Chapter 5

Bonds, Bond Valuation, and Interest Rates

Chapter 5 applies Time Value of Money techniques to the valuation of bonds, defines some new terms, and discusses how interest rates are determined.

Things to Absorb. Know everything until section 5-14, although the likelihood of yield-to-call being on an exam is low. This chapter develops the valuation techniques of fixed income securities. Bonds are valued similar to an ordinary annuity. You already know the valuation techniques from Chapter 4. The most difficult part of this chapter is the terminology and learning the interrelationships between the various bond components. The most important relationship is that "If the market price decreases, this implies that the yield to maturity has increased," and this is often expressed as "rate up implies price down." Also, since most bonds make coupon payments twice per year, make sure you can compute the price and yield to maturity on semiannual coupon bonds. This chapter shows a conceptual way of determining the Yield/Interest Rate on Financial Securities as a function of the r* (Real risk-free rate) + IP (Inflation premium) + DRP (Default risk premium) + LP (Liquidity premium) + MRP (Maturity risk premium).

Do not need to absorb - details about junk bonds or the bankruptcy code of the United States

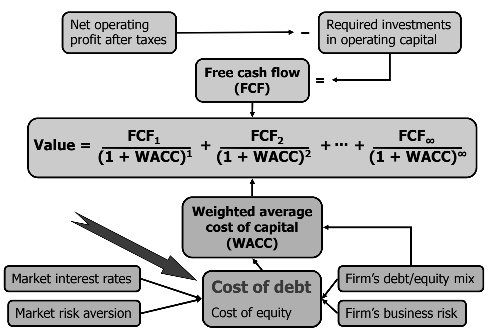
Things to Read - You will need to read the chapter.

Things to Do - Make 100 on the quiz. Also, since most bonds make coupon payments twice per year, make sure you can compute the price and yield to maturity on semiannual coupon bonds. You should be able to answer all of the end of chapter Questions and Problems.
Questions and Problems that you should be able to answer - Questions 1-3 and Problems - All. Note, I have used variations of every one of the end of chapter Questions and Problems in past semesters' quizzes and exams. Problems 7 and 12-22 are questions types I have used on recent exams.

Topics in Chapter

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

Determinants of Intrinsic Value: The Cost of Debt



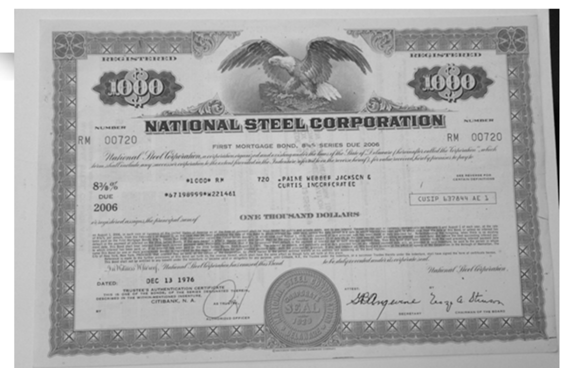
A bond is a debt instrument issued by governments or corporations to raise money

- **3rd most important Finance concept – Inverse relationship between Prices and Yields**
  - **Rate up implies price down**

Bond Basics

*When governments or companies issue **bonds**, they promise to make a series of interest payments and then repay the debt.*

- **Face Value = Par Value = Principal Value = $1000 = Payment at the Maturity of the Bond (FV)**
- **Maturity = Number of Coupons Remaining (N)**
- **Coupon Rate (Annual Interest Payment as a percent of Face Value ($1000))**.
  - Allow us to compute the Coupon (PMT)
- **Interest Rate = Yield to Maturity (I/YR)**
- **Price = Value (if markets are efficient) (PV)**



r_d = r* + IP + DRP + LP + MRP.

Here:

r_d	=	Required rate of return on a debt security.
r*	=	Real risk-free rate.
IP	=	Inflation premium.
DRP	=	Default risk premium.
LP	=	Liquidity premium.
MRP	=	Maturity risk premium.

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Key Features of a Bond

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

(More…)

Key Features of a Bond

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

Call Provision

- 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.

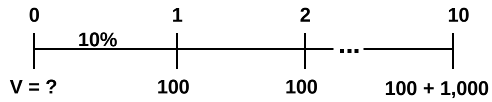
What's a sinking fund?

- 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

- Call x% at par per year for sinking fund purposes.
  - Call if r_d is below the coupon rate and bond sells at a premium.
- Buy bonds on open market.
  - Use open market purchase if r_d is above coupon rate and bond sells at a discount.

Value of a 10-year, 10% coupon bond if r_d = 10%



$$V_B = \frac{\$100}{(1 + r_d)^1} + \ldots + \frac{\$100}{(1 + r_d)^N} + \frac{\$1{,}000}{(1 + r_d)^N}$$

$$= \$90.91 + \ \ldots \ + \$38.55 \ + \$385.54$$
$$= \$1{,}000.$$

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	= 385.54
Value of bond	= $1,000.00

	N	I/YR	PV	PMT	FV
INPUTS	10	10		100	1000
OUTPUT			-1,000		

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

	N	I/YR	PV	PMT	FV
INPUTS	10	13		100	1000
OUTPUT			-837.21		

When r_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%?

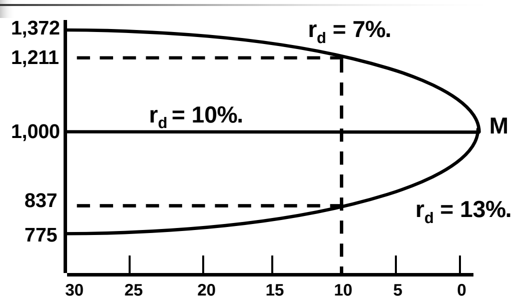
INPUTS	10	7		100	1000
	N	I/YR	PV	PMT	FV
OUTPUT			-1,210.71		

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

Bond Value ($) vs. Years remaining to Maturity

- 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%?
- See next slide.

Bond Value ($) vs. Years remaining to Maturity



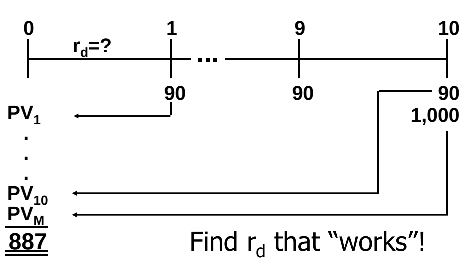
Bond Value ($) vs. Years remaining to Maturity

- 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."
- It assumes the bond will not default.

YTM on a 10-year, 9% annual coupon, $1,000 par value bond selling for $887



Find r_d that "works"!

Find r_d

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

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

	N	I/YR	PV	PMT	FV
INPUTS	10		-887	90	1000
OUTPUT		10.91			

What's "yield to maturity"?

- 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.

	N	I/YR	PV	PMT	FV
INPUTS	10		-1134.2	90	1000
OUTPUT		7.08			

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

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Definitions

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

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

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

9% coupon, 10-year bond, P = $887, and YTM = 10.91%

$$\text{Current yield} = \frac{\$90}{\$887}$$

$$= 0.1015 = 10.15\%.$$

YTM = Current yield + Capital gains yield.

Cap gains yield = YTM - Current yield
= 10.91% - 10.15%
= 0.76%.

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

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.

	N	I/YR	PV	PMT	FV
INPUTS	2N	$r_d/2$	OK	INT/2	OK
OUTPUT					

Value of 10-year, 10% coupon, semiannual bond if rd = 13%.

	N	I/YR	PV	PMT	FV
INPUTS	2(10) 20	13/2 6.5		100/2 50	1000
OUTPUT			-834.72		

Spreadsheet Functions for Bond Valuation

- See *Ch05 Mini Case.xls* for details.
  - PRICE
  - YIELD

Callable Bonds and Yield to Call

- 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.

Nominal Yield to Call (YTC)

	N	I/YR	PV	PMT	FV
INPUTS	10		-1135.9	50	1050
OUTPUT		3.765 x 2 = 7.53%			

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%.

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

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

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What is the nominal risk-free rate?

- r_{RF} = (1+r*)(1+IP)-1
  = r*+ IP + (r*xIP)
  ≈ r*+ IP. (Because r*xIP is small)
- r_{RF} = Rate on Treasury securities.

Estimating IP

- Treasury Inflation-Protected Securities (TIPS) are indexed to inflation.
- The IP for a particular length maturity can be approximated as the difference between the yield on a non-indexed Treasury security of that maturity minus the yield on a TIPS of that maturity.

Bond Spreads, the DRP, and the LP

- A "bond spread" is often calculated as the difference between a corporate bond's yield and a Treasury security's yield of the same maturity. Therefore:
  - Spread = DRP + LP.
- Bond's of large, strong companies often have very small LPs. Bond's of small companies often have LPs as high as 2%.

Bond Ratings		% defaulting within:	
S&P and Fitch	Moody's	1 yr.	5 yrs.
Investment grade bonds:			
AAA	Aaa	0.00	0.00
AA	Aa	0.03	0.17
A	A	0.09	0.74
BBB	Baa	0.23	2.54
Junk bonds:			
BB	Ba	1.17	6.91
B	B	2.14	9.28
CCC	Caa	24.47	35.23

Source: Fitch Ratings

Bond Ratings and Bond Spreads (March 2012)

Long-term Bonds	Yield (%)	Spread (%)
10-Year T-bond	2.18	
AAA	4.11	1.93
AA	3.38	1.20
A	3.37	1.19
BBB	6.24	4.06
BB	6.28	4.10
B	7.02	4.84
CCC	9.98	7.80

What factors affect default risk and bond ratings?

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

(More…)

Bond Ratings Median Ratios
(S&P)

	Interest coverage	Return on capital	Debt to capital
AAA	23.8	27.6%	12.4%
AA	19.5	27.0%	28.3%
A	8.0	17.5%	37.5%
BBB	4.7	13.4%	42.5%
BB	2.5	11.3%	53.7%
B	1.2	8.7%	75.9%
CCC	0.4	3.2%	113.5%

Other Factors that Affect Bond Ratings

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

(More…)

Other Factors that Affect Bond Ratings

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

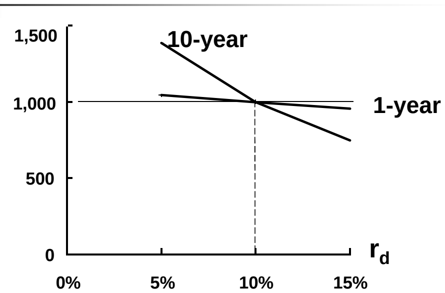
Interest rate (or price) risk for 1-year and 10-year 10% bonds

Interest rate risk:

Rising r_d causes bond prices to fall

	1-Year		10-Year	
r_d	Price	Change	Price	Change
5.0%	\$1,048		\$1,386	
		4.8%		38.6%
10.0%	\$1,000		\$1,000	
		4.5%		33.5%
15.0%	\$957		\$749	

Value



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%.

What is reinvestment rate risk?

- 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.

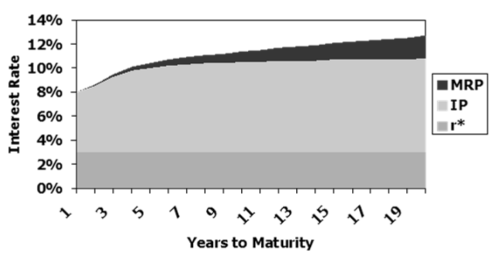
The Maturity Risk Premium

- 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!
- Yields on longer term bonds usually are greater than on shorter term bonds, so the MRP is more affected by interest rate risk than by reinvestment rate risk.

Term Structure Yield Curve

- Term structure of interest rates: the relationship between interest rates (or yields) and maturities.
- A graph of the term structure is called the yield curve.

Hypothetical Treasury Yield Curve



Bankruptcy

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

Bankruptcy

- 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.

Bankruptcy

- 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:

- Past due property taxes
- Secured creditors from sales of secured assets.
- Trustee's costs
- Expenses incurred after bankruptcy filing
- Wages and unpaid benefit contributions, subject to limits
- Unsecured customer deposits, subject to limits
- Taxes
- Unfunded pension liabilities
- Unsecured creditors
- Preferred stock
- Common stock

Bankruptcy

- 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.

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