

Chapter 5



Valuing Bonds

Topics Covered

⇒ Bond Characteristics

- Reading the financial pages after introducing the terminologies of bonds in the next slide (p.119 Figure 5-2)

⇒ Bond Prices and Yields

- Bond prices and interest rates
- YTM vs. current yield
- Rate of Return
- Interest Rate Risk
- The Yield Curve
- Nominal and Real Rates of Interest
- Default Risk
- Variations in Corporate Bonds

Bonds

Terminology

- ➡ Bond - Security that obligates the issuer to make specified payments to the bondholder.
- ➡ Coupon - The interest payments made to the bondholder.
- ➡ Face Value (Par Value or Maturity Value) - Payment at the maturity of the bond.
- ➡ Coupon Rate - Annual interest payment, as a percentage of face value.

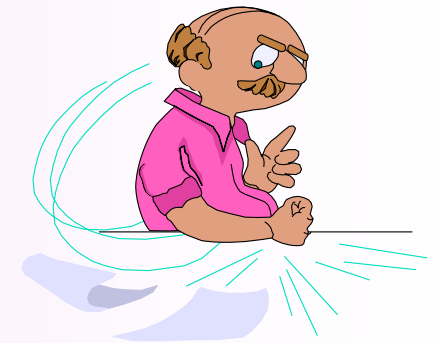
Bonds

WARNING

The coupon rate IS NOT the discount rate used in the Present Value calculations.

The coupon rate merely tells us what cash flow the bond will produce.

Since the coupon rate is listed as a %, this misconception is quite common.



Bond Pricing

The price of a bond is the Present Value of all cash flows generated by the bond (i.e. coupons and face value) discounted at the required rate of return.

$$PV = \frac{cpn}{(1+r)^1} + \frac{cpn}{(1+r)^2} + \dots + \frac{(cpn + par)}{(1+r)^t}$$

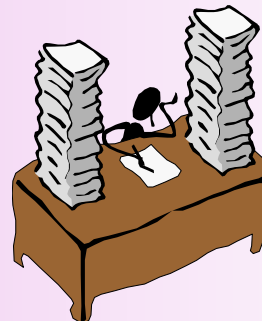
Bond Pricing

Example

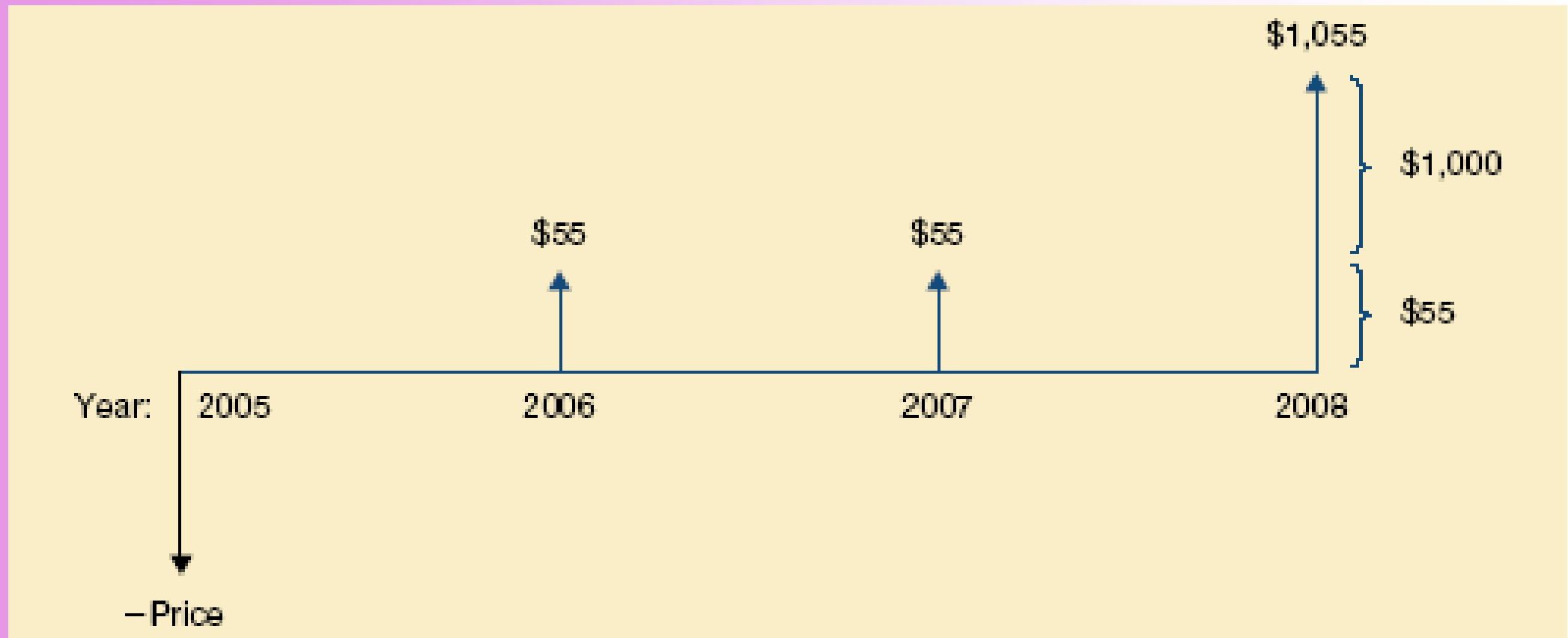
What is the price of a 5.5 % annual coupon bond, with a \$1,000 face value, which matures in 3 years? Assume a required return of 3.5%.

$$PV = \frac{55}{(1.035)^1} + \frac{55}{(1.035)^2} + \frac{1,055}{(1.035)^3}$$

$$PV = \$1,056.03$$



Bond Pricing



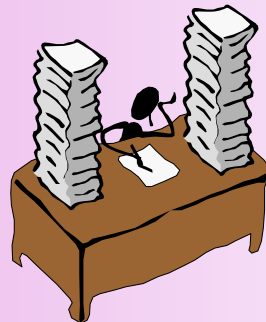
Bond Pricing

Example (continued)

What is the price of the bond if the required rate of return is 5.5 %?

$$PV = \frac{55}{(1.055)^1} + \frac{55}{(1.055)^2} + \frac{1,055}{(1.055)^3}$$

$$PV = \$1,000$$



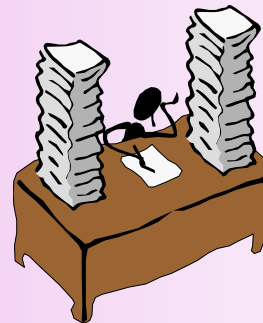
Bond Pricing

Example (continued)

What is the price of the bond if the required rate of return is 15 %?

$$PV = \frac{55}{(1.15)^1} + \frac{55}{(1.15)^2} + \frac{1,055}{(1.15)^3}$$

$$PV = \$783.09$$



Bond Pricing

Conclusion:

- ⇒ When the market interest rate exceeds the coupon rate, bonds sell for less than face value**
- ⇒ When the market interest rate is below the coupon rate, bonds sell for more than face value**
- ⇒ When the market interest rate equals the coupon rate, bonds are worth its face value.**

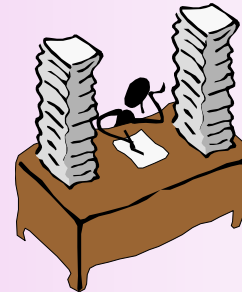
Bond Pricing

Example

*What is the price of the bond if the required rate of return is 3.5% AND the coupons are paid **semi-annually**?*

$$PV = \frac{27.50}{(1.0175)^1} + \frac{27.50}{(1.0175)^2} + \dots + \frac{27.50}{(1.0175)^5} + \frac{1,027.50}{(1.0175)^6}$$

$$PV = \$1,056.49$$



Bond Pricing

Example

Q: How did the calculation change, given semi-annual coupons versus annual coupon payments?

Time Periods

Paying coupons twice a year, instead of once doubles the total number of cash flows to be discounted in the PV formula

Discount Rate

Since the time periods are now half years, the discount rate is also changed from the annual rate to the half year rate

Bond Yields

- ➡ Current Yield - Annual coupon payments divided by bond price.
- ➡ Yield To Maturity - Interest rate for which the present value of the bond's payments equal the price.

Bond Yields

Calculating Yield to Maturity (YTM= r)

If you are given the price of a bond (PV) and the coupon rate, the yield to maturity can be found by solving for r .

$$PV = \frac{cpn}{(1+r)^1} + \frac{cpn}{(1+r)^2} + \dots + \frac{(cpn + par)}{(1+r)^t}$$

Bond Yields

Example

What is the YTM of a 5.5 % annual coupon bond, with a \$1,000 face value, which matures in 3 years? The market price of the bond is \$1,056.03.

$$PV = \frac{55}{(1+r)^1} + \frac{55}{(1+r)^2} + \frac{1,055}{(1+r)^3}$$

$$PV = \$1,056.03$$

Bond Yields

WARNING

Calculating YTM by hand can be very tedious

* It is highly recommended that you learn to use the “IRR” or “YTM” or “i” functions on a financial calculator (p.125)

Bond Yields

Rate of Return - Earnings per period per dollar invested.

$$\text{Rate of return} = \frac{\text{total income}}{\text{investment}} = \frac{\text{coupon income} + \text{price change}}{\text{investment}}$$

* Rate of Return vs. Yield to Maturity (p.127 Example 5.5)

- When interest rates do not change, the bond price changes with time so that the total return on the bond is equal to the yield to maturity.
- If the bond's yield to maturity increases, the rate of return during the period will be less than that yield.
- If the bond's yield to maturity decreases, the rate of return during the period will be greater than that yield.

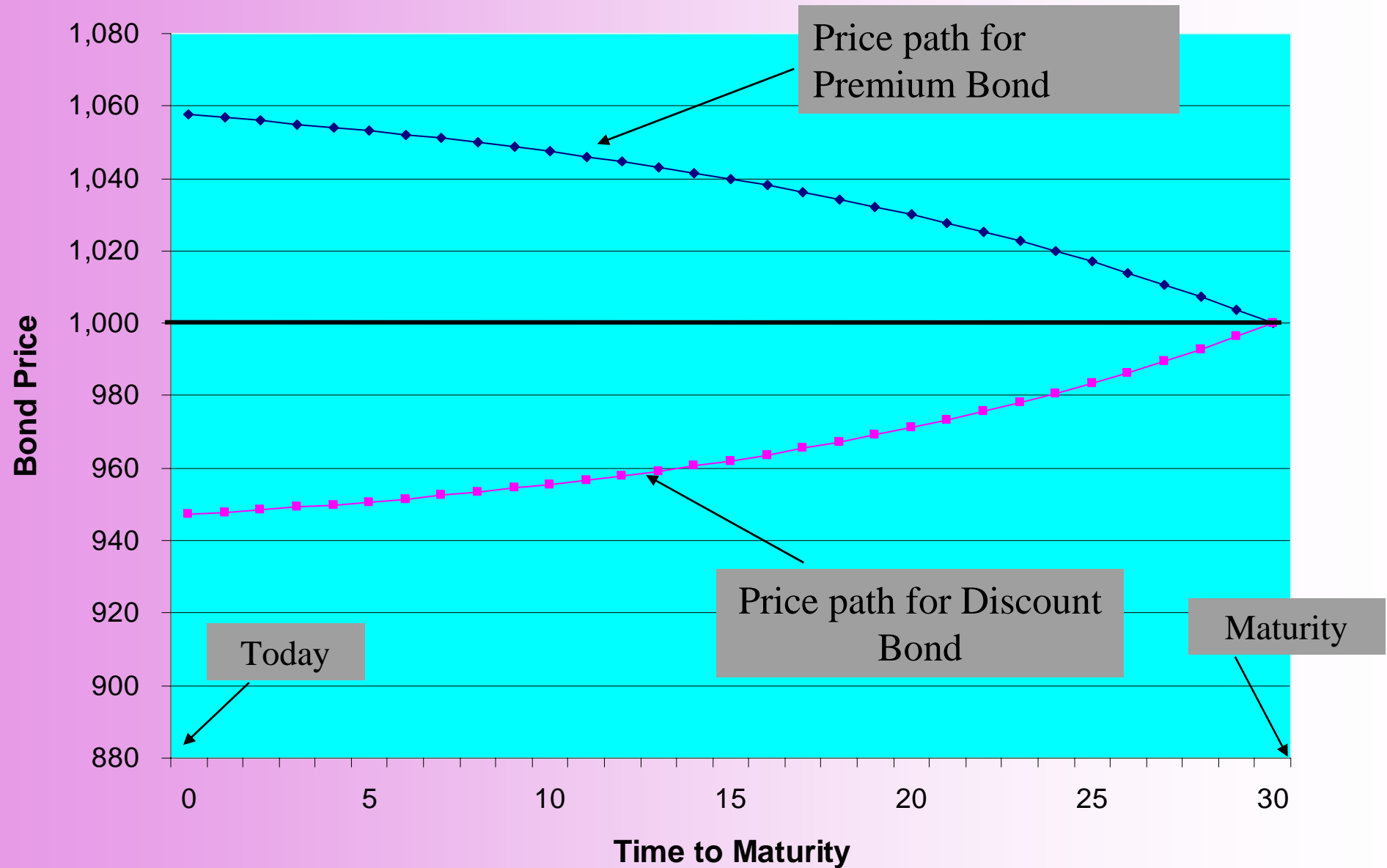
Bond Valuation Spreadsheet

| | | | | |
|------------------------------------|--|-------------------------------------|-------------------------|--|
| | | | | |
| | Valuing bonds using a spreadsheet | | | |
| | | | | |
| | 5.5 % coupon | | 5.5% coupon | |
| | maturing May 2005 | | 10-year maturity | |
| | | | | |
| Settlement date | 5/15/05 | | 1/1/05 | |
| Maturity date | 5/15/08 | | 1/1/15 | |
| Annual coupon rate | 0.055 | | 0.055 | |
| Yield to maturity | 0.035 | | 0.035 | |
| Redemption value (% of face value) | 100 | | 100 | |
| Coupon payments per year | 1 | | 1 | |
| | | | | |
| Bond price (% of par) | 105.603 | | 116.633 | |
| | | | | |
| | | =PRICE(B7,B8,B9,B10,B11,B12) | | |
| | | | | |

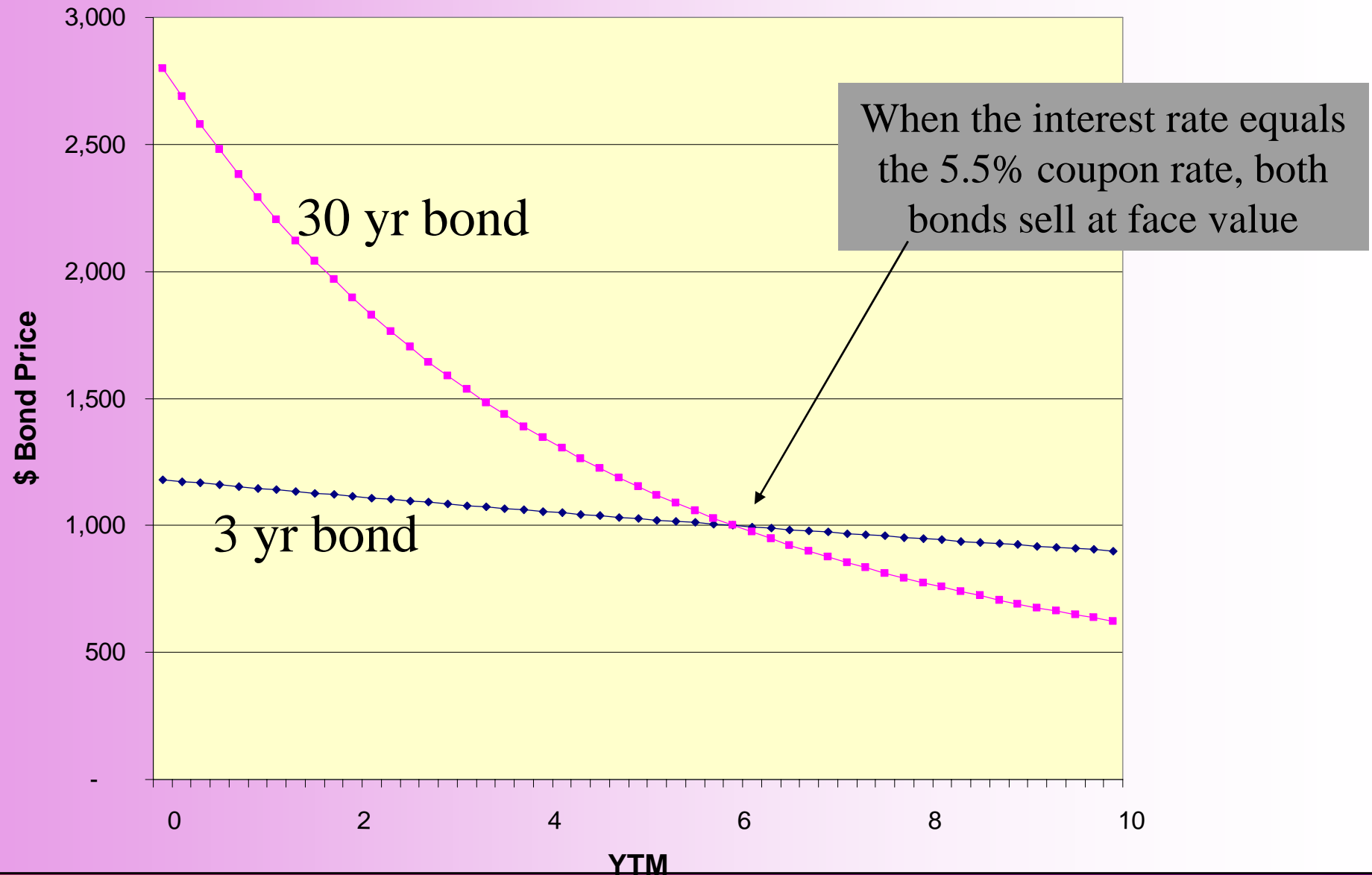
Bond Yield Spreadsheet

| | | | | | | |
|------------------------------------|---|------------------------------|---------------------------|--|--|--|
| | | | | | | |
| | Finding yield to maturity using a spreadsheet | | | | | |
| | May 2008 maturity bond, coupon rate = 5.5%, maturity = 3 years | | | | | |
| | | | | | | |
| | | | | | | |
| | Annual coupons | | Semiannual coupons | | | |
| | | | | | | |
| Settlement date | 5/15/05 | | 5/15/05 | | | |
| Maturity date | 5/15/08 | | 5/15/08 | | | |
| Annual coupon rate | 0.055 | | 0.055 | | | |
| Bond price | 105.603 | | 105.603 | | | |
| Redemption value (% of face value) | 100 | | 100 | | | |
| Coupon payments per year | 1 | | 2 | | | |
| | | | | | | |
| Yield to maturity (decimal) | 0.035 | | 0.0352 | | | |
| | | | | | | |
| | | =YIELD(B7,B8,B9,B10,B11,B12) | | | | |
| | | | | | | |
| | | | | | | |

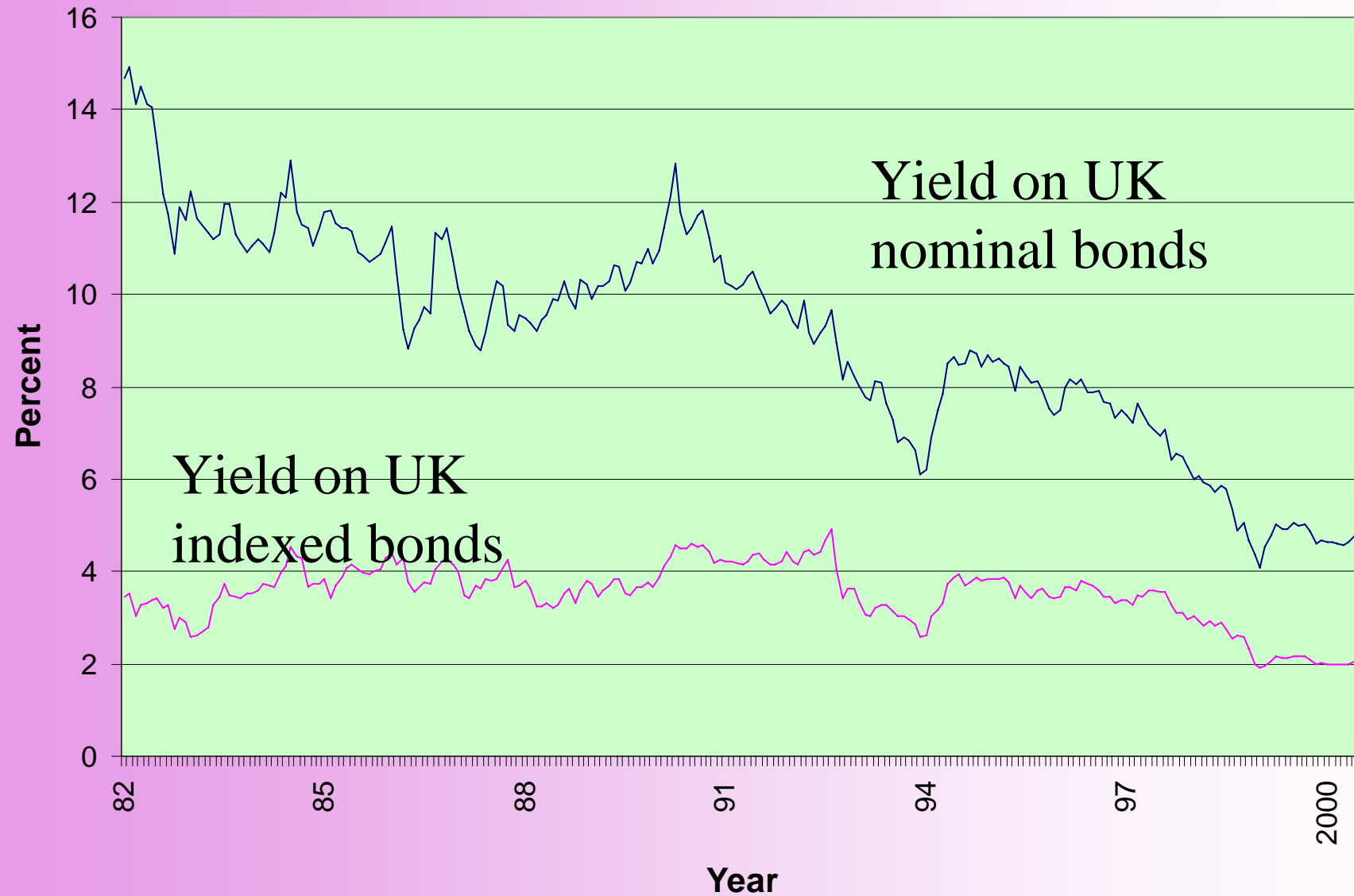
Interest Rate Risk



Interest Rate Risk



Nominal and Real rates



Default Risk

⇒ Default risk (Credit risk)

The risk that a bond issuer may default on its bonds

⇒ Default premium

The additional yield on a bond investors require for bearing credit risk

⇒ Investment grade

Bonds rated Baa or above by Moody's or BBB or above by Standard & Poor's

⇒ Junk bonds

Bond with a rating below Baa or BBB

Default Risk

| <u>Moody' s</u> | <u>Standard & Poor's</u> | <u>Safety</u> |
|-----------------|----------------------------------|---|
| Aaa | AAA | The strongest rating; ability to repay interest and principal is very strong. |
| Aa | AA | Very strong likelihood that interest and principal will be repaid |
| A | A | Strong ability to repay, but some vulnerability to changes in circumstances |
| Baa | BBB | Adequate capacity to repay; more vulnerability to changes in economic circumstances |
| Ba | BB | Considerable uncertainty about ability to repay. |
| B | B | Likelihood of interest and principal payments over sustained periods is questionable. |
| Caa | CCC | Bonds in the Caa/CCC and Ca/CC classes may already be in default or in danger of imminent default |
| Ca | CC | |
| C | C | C-rated bonds offer little prospect for interest or principal on the debt ever to be repaid. |

Corporate Bonds

- ⇒ Zero coupons (issued at prices considerably below par)
- ⇒ Floating rate bonds (Current Treasury bill rate + 2%)
- ⇒ Convertible bonds (with the right to exchange it for a specified number of shares of common stock, and with lower required interest rates)

Corporate Bonds

➔ **Callable bonds and Yield to Call** (8.5% coupon, 30-year maturity bond sells for \$1,040 and is callable in 10 years with a call price \$1,060)

| | Calculator Input | Yield to Call | Yield to Maturity |
|-------------------|------------------|---------------|-------------------|
| Coupon Payment | PMT | 85 | 85 |
| Number of Periods | n | 10 | 30 |
| Final Payment | FV | 1,060 | 1,000 |
| Price | PV | -1,040 | -1,040 |
| Answer | Compute i | 8.3% | 8.14% |

The Yield Curve

Term Structure of Interest Rates - A listing of bond maturity dates and the interest rates that correspond with each date.

Yield Curve - Graph of the term structure
(p.130 Figure 5-7)