Lecture 3

Bonds and their valuation

Chapter 6/168

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Topics Covered

- Bond Characteristics
- Interest Rates and Bond Prices
- Current Yield and Yield to Maturity
- Bond Rates of Return
- The Yield Curve
- Corporate Bonds and the Risk of Default

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6.1.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 Principal Value) – Payment at the maturity of the bond.
- Coupon Rate – Annual interest payment, as a percentage of face value.

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Bonds (Contd)

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.

6.2.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.

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

Bond Pricing (Contd)

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%.

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

$$PV = \$1,056.03$$

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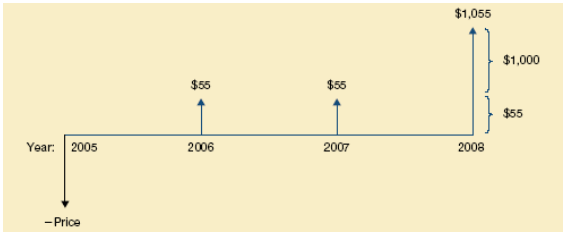
Bond Cash Flows



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Bond Pricing (Contd)

Example (continued)

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

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

$$PV = \$1,000$$

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Bond Pricing (Contd)

Example (continued)

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

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

$$PV = \$783.09$$

Conclusion: When 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.

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Ex 1

- a bond with face value $ 1,000 has a current yield of 9% and a coupon rate of 10%, what the bond's price?

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Bond Pricing (Contd)

Example (continued)

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

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

$$PV = \$1{,}056.49$$

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Bond Pricing (Contd)

Example (continued)

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

Time Periods	***Discount Rate***
Paying coupons twice a year, instead of once, doubles the total number of cash flows to be discounted in the PV formula.	*Since the time periods are now half years, the discount rate is also changed from the annual rate to the half year rate.*

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Ex 1

- a bond with face value $ 1,000 has a current yield of 9% and a coupon rate of 10%, what the bond's price, If, *given semi-annual coupons versus annual coupon payments?*

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6.3.Bond Yields

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

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Bond Yields (Contd)

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.

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

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Bond Yields (Contd)

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.

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

$$PV = \$1{,}056.03$$

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Bond Yields (Contd)

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.

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Ex 1

- You buy an 8% coupon, 3 year maturity bond for $980. A year later, the bond price is $1,100, what is the new yield to marturity on thebond

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6.4.Bond Rates of Return

Rate of Return – Earnings per period per dollar invested.

$$\text{Rate of return} = \frac{\text{total income}}{\text{investment}}$$

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

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Bond Valuation Spreadsheet

	Valuing bonds using a spreadsheet		
	5.5 % coupon maturing May 2005		5.5% coupon 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)	

Esc and Double click on spreadsheet to access

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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)				

Esc and Double click on spreadsheet to access

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Interest Rate Risk

- The possibility of the change in interest rates changing the value of the bond is termed as the interest rate risk. For example when interest rates go up the price of the bond falls and vice versa. **The following rules are important:**

(a) All other things being equal, the longer the time to maturity, the greater the interest rate risk; and

(b) the lower the coupon rate, the greater the interest rate risk.

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6.5.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.

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The Yield Curve (Contd)

- Longer the maturity, higher the yield. Assuming this to be true, do investors invest only in long-maturity bonds?
- Even the yield curve is upward-sloping, investors might stay away from long-term bonds because prices of long-term bonds fluctuate much more than prices of short-term bonds. Also, short-term investors can profit if interest rates rise.

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6.6.Default Risk

- Default (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 – bonds with a rating below Baa or BBB.

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Default Risk (Contd)

Moody's	Standard & Poor's	Safety
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
Ca	CC	in default or in danger of imminent default
C	C	C-rated bonds offer little prospect for interest or principal on the debt ever to be repaid.

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Variations in Corporate Bonds

- coupon bond – bond has a coupon rate of I, after period time received par value.

With:

– I=i*C

- C: face value ; i: interest

$$P_0 = \frac{I}{(1+r_d)^1} + \frac{I}{(1+r_d)^2} + \ldots + \frac{I}{(1+r_d)^n} + \frac{C}{(1+r_d)^n}$$

$$P_0 = I * \frac{1-(1+r_d)^{-n}}{r_d} + \frac{C}{(1+r_d)^n}$$

Ex 1

- A 10-year Treasury bond is issued with face value of $1,000, paying interest of $50 per year. If market yield increase shortly after T-bond is issued, what is bond price ?

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Variations in Corporate Bonds

- Floating-rate bond – coupon rate changes over time, and is tied to some measures of current market interest rates.
- Convertible bond – offers holders the right to exchange it for a specified number of shares of common stock.

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Bond Pricing (Contd)

- Consol bond – is a bond that has no maturity and pays a fixed coupon.

  $PV = \frac{C}{r}$

- Zero-coupon bond – bond has a coupon rate of 0.

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

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Ex 2

- Lifecompany has issued cousol bonds with coupon payments of $50.If the required rate of return on these bonds at the time they were issued was 6%, at what price were they sold to the public? If the requied return today is 10%, at what price do the consols sell?

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Thanks for your attention

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