

# **CHAPTER 4**

## **Bonds and Their Valuation**

- **Key features of bonds**
- **Bond valuation**
- **Measuring yield**
- **Assessing risk**

## Key Features of a Bond

1. **Par value:** Face amount; paid at maturity. Assume \$1,000.
2. **Coupon interest rate:** Stated interest rate. Multiply by par value to get dollars of interest. Generally fixed.

(More...)

3. **Maturity:** Years until bond must be repaid. Declines.
4. **Issue date:** Date when bond was issued.
5. **Default risk:** Risk that issuer will not make interest or principal payments.

## How does adding a call provision affect a bond?

- Issuer can refund if rates decline. That helps the issuer but hurts the investor.
- Therefore, borrowers are willing to pay more, and lenders require more, on callable bonds.
- Most bonds have a **deferred call** and a **declining call premium**.

## What's a sinking fund?

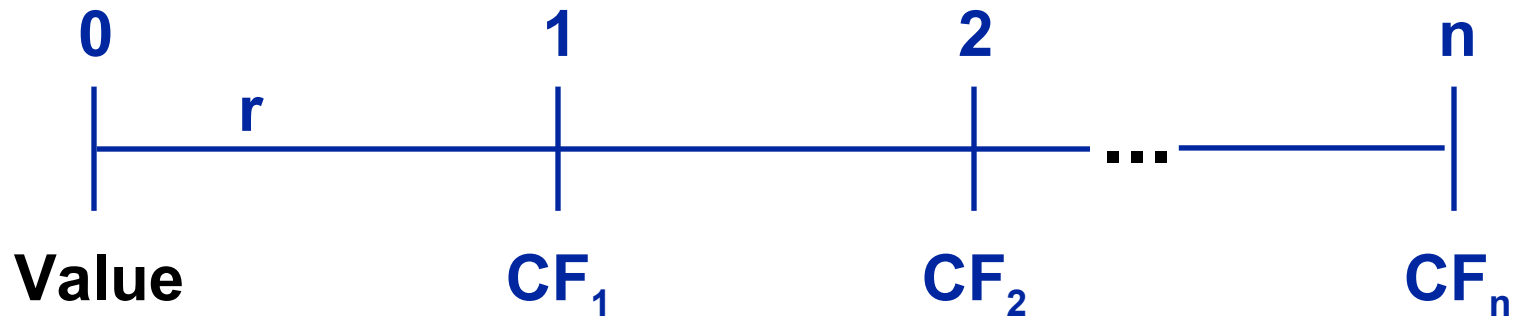
- Provision to **pay off a loan** over its life rather than all at maturity.
- Similar to **amortization** on a term loan.
- **Reduces risk** to investor, shortens average maturity.
- But not good for investors if rates decline after issuance.

## Sinking funds are generally handled in 2 ways

1. **Call  $x\%$  at par** per year for sinking fund purposes.
2. Buy bonds on **open market**.

Company would **call** if  $r_d$  is below the coupon rate and bond sells at a premium. Use **open market** purchase if  $r_d$  is above coupon rate and bond sells at a discount.

# Financial Asset Valuation



$$PV = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \dots + \frac{CF_n}{(1+r)^n}.$$

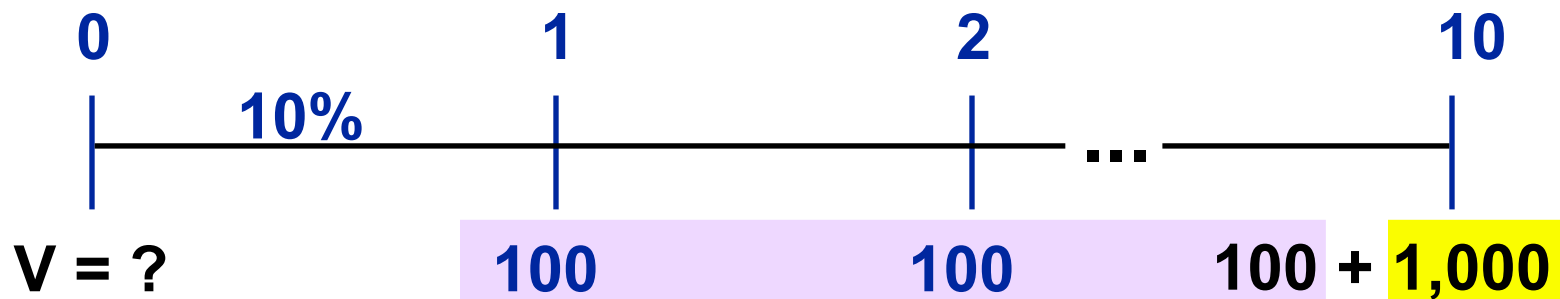
- The discount rate ( $r_i$ ) is the opportunity cost of capital, i.e., the rate that could be earned on alternative investments of equal risk.

$$r_i = r^* + IP + LP + MRP + DRP$$

for debt securities.



**What's the value of a 10-year, 10% coupon bond if  $r_d = 10\%$ ?**



$$\begin{aligned}
 V_B &= \frac{\$100}{(1+r_d)^1} + \dots + \frac{\$100}{(1+r_d)^{10}} + \frac{\$1,000}{(1+r_d)^{10}} \\
 &= \$90.91 + \dots + \$38.55 + \$385.54 \\
 &= \$1,000.
 \end{aligned}$$

The bond consists of a 10-year, 10% annuity of \$100/year plus a \$1,000 lump sum at  $t = 10$ :

PV annuity	=	\$ 614.46
PV maturity value	=	<u>385.54</u>
Value of bond	=	<u><b>\$1,000.00</b></u>

**INPUTS**

10

N

10

I/YR

PV

100

PMT

1000

FV

**OUTPUT**

-1,000

What would happen if expected inflation rose by 3%, causing  $r = 13\%$ ?

INPUTS

10

N

13

I/YR

PV

100

PMT

1000

FV

OUTPUT

-837.21

When  $k_d$  rises, above the coupon rate, the bond's value falls below par, so it sells at a **discount**.

What would happen if inflation fell, and  $r_d$  declined to 7%?

INPUTS

10

7

100

1000

N

I/YR

PV

PMT

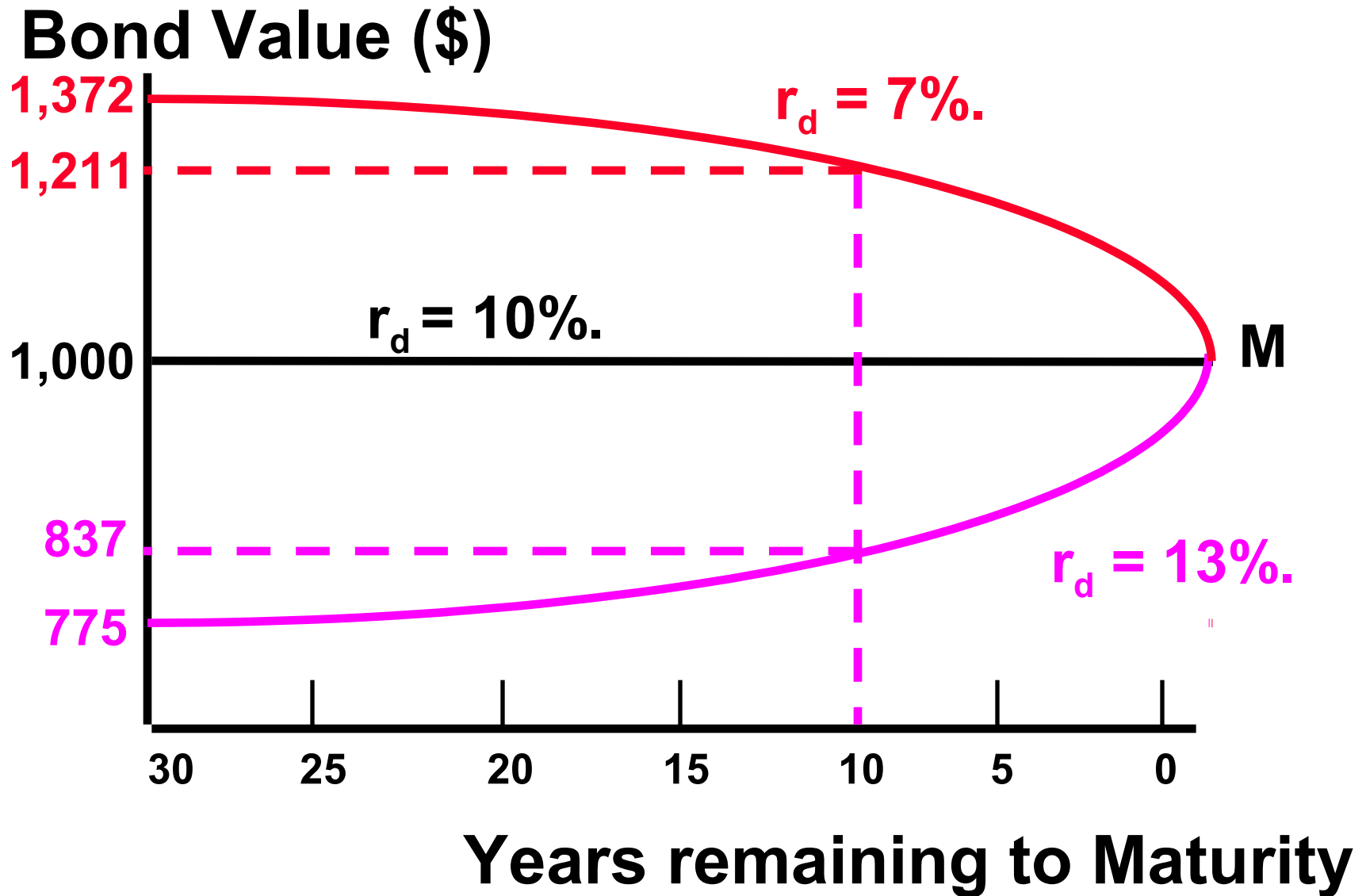
FV

OUTPUT

-1,210.71

If coupon rate  $> r_d$ , price rises above par, and bond sells at a premium.

**Suppose the bond was issued 20 years ago and now has 10 years to maturity. What would happen to its value over time if the required rate of return remained at 10%, or at 13%, or at 7%?**



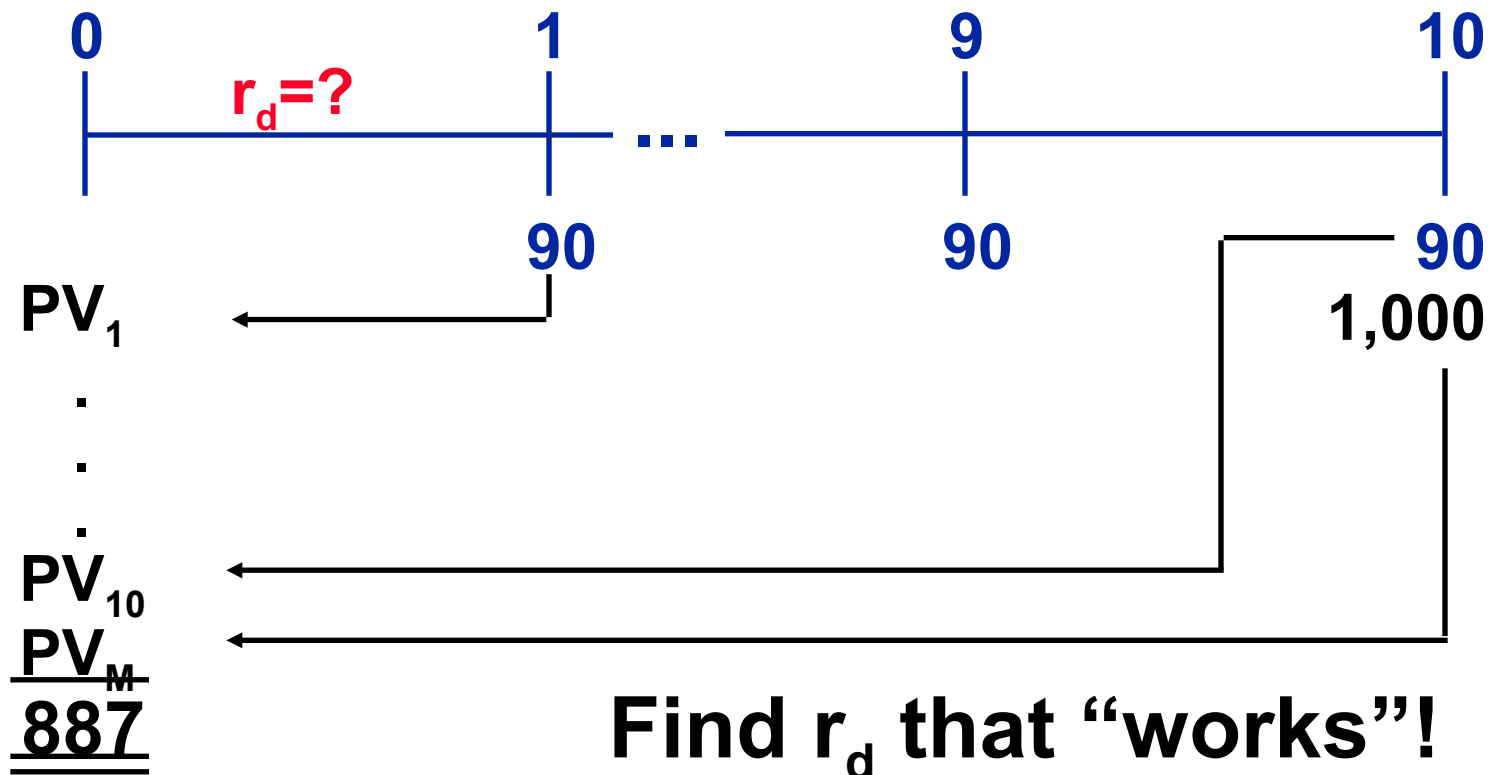
- **At maturity, the value of any bond must equal its par value.**
- **The value of a premium bond would decrease to \$1,000.**
- **The value of a discount bond would increase to \$1,000.**
- **A par bond stays at \$1,000 if  $r_d$  remains constant.**

## What's “yield to maturity”?

- **YTM** is the rate of return earned on a bond held to maturity. Also called “promised yield.”



**What's the YTM on a 10-year, 9% annual coupon, \$1,000 par value bond that sells for \$887?**



**Find  $r_d$**

$$V_B = \frac{INT}{(1+r_d)^1} + \dots + \frac{INT}{(1+r_d)^N} + \frac{M}{(1+r_d)^N}$$

$$887 = \frac{90}{(1+r_d)^1} + \dots + \frac{90}{(1+r_d)^{10}} + \frac{1,000}{(1+r_d)^{10}}$$

**INPUTS**

10

**N**

**I/YR**

-887

**PV**

90

**PMT**

1000

**FV**

**OUTPUT**

10.91

- If coupon rate  $< r_d$ , bond sells at a discount.
- If coupon rate  $= r_d$ , bond sells at its par value.
- If coupon rate  $> r_d$ , bond sells at a premium.
- If  $r_d$  rises, price falls.
- Price = par at maturity.

**Find YTM if price were \$1,134.20.**

**INPUTS**

10

**N**

**I/YR**

-1134.2

**PV**

90

**PMT**

1000

**FV**

**OUTPUT**

7.08

**Sells at a premium. Because  
coupon = 9% >  $r_d$  = 7.08%,  
bond's value > par.**

## Definitions

$$\text{Current yield} = \frac{\text{Annual coupon pmt}}{\text{Current price}}$$

$$\text{Capital gains yield} = \frac{\text{Change in price}}{\text{Beginning price}}$$

$$\text{Exp total return} = \text{YTM} = \text{Exp Curr yld} + \text{Exp cap gains yld}$$

**Find current yield and capital gains yield for a 9%, 10-year bond when the bond sells for \$887 and YTM = 10.91%.**

$$\begin{aligned}\text{Current yield} &= \frac{\$90}{\$887} \\ &= 0.1015 = \boxed{10.15\%}.\end{aligned}$$

**YTM = Current yield + Capital gains yield.**

$$\begin{aligned}\text{Cap gains yield} &= \text{YTM} - \text{Current yield} \\ &= 10.91\% - 10.15\% \\ &= \boxed{0.76\%}.\end{aligned}$$

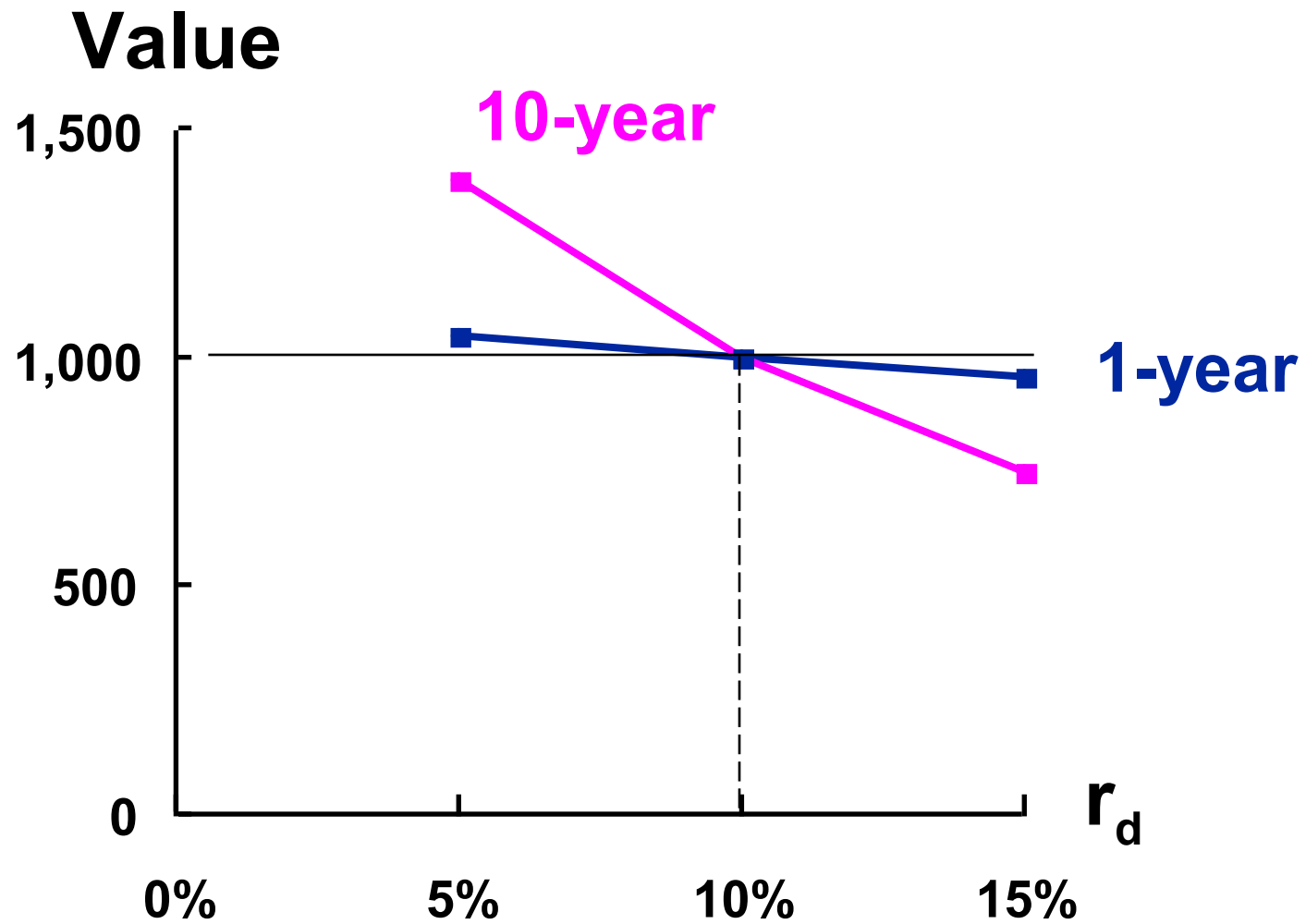
**Could also find values in Years 1 and 2, get difference, and divide by value in Year 1. Same answer.**

**What's interest rate (or price) risk?**  
**Does a 1-year or 10-year 10% bond**  
**have more risk?**

**Interest rate risk: Rising  $r_d$  causes bond's price to fall.**

<u><math>r_d</math></u>	<b>1-year</b>	<u>Change</u>	<b>10-year</b>	<u>Change</u>
5%	\$1,048		\$1,386	
10%	1,000	4.8%	1,000	38.6%
15%	956	4.4%	749	25.1%





## What is reinvestment rate risk?

**The risk that CFs will have to be reinvested in the future at lower rates, reducing income.**

**Illustration:** Suppose you just won \$500,000 playing the lottery. You'll invest the money and live off the interest. You buy a 1-year bond with a YTM of 10%.

**Year 1 income = \$50,000. At year-end get back \$500,000 to reinvest.**

**If rates fall to 3%, income will drop from \$50,000 to \$15,000. Had you bought 30-year bonds, income would have remained constant.**

- **Long-term bonds:** High interest rate risk, low reinvestment rate risk.
- **Short-term bonds:** Low interest rate risk, high reinvestment rate risk.
- **Nothing is riskless!**

**True or False:** “All 10-year bonds have the same price and reinvestment rate risk.”

**False!** Low coupon bonds have less reinvestment rate risk but more price risk than high coupon bonds.

## Semiannual Bonds

1. Multiply years by 2 to get periods =  **$2n$** .
2. Divide nominal rate by 2 to get periodic rate =  $r_d/2$ .
3. Divide annual INT by 2 to get PMT =  **$INT/2$** .

**INPUTS**

**$2n$**

**$r_d/2$**

**OK**

**$INT/2$**

**OK**

**N**

**I/YR**

**PV**

**PMT**

**FV**

**OUTPUT**

Find the value of 10-year, 10% coupon, semiannual bond if  $r_d = 13\%$ .

**INPUTS**

2(10)

20

N

13/2

6.5

I/YR

100/2

50

PMT

1000

FV

**OUTPUT**

-834.72

## **Spreadsheet Functions for Bond Valuation**

- **See Ch 04 Mini Case.xls for details.**
  - **PRICE**
  - **YIELD**



**You could buy, for \$1,000, either a 10%, 10-year, annual payment bond or an equally risky 10%, 10-year semiannual bond. Which would you prefer?**

**The semiannual bond's EFF% is:**

$$\text{EFF}\% = \left(1 + \frac{i_{\text{Nom}}}{m}\right)^m - 1 = \left(1 + \frac{0.10}{2}\right)^2 - 1 = 10.25\% .$$

**10.25% > 10% EFF% on annual bond, so buy semiannual bond.**

**If \$1,000 is the proper price for the semiannual bond, what is the proper price for the annual payment bond?**

- Semiannual bond has  $r_{\text{Nom}} = 10\%$ , with  $\text{EFF}\% = 10.25\%$ . Should earn same  $\text{EFF}\%$  on annual payment bond, so:

<b>INPUTS</b>	10	10.25		100	1000
	<b>N</b>	<b>I/YR</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
<b>OUTPUT</b>			-984.80		

- **At a price of \$984.80, the annual and semiannual bonds would be in equilibrium, because investors would earn  $EFF\% = 10.25\%$  on either bond.**

**A 10-year, 10% semiannual coupon, \$1,000 par value bond is selling for \$1,135.90 with an 8% yield to maturity. It can be called after 5 years at \$1,050.**

**What's the bond's nominal yield to call (YTC)?**

**INPUTS**

10

N

-1135.9

I/YR

PV

50

PMT

1050

FV

**OUTPUT** $3.765 \times 2 = 7.53\%$

**$r_{\text{Nom}} = 7.53\%$  is the rate brokers would quote. Could also calculate EFF% to call:**

$$\text{EFF}\% = (1.03765)^2 - 1 = 7.672\%.$$

**This rate could be compared to monthly mortgages, and so on.**

**If you bought bonds, would you be more likely to earn YTM or YTC?**

- **Coupon rate = 10% vs. YTC =  $r_d$  = 7.53%. Could raise money by selling new bonds which pay 7.53%.**
- **Could thus replace bonds which pay \$100/year with bonds that pay only \$75.30/year.**
- **Investors should expect a call, hence YTC = 7.5%, not YTM = 8%.**

- In general, if a bond sells at a premium, then (1) coupon  $> r_d$ , so (2) a call is likely.
- So, expect to earn:
  - YTC on premium bonds.
  - YTM on par & discount bonds.

- **Disney recently issued 100-year bonds with a YTM of 7.5%--this represents the promised return. The expected return was less than 7.5% when the bonds were issued.**
- **If issuer defaults, investors receive less than the promised return. Therefore, the expected return on corporate and municipal bonds is less than the promised return.**



## Bond Ratings Provide One Measure of Default Risk

	Investment Grade				Junk Bonds			
Moody's	Aaa	Aa	A	Baa	Ba	B	Caa	C
S&P	AAA	AA	A	BBB	BB	B	CCC	D

## **What factors affect default risk and bond ratings?**

- **Financial performance**
  - **Debt ratio**
  - **Coverage ratios, such as interest coverage ratio or EBITDA coverage ratio**
  - **Current ratios**

(More...)

- **Provisions in the bond contract**
  - **Secured versus unsecured debt**
  - **Senior versus subordinated debt**
  - **Guarantee provisions**
  - **Sinking fund provisions**
  - **Debt maturity**

(More...)

## ■ Other factors

- Earnings stability
- Regulatory environment
- Potential product liability
- Accounting policies

## **Top Ten Largest U.S. Corporate Bond Financings, as of July 1999**

<b><u>Issuer</u></b>	<b><u>Date</u></b>	<b><u>Amount</u></b>
<b>Ford Motor Co.</b>	<b>July 1999</b>	<b>\$8.6 billion</b>
<b>AT&amp;T</b>	<b>Mar 1999</b>	<b>\$8.0 billion</b>
<b>RJR Holdings</b>	<b>May 1989</b>	<b>\$6.1 billion</b>
<b>WorldCom</b>	<b>Aug 1998</b>	<b>\$6.1 billion</b>
<b>Sprint</b>	<b>Nov 1998</b>	<b>\$5.0 billion</b>

# Bankruptcy

- **Two main chapters of Federal Bankruptcy Act:**
  - **Chapter 11, Reorganization**
  - **Chapter 7, Liquidation**
- **Typically, company wants Chapter 11, creditors may prefer Chapter 7.**

- **If company can't meet its obligations, it files under Chapter 11. That stops creditors from foreclosing, taking assets, and shutting down the business.**
- **Company has 120 days to file a reorganization plan.**
  - **Court appoints a “trustee” to supervise reorganization.**
  - **Management usually stays in control.**

- **Company must demonstrate in its reorganization plan that it is “worth more alive than dead.”**

**Otherwise, judge will order liquidation under Chapter 7.**



■ **If the company is liquidated, here's the payment priority:**

- 1. Secured creditors from sales of secured assets.**
- 2. Trustee's costs**
- 3. Wages, subject to limits**
- 4. Taxes**
- 5. Unfunded pension liabilities**
- 6. Unsecured creditors**
- 7. Preferred stock**
- 8. Common stock**

- In a liquidation, unsecured creditors generally get **zero**. This makes them more willing to participate in reorganization even though their claims are greatly scaled back.
- Various groups of creditors vote on the reorganization plan. If both the majority of the creditors and the judge approve, company “emerges” from bankruptcy with lower debts, reduced interest charges, and a chance for success.