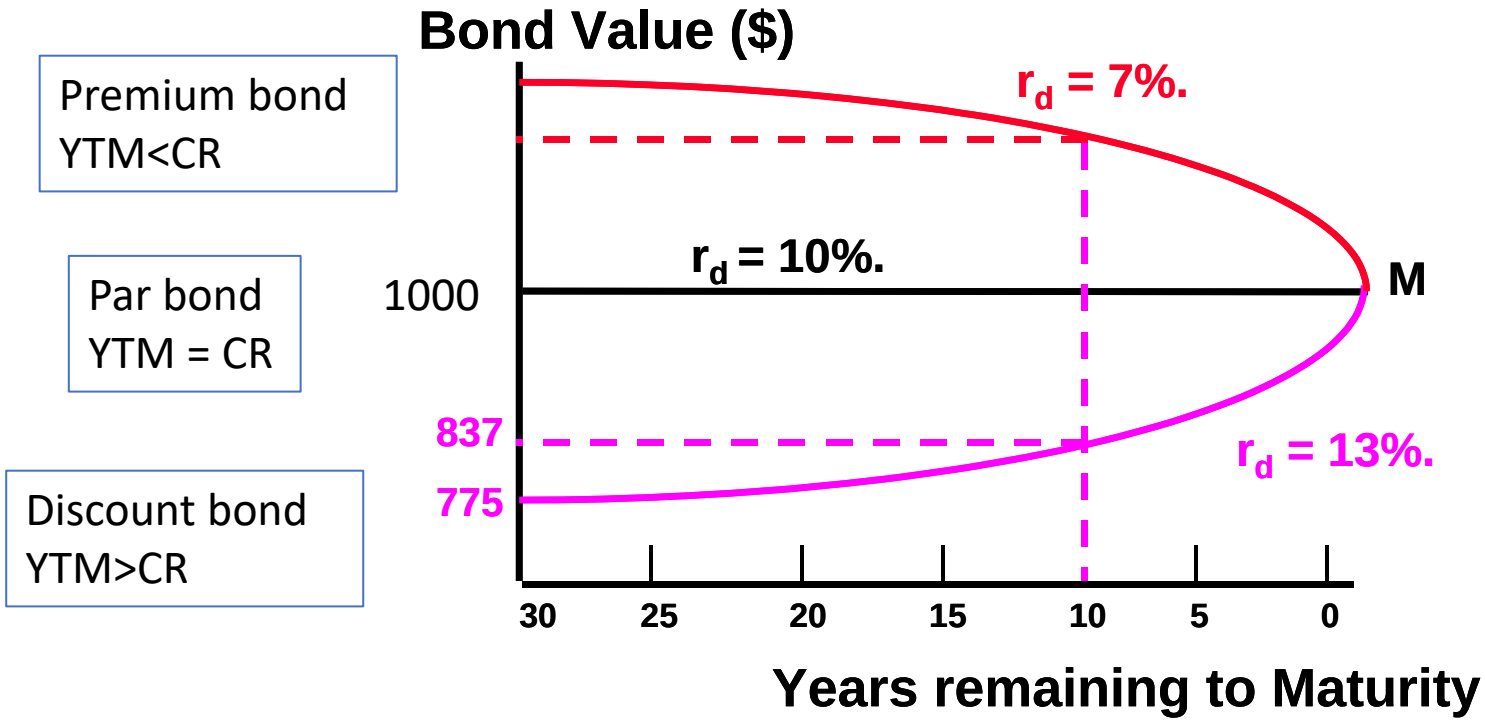
Data used: 1000 par, 10% annual coupon, 30 years to maturity

YTM	Bond price
0%	$4,000.00
1%	$3,322.69
2%	$2,791.72
3%	$2,372.03
4%	$2,037.52
5%	$1,768.62
6%	$1,550.59
7%	$1,372.27
8%	$1,225.16
9%	$1,102.74
10%	$1,000.00
11%	$913.06
12%	$838.90
13%	$775.13
14%	$719.89
15%	$671.70
16%	$629.37
17%	$591.94
18%	$558.66
19%	$528.88
20%	$502.11



Changes in Term to Maturity (Time to maturity)

- As a bond approaches its maturity date, the price must approach its face value.



Practice: Annual Bond Price

Calculate the price of a bond with a 10% annual coupon has a face value of $1,000, 20 years to maturity, if:

a. The required rate of return (yield to maturity) is 8%. (1,196.36)
b. The required rate of return (yield to maturity) is 10%. (1,000.00)
c. The required rate of return (yield to maturity) is 12%. (850.61)

Semi Annual Coupons

- In practice, bonds issued in the United States usually make coupon payments twice a year. So, if an ordinary bond has a coupon rate of 14%, then the owner will get a total of $140 per year, but this $140 will come in two payments of $70 each. Suppose we are examining such a bond. The yield to maturity is at 16%, and it has 10 years to maturity.

- Bond yields are quoted like APRs; the quoted rate is equal to the actual rate per period multiplied by the number of periods. In this case, with a 16% quoted with semi-annual payments, the true yield is 8% per six months (16%/2). The bond matures in ten years. What is the bond's price? What is the effective annual yield on this bond?

- Based on our discussion, we know the bond will sell at a discount because it has a coupon rate of 7% every six months when the market requires 8% every six months. So, if our answer exceeds $1,000, we know we have made a mistake.

Example: Semi Annual Coupons
Coupon rate 14%, Yield to maturity rate16%, Years to maturity 10

To get the exact price, we first calculate the present value of the bond's face value of $1,000 paid in ten years. This ten-year period has 20 periods of six months each. At 8% per period, the value is:

$$\text{Present value} = \frac{\$1{,}000}{1.08^{20}} = \frac{\$1{,}000}{4.6610} = \$214.55$$

The coupons can be viewed as a 20-period annuity of $70 per period. At an 8% discount rate, the present value of such an annuity is:

$$\text{Annuity present value} = \$70 \times \frac{\left(1 - \frac{1}{1.08^{20}}\right)}{.08} \qquad = \$70 \times \frac{(1 - .21455)}{.08}$$

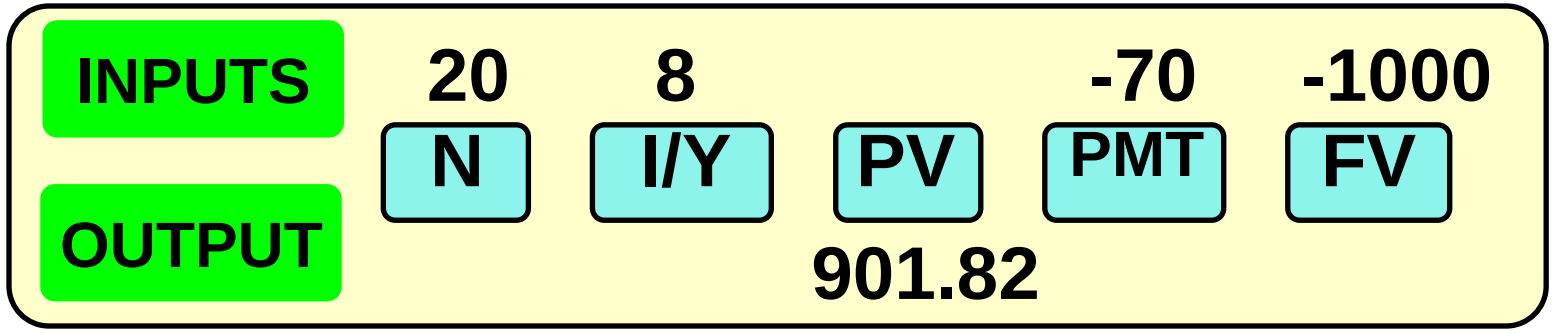
$$= \$70 \times 9.8181 \qquad = \$687.27$$

The total present value gives us what the bond should sell for:

Total present value = $214.55 + 687.27 = $901.82

Coupon rate 14% (semi-annual), Yield to maturity rate16%, Years to maturity 10

- **Financial calculator solution**



- **Excel =PV(Rate,Nper,Pmt,FV,Type)**
  =PV(.16/2,10*2,-70,-1000,0) = $901.82

Effective Annual Rate of Return on the 8% Semiannual Bond

$$EAR = \left[1 + \frac{R}{m}\right]^{m} - 1$$

$$EAR = \left[1 + \frac{.08}{2}\right]^{2} - 1 = 8.16\%$$

m = the number of times compounding occur each year

R = APR

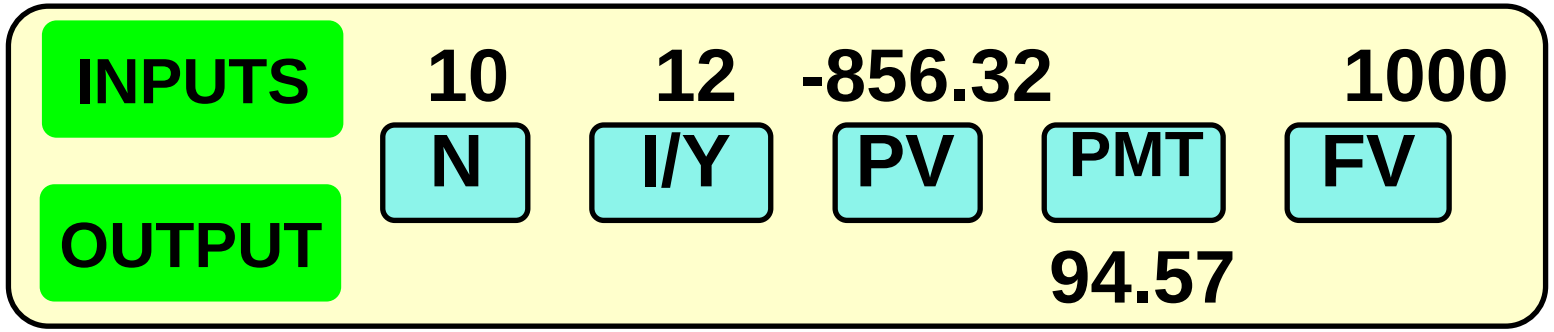
Practice: Semiannual Bond Price

Calculate the price of a bond with a 10% semiannual coupon has a face value of $1,000, 20 years to maturity, if:

a. The required rate of return (yield to maturity) is 8%. (1,197.93)
b. The required rate of return (yield to maturity) is 10%. (1,000.00)
c. The required rate of return (yield to maturity) is 12%. (849.54)

Finding the coupon

- Find the coupon rate on an annual bond with $1,000 par, 10 years to maturity and 12% required rate of return, if current market price is $ 856.32



If annual coupon payment is $94.57
Then coupon rate is = 94.57/1000 = 9.46%

Interest Rate Risk

- *Interest rate* risk arises from fluctuating interest rates, and the degree of interest rate risk a bond has depends on its sensitivity to interest rate changes, which directly depends on two things:

1. Time to maturity.
2. Coupon rate.

- All other things being equal:

1. **The longer the time to maturity, the greater the interest rate risk.**
2. **The lower the coupon rate, the greater the interest rate risk**.

- Interest rate risk increases at a decreasing rate.
- We can illustrate the effect of interest rate risk using the 100-year BellSouth (AT&T) issue:

Maturity	Coupon Rate	Price on 12/31/95 (when issued)	Price on 3/6/09 (4 years later)	Percentage Change in (Price 2009-Price 1995)/Price 1995	Price on 11/08/19 (10 years later)	Percentage Change in (Price 2019– Price 2009)/Price 2009
2095	7.00%	$1,000.00	$803.43	−19.66%	$1,229.50	53.03%

Change rate = (ending price – beginning price)/ Beginning price

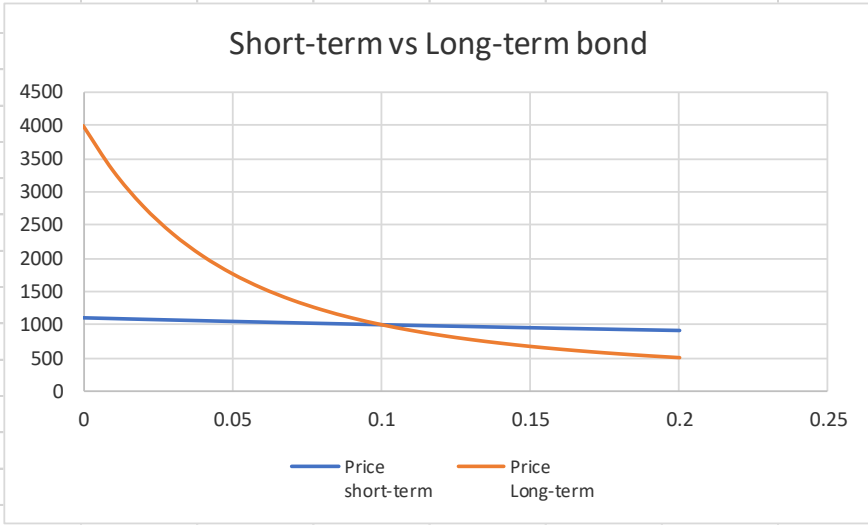
Interest Rate Risk and Time to Maturity

The longer the time to maturity, the greater the interest rate risk

Long term bonds prices are more sensitive to changes in interest rates than short term bonds

Notice the slope of the line connecting prices is much steeper for the 30-year bond than for the 1-year bond.
This tells us a relatively small change in interest rates will lead to a substantial change in the bond's value.

CR	10%	10%
Face	1,000.00	1,000.00
Years to m	1	30
rate	Price short-term	Price Long-term
0%	$1,100.00	$4,000.00
1%	$1,089.11	$3,322.69
2%	$1,078.43	$2,791.72
3%	$1,067.96	$2,372.03
4%	$1,057.69	$2,037.52
5%	$1,047.62	$1,768.62
6%	$1,037.74	$1,550.59
7%	$1,028.04	$1,372.27
8%	$1,018.52	$1,225.16
9%	$1,009.17	$1,102.74
10%	$1,000.00	$1,000.00
11%	$990.99	$913.06
12%	$982.14	$838.90
13%	$973.45	$775.13
14%	$964.91	$719.89
15%	$956.52	$671.70
16%	$948.28	$629.37
17%	$940.17	$591.94
18%	$932.20	$558.66
19%	$924.37	$528.88
20%	$916.67	$502.11



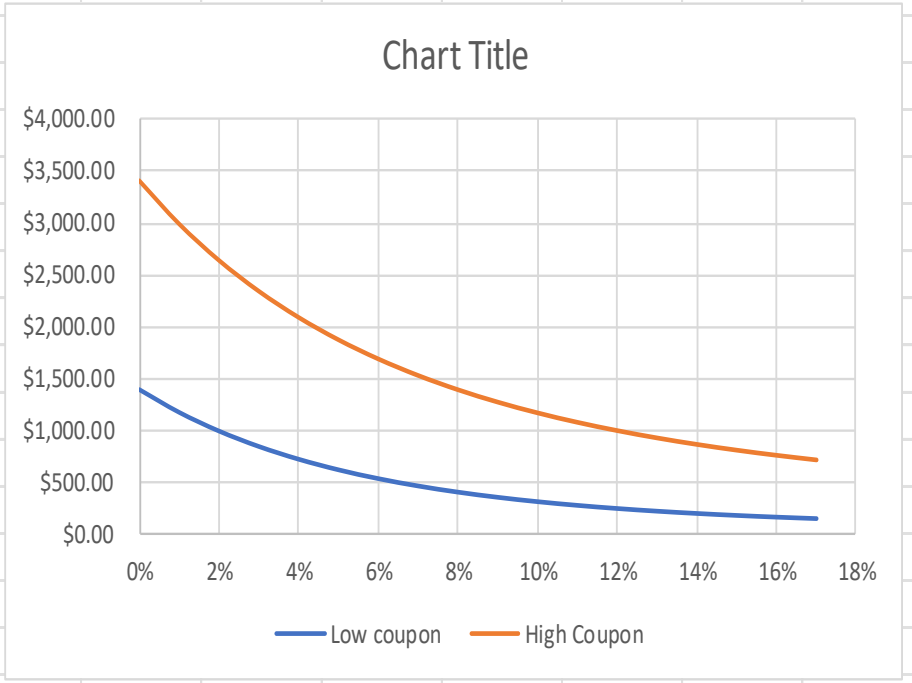
Interest Rate Risk and Coupon rate

The lower the coupon rate, the greater the interest rate risk.

Data used: $1000 par, 20 years to maturity
Low coupon bond: 2%
High coupon bond 12%

High-coupon bonds prices are less sensitive to changes in interest rates than are low coupon bonds

0%	$1,400.00	$3,400.00	-15.68%	-12.21%
1%	$1,180.46	$2,985.01	-15.29%	-11.72%
2%	$1,000.00	$2,635.14	-14.88%	-11.24%
3%	$851.23	$2,338.97	-14.45%	-10.76%
4%	$728.19	$2,087.23	-14.02%	-10.29%
5%	$626.13	$1,872.35	-13.56%	-9.84%
6%	$541.20	$1,688.20	-13.10%	-9.39%
7%	$470.30	$1,529.70	-12.63%	-8.95%
8%	$410.91	$1,392.73	-12.15%	-8.54%
9%	$361.00	$1,273.86	-11.66%	-8.13%
10%	$318.91	$1,170.27	-11.17%	-7.75%
11%	$283.30	$1,079.63	-10.68%	-7.38%
12%	$253.06	$1,000.00	-10.19%	-7.02%
13%	$227.28	$929.75	-9.70%	-6.69%
14%	$205.22	$867.54	-9.23%	-6.38%
15%	$186.29	$812.22	-8.76%	-6.08%
16%	$169.96	$762.85	-8.31%	-5.80%
17%	$155.83	$718.61	-7.88%	-5.54%



The reason bonds with lower coupons have greatest interest rate risk is that:

The bond with the higher coupon has a larger cash flow early in its life, so its value is less sensitive to changes in the discount rate.

Bond Return Measures

There are several ways to calculate the returns offered by bonds:

- **Current Yield:** $$Current\ Yield = \frac{Annual\ Payment}{Current\ Bond\ Price}$$

Current yield is a rough measure of the return earned over the next year, but it ignores compounding and the change in price that may occur over the life of the bond.

- **Yield to Maturity**

Yield to Maturity (YTM) Is equal to the rate of return that equates the price of the bond to the present value of the coupon and principal payments. So, it is the rate implied by the current bond price.
Finding the YTM requires trial and error if you do not have a financial calculator or access to spread sheets and is similar to the process for finding *IRR*.

It is the compound annual rate of return that can be expected if the bond is held to maturity, it accounts for both interest payments and capital gains.

$$\text{Bond Price} = C\left[\frac{1-\frac{1}{(1+\text{YTM})^{T}}}{\text{YTM}}\right] + \frac{\text{F}}{(1+YTM)^{\text{T}}}$$

A bond's yield to maturity should not be confused with its current yield, which is the bond's annual coupon divided by its price.

Bond Yield to Maturity

$$\text{Bond value} = C \times \left[1 - 1 \Big/ (1+r)^t \right] \Big/ r + F \Big/ (1+r)^t$$

Finding the Yield on a Bond

Given a bond value, coupon, time to maturity, and face value, it is possible to find the implicit discount rate, or yield to maturity, by trial and error only. To do this, try different discount rates until the calculated bond value equals the given value (or let a financial calculator do it for you). Remember that increasing the rate decreases the bond value.

Finding the Yield to Maturity: Trial and Error

- Suppose we are interested in a six-year, 8% coupon bond with annual payments. A broker quotes a price of $955.14. What is the yield on this bond?

- Price of a bond can be written as the sum of its annuity and lump sum components. Knowing there is an $80 coupon for six years and a $1,000 face value, we can say that the price is:

$$\text{Bond value} = C \times \left[1 - 1/(1+r)^t\right]/r + F/(1+r)^t$$

$$\$955.14 = \$80 \times \left[1 - 1/(1+r)^6\right]/r + 1{,}000/(1+r)^6.$$

- where r is the unknown discount rate, or yield to maturity; we cannot solve it for r explicitly so we must use trial and error.

- Bond has an $80 coupon and is **selling at a discount, so the yield is greater than 8%**. If we compute the price at 10%, we will see 10% is too high because the value we calculate ($912.89) is lower than the actual price ($955.14):

$$\text{Bond value} = \$80 \times \left(1 - 1/1.10^6\right)/.10 + \$1{,}000/1.10^6.$$

$$= \$80 \times 4.3553 + \$1{,}000/1.7716 \quad \mathbf{= \$912.89.}$$

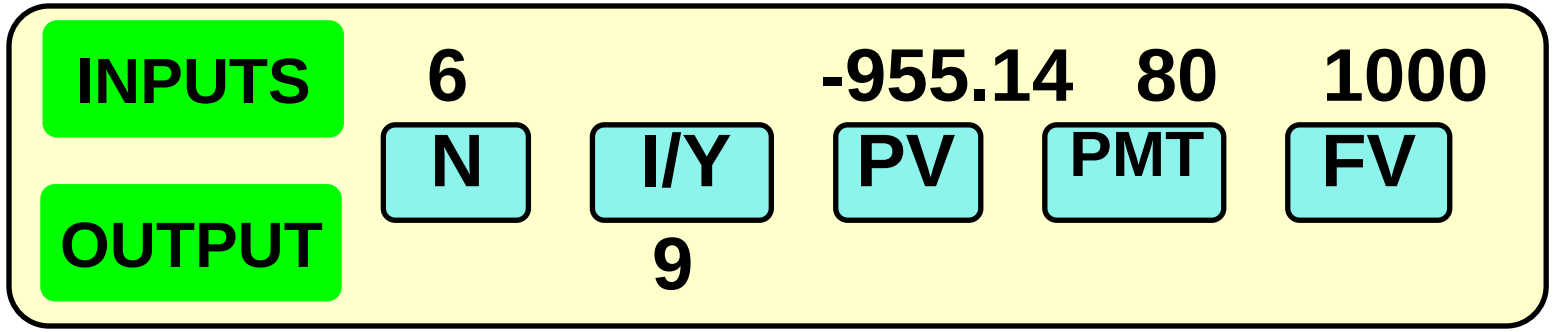
In the example we just worked on the previous slide, the bond's annual coupon was $80, and its price was $955.14.

$$Current\ \ Yield = \frac{Annual\ \ Payment}{Current\ \ Bond\ \ \Pr ice}$$=80/955.14 = .00838 = 8.38%

- Yield to maturity was 9 percent (found by trial and error)
- Next slide we calculate Yield to maturity using financial calculator and Excel.

Bond has an 8% **annual coupon rate** and is selling for $955.14 and has 6 years to maturity and face value of $1000

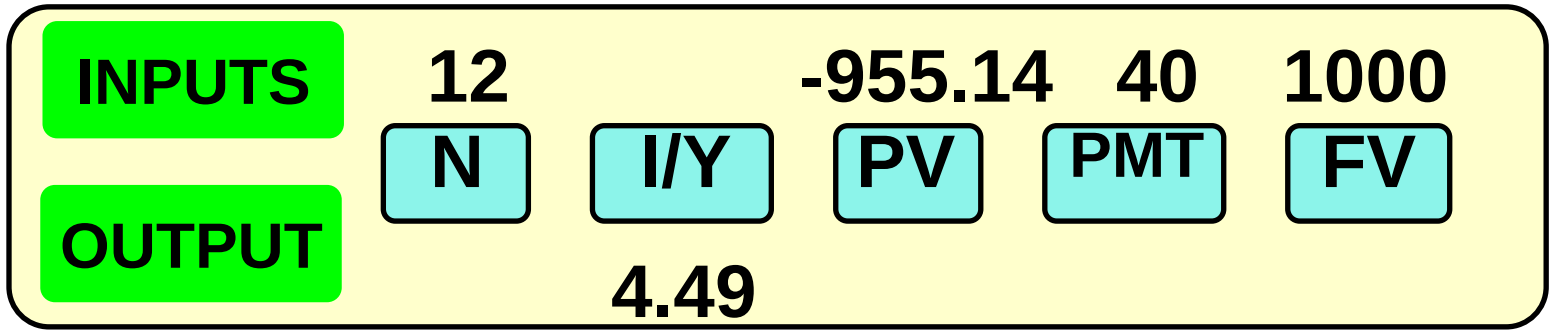
- **Financial calculator solution**



- **Excel =Rate(Nper,Pmt,PV,FV,Type,guess)**
  =PV(6,80,-955.14,1000,0) = 9%

Bond has an 8% **semi-annual coupon rate** and is selling for $955.14 and has 6 years to maturity and face value of $1000

- **Financial calculator solution**



4.49% is semiannual yield to maturity. Annual YTM = 4.49x2 = 9.98%

- **Excel =Rate(Nper,Pmt,PV,FV,Type,guess)**
  =PV(6*2,80/2,-955.14,1000,0) = 4.49%

4.49% is semiannual yield to maturity. Annual YTM = 4.49x2 = 9.98%

Finding bond number of years to maturity

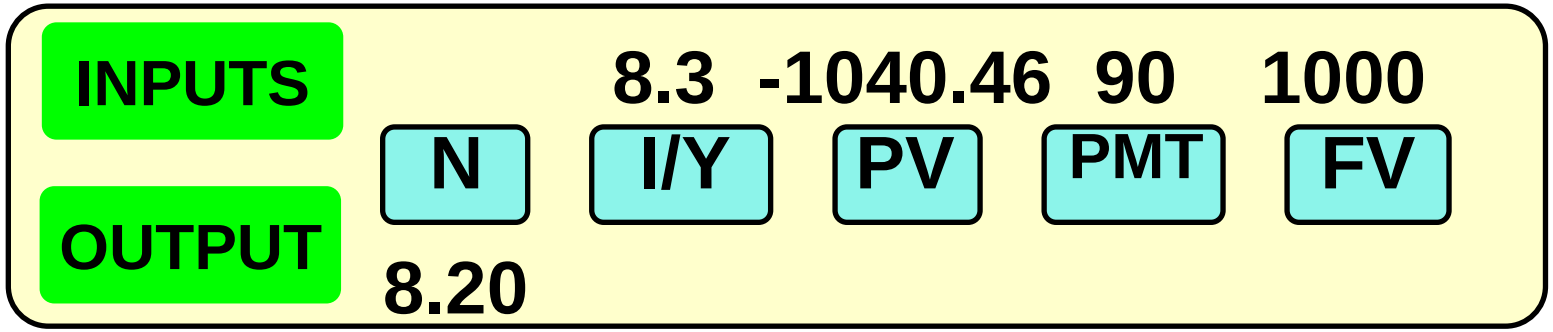
Moham Corporation has 9% coupon bonds making annual payments with a YTM of 8.3%. The current yield on these bonds is 8.65%. How many years do these bonds have left until they mature? (assume face value is $1,000)

Step 1: Use current yield to find Current price:

.0865= 90/price

Current Price = 90/.0865 = $1,040.46

Step 2: Use financial calculator or formula to find number of years (N)



Practice - Yield to Maturity and Current Yield

1) What is the **Yield to maturity** and **Current Yield** on $1,000, 8% annual coupon bond and 10-years to maturity, if the current market price of the bond is:

a. $800 (YTM: 11.46%) (CY: 10%)
b. $1,000 (YTM: 8%) (CY: 8%)
c. $1.100 (YTM: 6.60%) (CY: 7.27%)

2)) What is the **Yield to maturity, and Current Yield** on $1,000, 8% semi-annual coupon bond and 10-years to maturity, if the current market price of the bond is:

a. $800 (YTM: 11.40%) (CY: 10%)
b. $1,000 (YTM: 8%) (CY: 8%)
c. $1.100 (YTM: 6.62%) (CY: 7.27%)

Current Events - Example

A bond has a quoted price of $1,080.42. It has a face value of $1,000, a semi-annual coupon of $30 (coupon rate 6% pay semi-annual coupon of $30) and a maturity of five years. What is its **current yield**? What is its **yield to maturity**? Which is bigger? Why?

Notice that this bond makes semi-annual payments of $30, so the annual payment is $60.

The current yield is thus $60÷1,080.42 = .0555, or 5.55%.

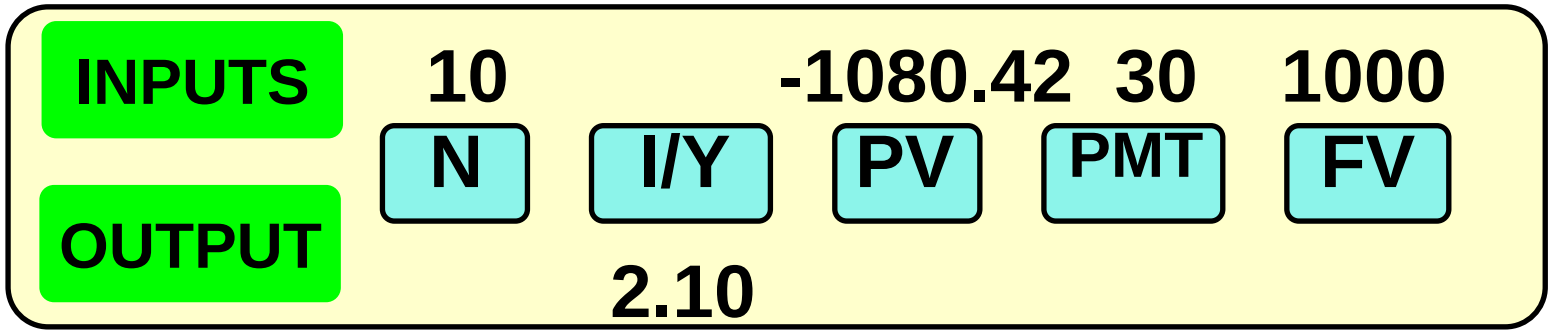
To calculate the yield to maturity, In this case, the bond pays $30 every six months and has 10 six-month periods until maturity. So, we need to find r as follows:

$$\$1,080.42 = \$30 \times \left[1 - 1/(1+r)^{10}\right]/r + 1,000/(1+r)^{10}$$

After some trial and error, we find that r is equal to about 2.1%. But the tricky part is that this 2.1% is the yield *per six months*. We have to double it to get the yield to maturity, so the yield to maturity is 4.2%, which is less than the current yield. The reason is that the current yield ignores the built-in loss of the premium between now and maturity.

Bond has an 6% **semi-annual coupon rate** and is selling for $1,080.42 and has 5 years to maturity and face value of $1000

- **Financial calculator solution**



2.1% is semiannual Yield to maturity
We must multiply it by 2 to get the Yield to Maturity = 2.1% x 2 =4.2%

- **Excel =Rate(Nper,Pmt,PV,FV,Type,guess)**
  =PV(5*2,60/2,-1080.42,1000,0) = 2.10%

2.1% is semiannual Yield to maturity
We must multiply it by 2 to get the Yield to Maturity = 2.1% x 2 =4.2%

Practice:

Bond sells for $935.08 and has a 10% annual coupon rate and 12 years to maturity. What's the yield?

Enter	12		100	–935.08	1,000
	N	I/Y	PMT	PV	FV
Solve for		11			

Bond has yield of 11%. It has a 12% annual coupon and 12 years to maturity, so what's the price?

Enter	12	11	120		1,000
	N	I/Y	PMT	PV	FV
Solve for				–1,064.92	

Bond with a price of $902.29, 10 years to maturity, and a coupon rate of 6%. Assuming this bond pays **semi-annual** interest, what's the bond's yield?

Enter	20		30	–902.29	1,000
	N	I/Y	PMT	PV	FV
Solve for		3.7			

Yield to maturity = 3.7% x 2 = 7.4%

More about Bond Features

Securities issued by corporations may be classified roughly as *equity securities* and *debt securities.*

Generally, equity represents an ownership interest, and it is a residual claim, meaning equity holders are paid after debt holders.

Major differences between debt and equity are the following:

- Debt is not an ownership interest in the firm. Creditors generally do not have voting power.
- Corporation's payment of interest on debt is considered a cost of doing business and is tax deductible (up to certain limits). Dividends paid to stockholders are *not tax* deductible.
- Unpaid debt is a liability of the firm. If it is not paid, the creditors can legally claim the assets of the firm. This action can result in liquidation or reorganization, two of the possible consequences of bankruptcy. Thus, one of the costs of issuing debt is the possibility of financial failure. This possibility does not arise when equity is issued.

Long-term Debt: The Basics

- All long-term debt securities are promises made by the issuing firm to pay principal when due and to make timely interest payments on the unpaid balance.

Maturity of a long-term debt instrument is the length of time the debt remains outstanding with some unpaid balance.

- *Short-term debt securities,* or *unfunded debt,* have a maturity of one year or less.
- *Long-term debt securities* have maturities of more than one year.

Debt securities are typically called *notes, debentures, or bonds.*

- Difference between notes and bonds is original maturity, with those of 10 years or less being called notes and longer-term issues being called bonds.

- Major forms of long-term debt are public-issue and privately placed, with the main difference being privately placed debt is directly placed with a lender and not offered to the public.

Features of an INTEL Bond

Term		Explanation
Amount of issue	$2 billion	The company issued $2 billion worth of bonds.
Date of issue	2/10/2023	The bonds were sold on 2/10/2023.
Maturity	2/10/2053	The bonds mature on 2/10/2053.
Face value	$2,000	The denomination of the bonds is $2,000.
Annual coupon	5.70	Each bondholder will receive $114 per bond per year (5.70% of face value).
Offer price	99.957	The offer price will be 99.957% of the $2,000 face value, or $1,999.14, per bond.
Coupon payment dates	2/10, 8/10	Coupons of $114/2 = $57 will be paid on these dates.
Security	None	The bonds are not secured by specific assets.
Sinking fund	None	The bonds have no sinking fund.
Call provision	At any time	The bonds do not have a deferred call.
Call price	Treasury rate plus .30%	The bonds have a “make-whole” call price.
Rating	Moody’s A1 S&P A	The bonds have a high credit rating.

The Indenture

- The **indenture** (That is, *deed of trust*) is the written agreement between the corporation (the borrower) and the lender (the investor) detailing the terms of the debt issue.

Indenture generally includes the following provisions:

- Basic terms of the bonds.
- Total amount of bonds issued.
- Description of property used as security.
- Repayment arrangements.
- Call provisions.
- Sinking fund provision
- Details of the protective covenants.

Usually, a trustee (for example, a bank) is appointed by the corporation to represent the bondholders and the trustee must:

- Make sure the terms of the indenture are obeyed.
- Manage the sinking fund.
- Represent the bondholders in default.

Terms of a Bond

Principal value is stated on bond certificate.

Par value of a bond is almost always the same as the face value, with the terms used interchangeably in practice.

- Corporate bonds historically had a face value of $1,000.
- Municipal bonds often have par valued of $5,000.
- Treasury bonds with par values of $10,000 or $100,000 are common.

Corporate bonds are usually in **registered form**, meaning the registrar of the company records ownership of each bond with payment being made directly to the owner of record.

Bonds can also be in **bearer form;** in which case the bond is issued without record of the owner's name with payment being made to whomever holds the bond.

- Difficult to recover if bonds are lost or stolen.
- Because the company does not know who owns its bonds, it cannot notify bondholders of important events.

Security

Debt securities are classified according to the collateral and mortgages used to protect the bondholder .

Mortgage securities are secured by a mortgage on the real property of the borrower, with the property involved typically being real estate (For Example, land or buildings).

- Legal document that describes the mortgage is called a *mortgage trust indenture or trust deed.*
- Sometimes mortgages are on specific property (For Example, railroad car).
- *Blanket mortgage* pledges all real property owned by the company.

- Bonds usually represent unsecured obligations of the company.
- A **debenture** is an unsecured debt, usually with a maturity of 10 years or more.
- Most public bonds issued in the U.S. by industrial and financial companies are typically debentures.

- A **note** is an unsecured debt, usually with a maturity under 10.

Seniority and Repayment

Seniority indicates preference in position over other lenders, with debts sometimes labelled as senior or *junior* to indicate seniority.

- Some debt is *subordinated* (For example, subordinated debenture), and holders of such debt must give preference to other specified creditors.
- Debt cannot be subordinated to equity.

Bonds can be repaid at maturity, at which time the bondholder will receive the stated, or face, value of the bond; or they may be repaid in part or in entirety before maturity.

- Early repayment is common and is often handled through a **sinking fund**, an account managed by the bond trustee for early redemption.

- There are various types of sinking fund arrangements; for example:
  - Some sinking funds start about 10 years after the initial issuance.
  - Some sinking funds establish equal payments over the life of the bond.
  - Some high-quality bond issues establish payments to the sinking fund that are not sufficient to redeem the entire issue.

Sinking Funds Provision

- Some bonds include sinking funds provision.
- It facilitates the orderly retirement of the bond issue.
- Sinking funds provide extra protection to bondholders.
- There are many kinds of sinking-fund arrangements.
- Usually sets a fund to buy back certain percentage of the issue each year.
- In most cases the firm is given the right to handle the sinking fund in one of two ways:
  - Call in for redemption at par value a percentage of the bonds each year.
  - Buy the required number if bonds on the open market.

    The company will choose the least cost method.
- Can also require the issuer to invest an amount each year to make sure they have enough to repay the bond holders at maturity.

The Call Provision

Call provision is an agreement giving the corporation the option to repurchase a bond at a specified price prior to maturity.

- Corporate bonds are usually callable.

- Call price is usually above the bond's stated value (That is, par value), with the difference between the call price and the stated value being the **call premium**.

Deferred call provisions prohibit the company from redeeming a bond prior to a certain date.

- During period of prohibition, the bond is said to be **call-protected.**

Make-whole" call is a new type of call provision where bondholders receive approximately what the bonds are worth if they are called.

- To find the make-whole call price, calculate the PV of the remaining interest and principal payments at a rate specified in the indenture.

Protective Covenants

- A **protective covenant** limits certain actions that might be taken during the loan's term, usually to protect the lender's interest

1. *Negative covenant* is a "thou shalt not" type of covenant that limits or prohibits actions the company might take; examples include:

    - Firm must limit amount of dividends paid, according to some formula.
    - Firm cannot pledge any assets to other lenders.
    - Firm cannot merge with another firm.
    - Firm cannot sell or lease any major assets without lender's approval.
    - Firm cannot issue additional long-term debt.

2. *Positive covenant* is a "thou shalt" type of covenant that specified an action the company agrees to take or a condition the company must abide by; examples include:

    - Company must maintain working capital at or above some specified minimum level.
    - Company must periodically furnish audited financials to lender.
    - Firm must maintain any collateral or security in good condition.

Bond Ratings

Firms often pay to have their debt rated, with ratings serving as an assessment of the creditworthiness of the corporate issuer .

- Leading bond-rating firms are Moody's and Standard & Poor's (S&P).
- Definitions of creditworthiness used by Moody's and S&P are based on how likely the firm is to default and the protection creditors have in the event of a default.

Ratings can change as the issuer's financial strength changes.

- Highest rating a firm's debt can have is AAA or Aaa, and such debt is judged to be the best quality and to have the lowest degree of risk.
- AA or Aa ratings indicate very good quality debt and are much more common
- Investment-grade bonds are rated at least BBB or Baa.
- Large part of corporate borrowing takes the form "junk" bonds, which are rated below investment grade if rated at all.

Rating agencies don't always agree (for example, "crossover" bonds).

Bond Ratings

		Investment-Quality Bond Ratings				Low-Quality, Speculative, and/or "Junk" Bond Ratings					
		High Grade		Medium Grade		Low Grade		Very Low Grade			
Standard & Poor's		AAA	AA	A	BBB	BB	B	CCC	CC	C	D
Moody's		Aaa	Aa	A	Baa	Ba	B	Caa	Ca	C	
Moody's	**S&P**										
Aaa	AAA	Debt rated Aaa and AAA has the highest rating. Capacity to pay interest and principal is extremely strong.									
Aa	AA	Debt rated Aa and AA has a very strong capacity to pay interest and repay principal. Together with the highest rating, this group comprises the high-grade bond class.									
A	A	Debt rated A has a strong capacity to pay interest and repay principal, although it is somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than debt in high-rated categories.									
Baa	BBB	Debt rated Baa and BBB is regarded as having an adequate capacity to pay interest and repay principal. Whereas it normally exhibits adequate protection parameters, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity to pay interest and repay principal for debt in this category than in higher-rated categories. These bonds are medium-grade obligations.									
Ba; B Caa Ca C	BB; B CCC CC C	Debt rated in these categories is regarded, on balance, as predominantly speculative with respect to capacity to pay interest and repay principal in accordance with the terms of the obligation. BB and Ba indicate the lowest degree of speculation, and Ca, CC, and C the highest degree of speculation. Although such debt is likely to have some quality and protective characteristics, these are outweighed by large uncertainties or major risk exposures to adverse conditions. Issues rated C by Moody's are typically in default.									
	D	Debt rated D is in default, and payment of interest and/or repayment of principal is in arrears.									

Bond Ratings

CREDIT QUALITY	MOODY'S	STANDARD & POOR'S	FITCH RATINGS
Investment Grade (Lowest Risk)	Aaa	AAA	AAA
Investment Grade	Aa1	AA+	AA+
Investment Grade	Aa2	AA	AA
Investment Grade	Aa3	AA-	AA-
Investment Grade	A1	A+	A+
Investment Grade	A2	A	A
Investment Grade	A3	A-	A-
Investment Grade	Baa1	BBB+	BBB+
Investment Grade	Baa2	BBB	BBB
Investment Grade	Baa3	BBB-	BBB-
Speculative Grade	Ba1	BB+	BB+
Speculative Grade	Ba2	BB	BB
Speculative Grade	Ba3	BB-	BB-

Government Bonds

Biggest borrower in the world—by a wide margin—is everybody's favourite family member, Uncle Sam.

When the government wishes to borrow money for more than one year, it sells Treasury notes and bonds to the public.

- U.S. Treasury issues, unlike essentially all other bonds, have no default risk.
- Treasury issues are exempt from state income taxes.

State and local governments also borrow money by selling notes and bonds (That is, *municipal* notes and bonds, or "munis").

- Have varying degrees of default risk and are rated much like corporate issues
- Almost always callable.
- Coupons are exempt from federal income taxes; because of the tax break they receive, yields on munis are much lower than yields on taxable bonds.

Taxable Versus Municipal Bonds

Suppose taxable bonds are currently yielding 8%, while at the same time, munis of comparable risk and maturity are yielding 6%. Which is more attractive to an investor in a 40% bracket? What is the break-even tax rate? How do you interpret this rate?

- For an investor in a 40% tax bracket, a taxable bond yields 8 × (1 − .40) = 4.8% after taxes, so the muni is much more attractive. The break-even tax rate is the tax rate at which an investor would be indifferent between a taxable and a non-taxable issue. If we let t^* stand for the break-even tax rate, then we can solve for it as follows:

Taxable bond yield – (1-t) = munis rate

$$.08 \times (1 - t^*) = .06$$

$$1 - t^* = .06/.08 = .75$$

$$t^* = .25$$

- An investor in a 25% tax bracket would make 6 percent after taxes from either bond.

Zero Coupon Bonds

Zero coupon bonds, or *zeroes*, are bonds that make no coupon payments and are thus initially priced at a deep discount.

- For tax purposes, the issuer of a zero-coupon bond deducts interest every year even though no interest is actually paid.
- Similarly, the owner must pay taxes on interest accrued every year, even though no interest is actually received.

- Attractive investment for tax-exempt investors with long-term dollar-denominated liabilities (for example, pension funds) because the future dollar value is known with relative certainty.

Example: Zero coupon bond price

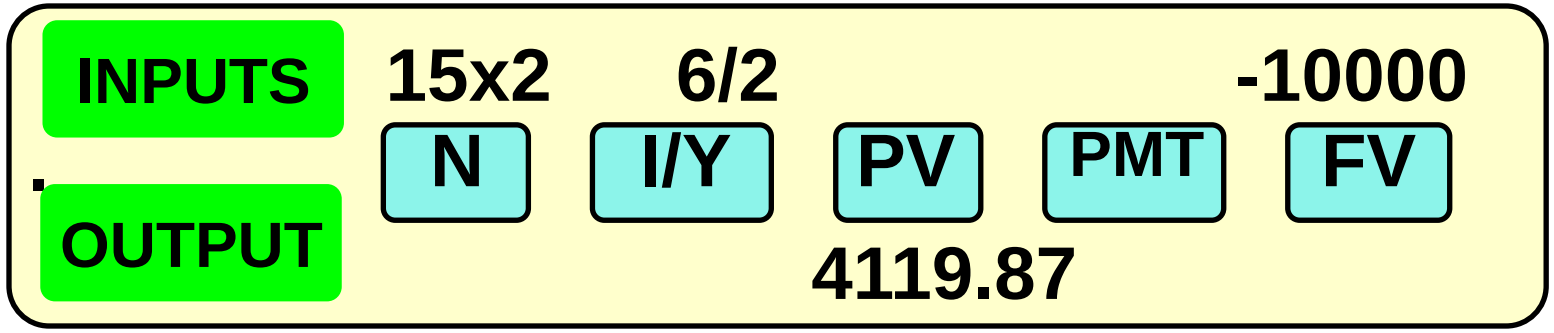
- A utility company issued a $10,000 zero coupon bond with 15 years to maturity. What is the expected price of this bond assuming the required rate of return is 6%?

- **Not: In practice, zero coupon bonds are calculated using semiannual periods.**

Zero coupon bond, Yield to maturity rate 6%, Years to maturity 15, $10,000 face value

Not: In practice, zero coupon bonds are calculated using semiannual periods.

- **Financial calculator solution**



- **Excel =PV(Rate,Nper,Pmt,FV,Type)**
  =PV(.06/2,15*2,0,-10000,0) = $4,119.87

Example: Zero Coupon Bond - Yield to Maturity

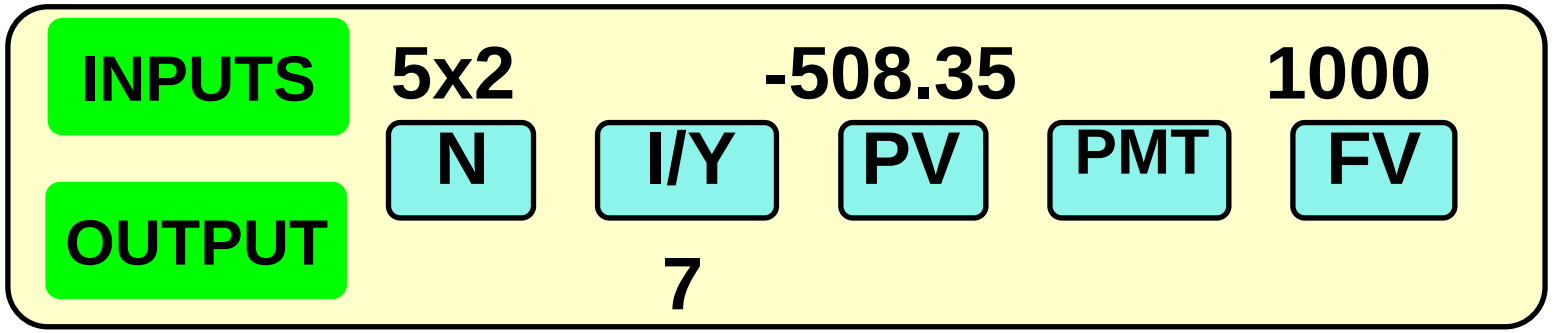
- Suppose the EIN Company issues a $1,000 face value, five-year zero-coupon bond. The initial price is set at $508.35.
- **Even though no interest payments are made on the bond, zero coupon bond calculations use semi-annual periods to be consistent with coupon bond calculations.**
- Using semi-annual periods, it is straightforward to verify that, at this price, the bond yields about 14% to maturity.

Year	Beginning Value	Ending Value	Implicit Interest Expense
1	$508.35	$ 582.01	$ 73.66
2	582.01	666.34	84.33
3	666.34	762.90	96.55
4	762.90	873.44	110.54
5	873.44	1,000.00	126.56
Total			$491.65

The total interest paid over the life of the bond is $1,000 − 508.35 = $491.65.

Zero coupon bond, price 508.35, Years to maturity 5, $1,000 face value,

- **Financial calculator solution**



7% is semiannual rate. Annual rate would be 7%x2= 14%

- **Excel =Rate(Nper,Pmt,PV,FV,Type,Guess)**
  =PV(,5*2,0,-1000,0) = 7%

(this is semi-annual. The annual rate is 14%)

Floating-rate Bonds

- With *floating-rate bonds (floaters),* coupon payments are adjustable, with adjustments tied to an interest rate index (For Example, Treasury bill interest rate or 30-year Treasury bond rate).

Value depends on how coupon payment adjustments are defined:

- In most cases, the coupon adjusts with a lag to some base rate.

Most floaters have the following features:

- Holder has right to redeem note at par on the coupon payment date after some specified amount of time (That is, *put* provision).
- Coupon rate has floor and ceiling, meaning the coupon is subject to a minimum and a maximum. In this case, the coupon rate is said to be "capped," and the upper and lower rates may be called the *collar.*

Inflation-linked bonds have coupons that are adjusted according to the inflation rate (principal amount may be adjusted as well) .

- May be called "TIPS," or Treasury Inflation-Protected Securities.

Other Types of Bonds

Catastrophe, or *cat*, *bonds* cover U.S.-named storms and earthquakes, with investors losing some or all of their money if one of these triggering events occurs.

In 2022, the World Bank issued *rhino impact bonds* (*RIB*) (which had previously been issued by Conservation Capital in 2019) designed to increase the population of black rhinos in Kenya and South Africa.

- Bondholders receive payments based on the "outcome payments" model; in this case, payments will be based on the population of black rhinos in five years.

Coronavirus bonds came to market during the COVID-19 pandemic; proceeds went toward pandemic-related work.

A *warrant* is a bond feature that gives the buyer of the bond the right to purchase shares of stock in the company at a fixed price.

- Very valuable feature is the stock price climbs substantially.
- Bonds with warrants are often issued at a very low coupon rate.

Other Types of Bonds

Income bonds are similar to conventional bonds, except that coupon payments depend on company income.

- Coupons are paid to bondholders only if firm's income is sufficient.

A *convertible bond* can be swapped for a fixed number of shares of stock any time before maturity at the holder's option.

A *put bond* allows the holder to force the issuer to buy back the bond at a stated price; this is the reverse of the call provision.

Reverse convertible is a relatively new item.

- One type generally offers a high coupon rate, but the redemption at maturity can be paid in cash at par value or paid in shares of stock.

Death bonds involve companies purchasing life insurance policies from individuals who are expected to die within the next 10 years and then selling bonds that are paid off from the life insurance proceeds when the policyholders pass away.

Structured notes are bonds that are based on stocks, bonds, commodities, or currencies.

Bond Markets
How Bonds are Bought and Sold

Total volume of trading in bonds far exceeds that in stocks.

Most trading in bonds takes place over the counter, or OTC .

One reason the bond markets are so big is that the number of bond issues far exceeds the number of stock issues, and there are two reasons for this:

1. A corporation would typically have only one common stock issue outstanding, whereas a large corporation could easily have a dozen or more note and bond issues outstanding .
2. Federal, state, and local borrowing is enormous.

A financial market is *transparent* if it is possible to easily observe its prices and trading volume .

- On the New York Stock Exchange, for example, it is possible to see the price and quantity for every single transaction.
- In the bond market, it is often not possible to observe either, resulting in a lack of transparency.

Bond Price Reporting

In 2002, transparency in the corporate bond market began to improve, as new regulations required dealers to report trade information through the Trade Reporting and Compliance Engine (TRACE).

- TRACE bond quotes are available online.

Each day, representative prices for outstanding Treasury issues are reported.

- **Bid price** is the price a dealer is willing to pay for a security.
- **Asked price** is the price a dealer is willing to take for a security.
- **Bid-ask spread** is difference between the bid price and asked price.

- Treasury prices are quoted as a percentage of face value.
  - If the bid price is 132.23 and the face value is $1,000, the quote represents $1,322.30.

- Change in the asked price from the previous day, measured as a percentage of face value, is also quoted.

Sample Wall Street Journal U.S. Treasury Note and Bond Prices

- Treasury Notes and Bonds

Maturity	Coupon	Bid	Asked	Chg	Asked Yield
5/15/2025	2.750	96.150	96.154	−0.006	4.406
7/31/2026	.625	88.270	88.274	−0.020	4.108
5/15/2027	2.375	93.206	93.212	−0.036	4.010
4/30/2028	1.250	87.142	87.152	−0.064	3.932
1/31/2029	1.750	88.200	88.210	−0.080	3.900
11/15/2030	.875	80.294	80.304	−0.788	3.727
2/15/2031	1.125	82.170	82.180	−0.102	3.657
5/15/2032	2.875	93.066	93.076	−0.136	3.746
11/15/2032	4.125	102.312	103.002	−0.834	3.753
2/15/2036	4.500	108.180	108.190	−0.910	3.663
2/15/2037	4.750	111.116	111.126	−0.940	3.700
2/15/2038	4.375	106.284	106.294	−0.942	3.729
5/15/2038	4.500	108.084	108.094	−0.946	3.767
8/15/2039	4.500	108.156	108.166	−0.974	3.779
8/15/2040	3.875	100.056	100.066	−0.966	3.858

Maturity	Coupon	Bid	Asked	Chg	Asked Yield
11/15/2040	1.375	67.042	67.052	−0.210	3.970
2/15/2041	**4.750**	**111.270**	**111.280**	**−0.962**	**3.831**
8/15/2041	3.750	97.300	97.310	−0.944	3.905
2/15/2042	3.125	88.290	88.300	−0.920	3.959
5/15/2042	3.000	86.310	87.000	−0.912	3.972
2/15/2043	3.125	88.054	88.064	−0.248	3.986
5/15/2044	3.375	91.040	91.050	−0.274	3.996
8/15/2045	2.875	83.114	83.124	−0.966	4.001
2/15/2046	2.500	77.220	77.230	−0.954	3.989
8/15/2047	2.750	81.052	81.062	−1.000	3.955
11/15/2048	3.375	91.110	91.120	−1.034	3.909
8/15/2049	2.250	73.024	73.034	−1.002	3.884
5/15/2050	1.250	56.144	56.154	−0.946	3.839
2/15/2051	1.875	66.104	66.114	−0.968	3.848
11/15/2052	4.000	103.110	103.130	−1.074	3.807

A Note about Bond Price Quotes

Clean price is the price of a bond net of accrued interest.

- This is the price that is typically quoted.

Dirty price is the price of a bond including accrued interest, also known as the full or invoice price.

- This is the price the buyer actually pays.

Suppose you buy a bond with a 12% annual coupon, payable semi-annually. You actually pay $1,080 for this bond, so $1,080 is the dirty price, or invoice, price. Further, on the day you buy it, the next coupon is due in four months, so you are between coupon dates. Notice that the next coupon will be $60.

- Accrued interest on a bond is calculated by taking the fraction of the coupon period that has passed, in this case two months out of six, and multiplying this fraction by the next coupon, $60.
- Accrued interest in this example is $2 \div 6 \times \$60 = \$20$. The bond's quoted price (i.e., clean price) would be $\$1{,}080 - 20 = \$1{,}060$.

Real Versus Nominal Rates and The Fisher Effect

Real rates are interest rates or rates of return that have been adjusted for inflation to reflect the real cost of funds to a borrower and the real yield to a lender or an investor.

Nominal rates are interest rates or rates of return that has not been adjusted for inflation. (it includes inflation)

Fisher effect describes the relationship between nominal returns, real returns, and inflation.

Let R stand for the nominal rate, r stand for the real rate, and h stand for the inflation rate; Fisher effect can be written as:

R: the nominal rate
r: real rate
h: inflation rate

$$1 + R = (1 + r) \times (1 + h)$$

$$R \approx r + h$$

Approximation

The Fisher Effect

Suppose prices are currently rising by 5% per year. In other words, the rate of inflation is 5%. An investment is available that will be worth $115.50 in one year. It costs $100 today.

Notice that with a present value of $100 and a future value in one year of $115.50, this investment has a 15.5 percent rate of return.

In calculating this 15.5 percent return, we did not consider the effect of inflation, so this is the nominal return.

What is the impact of inflation here?

Suppose pizzas cost $10 each at the beginning of the year. With $100, we can buy 10 pizzas. Because the inflation rate is 5%, pizzas will cost 5% more, or $10.50, at the end of the year.

$$1 + R = (1 + r) \times (1 + h)$$

$$1 + .1550 = (1 + r) \times (1 + .05)$$

$1 + r = 1.1550 \div 1.05 = 1.10$

$r = .10$, or **10%**

The Fisher Effect

- We can rearrange the Fisher effect as follows:

$$1+R=(1+r)\times(1+h)$$

$$R=r+h+r\times h$$

- Nominal rate is approximately equal to real rate plus inflation rate:

$$R\approx r+h$$

Example: The Fisher Effect

If investors require a 10 percent real rate of return, and the inflation rate is 8 percent, what must be the approximate nominal rate? The exact nominal rate?

- The nominal rate is approximately equal to the sum of the real rate and the inflation rate: 10% + 8% = 18%. From the Fisher effect, we have:

$$1 + R = (1 + r) \times (1 + h)$$

$$= 1.10 \times 1.08$$

$$= 1.1880$$

Therefore, the nominal rate will actually be closer to 19 percent.

Term Structure of Interest Rates

At any point in time, short-term and long-term interest rates will generally be different.

The **term structure of interest rates** is the relationship between nominal interest rates on default-free, pure discount securities and time to maturity; that is, the pure time value of money.

- When long-term rates are higher than short-term rates, we say that the term structure is *upward sloping.*
- When short-term rates are higher than long-term rates, we say the term structure is *downward sloping* .
- Term structure can also be “humped”, which is usually because rates increase at first, but then begin to decline as we look at longer- and longer-term rates .

Term Structure of Interest Rates

- What determines the shape of the term structure?

1. Real rate of interest.
2. Expected future inflation.
3. Interest rate risk premium.

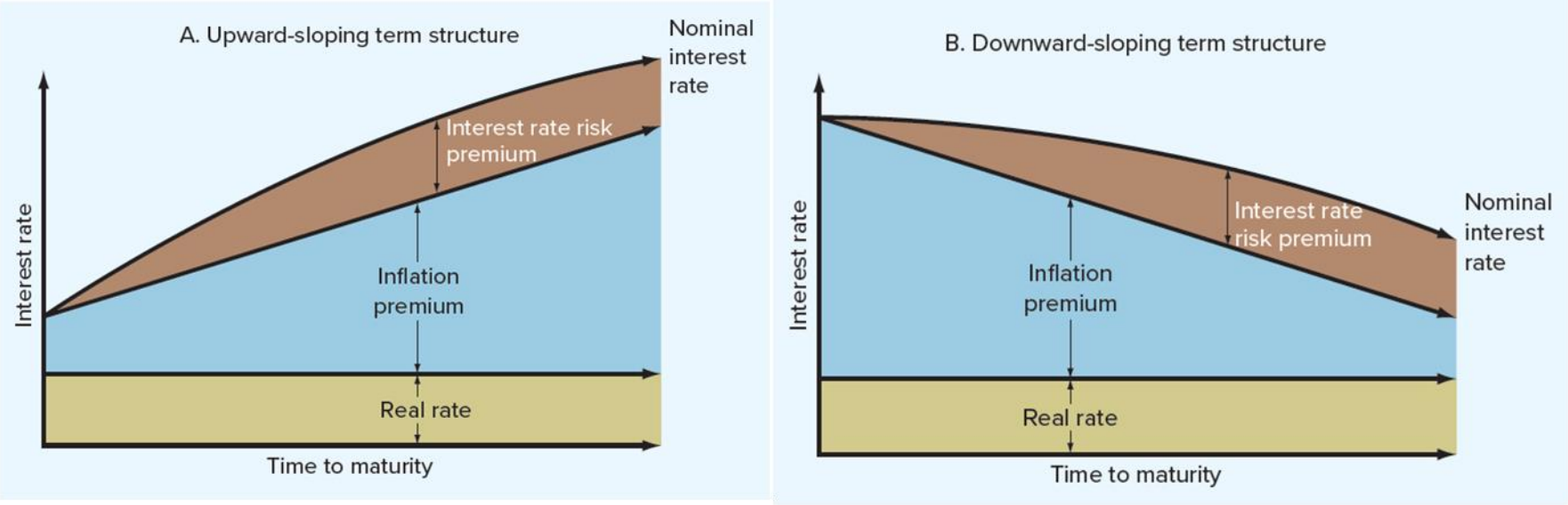
Inflation premium is the portion of a nominal interest rate that represents compensation for expected future inflation.

- Upward-sloping term structure may reflect anticipated increases in inflation, while a downward-sloping term structure probably reflects the belief that inflation will be falling in the future.

Interest rate risk premium is the compensation investors demand for bearing interest rate risk.

- Interest rate risk premium increases with maturity, but it increases at a decreasing rate. (maturity risk premium)

Term Structure of Interest Rates



- Access the text alternatives for slide images.

Bond Yields and the Yield Curve: Putting it All Together

Treasury yield curve is a plot of the yields on Treasury notes and bonds relative to maturity.

- Shape of yield curve reflects the term structure of interest rates.
- **Term structure is based on pure discount bonds, whereas the yield curve is based on coupon bond yields.**

Treasuries depend on the three components that underlie the term **structure:**

- Real rate.
- Expected future inflation.
- Interest rate risk premium. (maturity risk premium)

Recall Treasury notes and bonds are default-free, they are taxable, and they are highly liquid.

Bond Yields and the Yield Curve: Putting it All Together 2

A bond's yield is calculated assuming all promised payments will be made.

- If the issuer defaults, your actual yield will be lower.

Default risk premium is the portion of a nominal interest rate or bond yield that represents compensation for the possibility of default.

- Lower-rated bonds have higher yields.

Taxability premium is the portion of a nominal interest rate or bond yield that represents compensation for unfavourable tax status.

- Recall, municipal bonds are free from most taxes.

- **Liquidity premium** is the portion of a nominal interest rate or bond yield that represents compensation for lack of liquidity.

Conclusion

Bond yields represent the combined effect of no fewer than six things:

- Real rate of interest.
- Premiums representing compensation for the following:

1. Expected future inflation.
2. Interest rate risk. (maturity)
3. Default risk.
4. Taxability.
5. Lack of liquidity.

Determining the appropriate yield on a bond requires careful analysis of each of these effects.