FN 201 Business Finance

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B.E. International Program

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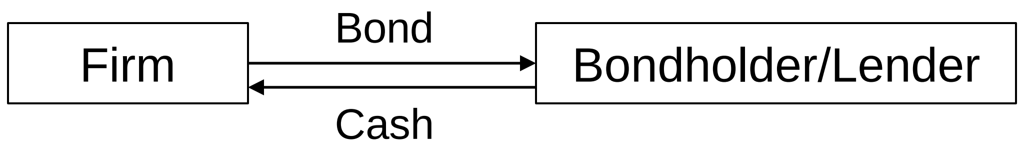
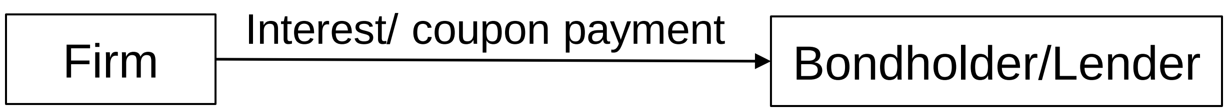
Lecture 4:
Interest and bond valuation

Bonds in general

- Bonds allow individuals with excess cash to lend this out to individuals or companies requiring cash;
  - Initially: Investors buy bond



  - In-between: Investors receive interest payments



  - At maturity: Firm retires bond

Debt Vs. Equity

Debt	Equity
Not an ownership interest	Ownership interest
Creditors do not have voting rights	Common stockholders vote for the board of directors and other issues
Interest is considered a cost of doing business and is tax deductible	Dividends are not considered a cost of doing business and are not tax deductible
Creditors have legal recourse if interest or principal payments are missed	Dividend are not a liability of the firm, and stockholders have no legal recourse if dividends are not paid
Excess debt can lead to financial distress and bankruptcy	An all equity firm cannot go bankrupt

Some bond terminology

Indenture	Written agreement between the corporation (the borrower), which includes; 1. The basic terms of the bonds 2. The total amount of bonds issued 3. A description of property used as security 4. The repayment arrangements 5. The call provisions 6. Details of protective covenants
Maturity date	The final repayment date
Time to maturity	Time until face value is paid, usually given in years
Coupon	The promised interest payment, regular interest payment
Face value/Par value/ Value at Par	Notional amount used to compute interest, amount repaid at the end of the loan
Coupon rate	Coupon quoted as a percent of face value, determines the amount of each coupon payment expressed as an APR (annual percentage rate)

Example of bond features

FEATURES OF A PEPSICO BOND		
TERM		**EXPLANATION**
Amount of issue	$1 billion	The company issued $1 billion worth of bonds.
Date of issue	01/15/2010	The bonds were sold on 01/15/2010.
Maturity	01/15/2040	The bonds mature on 01/15/2040.
Face value	$2,000	The denomination of the bonds is $2,000.
Annual coupon	5.50%	Each bondholder will receive $110 per bond per year (5.50% of face value).
Offer price	98.927	The offer price will be 98.927% of the $2,000 face value, or $1,978.54, per bond.
Coupon payment dates	01/15, 7/15	Coupons of $110/2 = $55 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 0.15%	The bonds have a "make whole" call price.
Rating	Aa2, A+	The bonds are in the middle of the investment grade rating.

Interest rate

- Required rate of return – rate of return that investors require from an investment given the risk of the investment.
- The discount rate – the opportunity cost of capital, i.e. the rate that could be earned on alternative investments of equal risk
- The discount rate that sets the PV of the bond payments equal to the bond's current price is called the yield-to-maturity

$$r = r^* + \pi + MRP + DRP + LP$$

Here

r = required rate of return on debt security

r*= Real risk-free rate

π= Inflation premium

MPR = Maturity risk premium

DRP = Default risk premium

LP = Liquidity premium

Bond rating

		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 higher-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.

Note: At times, both Moody's and S&P use adjustments (called notches) to these ratings. S&P uses plus and minus signs: A+ is the strongest A rating and A– the weakest. Moody's uses a 1, 2, or 3 designation, with 1 being the highest. Moody's has no D rating.

Bond classification

- Registered vs. Bearer forms
- Security
  - Collateral – secured by financial securities
  - Mortgage – secured by real property, normally land or buildings
  - Debentures – unsecured
  - Notes – unsecured debt with original maturity less than 10 years
- Convertible bond – bond which can be swapped for a fixed number of shares of stock anytime before maturity at the holder's option
- Put bond – the holder of the bonds can force the issuer to buy the bond back at a stated price.
- Callable bond - A bond that can be redeemed by the issuer prior to its maturity. Usually a premium is paid to the bond owner when the bond is called. Also known as a "redeemable bond."

Zero-coupon bond

- Zero-coupon bonds are the simplest type of bonds:
- Do not make any interest payments (i.e. they only repay the principle (face value) at maturity
- Always sell at a discount (a price lower than the face value), therefore often referred to as **pure discount bonds;** Treasury Bills are an example of zero-coupon bonds

Example

0	1
-96,618.36	100,000

- Your compensation is the difference between the initial price and the face value

Government bond

- Federal reserve treasury securities
  - Treasury bills (T-bills) – pure discount bonds with original maturity less than one year
  - Treasury notes (T-notes) – coupon debt with original maturity between one and ten years
  - Treasury bonds (T-bonds) – coupon debt with original maturity greater than ten years
- Municipal notes and bonds – issued by state and local governments

Floating-rate bond

- The coupon payment are adjustable.
- The value of floating-rate bond depends on exactly how the coupon payment adjustments are defined.
- Inflation-linked bond – the coupon are adjusted according to the rate of inflation
- TIPs – Treasury Inflation Protection Securities

Fundamental bond valuation model

$$P_0 = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \cdots + \frac{CF_n}{(1+r)^n}$$

P_0 = Price of asset at time 0 (today)

CF_t = cash flow expected at time t

r = discount rate reflecting asset's risk or required rate of return

n = number of discounting periods

Or use PV ordinary annuity + PV of bond face value

$$P_0 = \frac{\text{Interest}}{r}\left[1 - \frac{1}{(1+r)^n}\right] + \frac{\text{Principal}}{(1+r)^n}$$

Example

- TU is considering issuing a 30-year maturity bonds. Interest is paid annually, the bonds have a 1,000 baht par value, and the coupon interest rate is 10%. What is the value (or price) of this bond if it is issued today at the market rate of 10%.

Price to yield relationship

- Bond prices changes as yield change, and have the following relationships:
  - When yield is below the coupon rate, the bond will be priced at a premium to par value
  - When yield is above the coupon rate, the bond will be priced at a discount from its par value

Type of bonds	Definition
	A bond that sells at its par value.
	A bond that sells for more than its par value.
	A bond that sells for less than its par value.

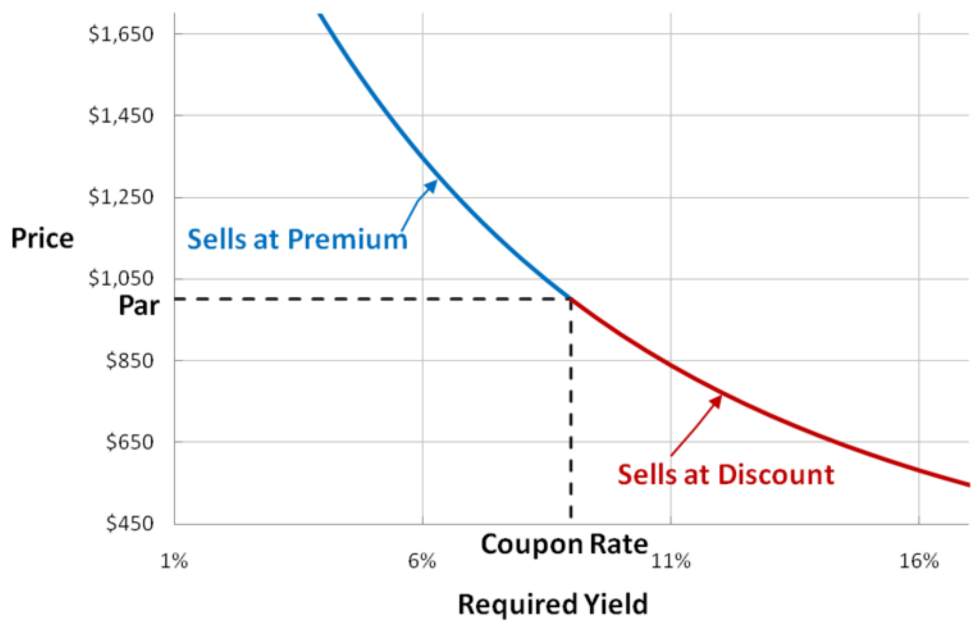
Example

- TU is considering issuing a 30-year maturity bonds. Interest is paid annually, the bonds have a 1,000 baht par value, and the coupon interest rate is 10%. What is the value (or price) of this bond if it is issued today at the market rate of;

Yield-to-maturity	7 percent	10 percent	13 percent
Price			

Price to yield relationship

- The price-yield relationship is not a straight line, but rather convex
  - As yields decline, prices increase at a increasing rate
  - As yields increase, prices fall at a declining rate



$1,000 Par value

9% coupon bond

Bond total return

$$\text{Total return} = \text{YTM} = \text{Capital gain yield} + \text{Current yield}$$

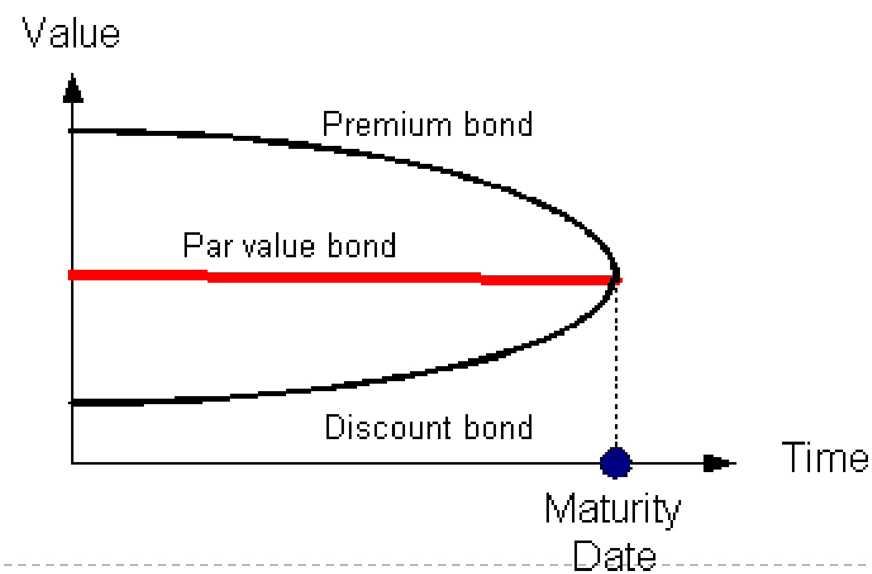
$$\frac{P_1 - P_0}{P_0} \quad + \quad \frac{I}{P_0}$$

	YTM (Total return: TR)	Capital gain yield	Current yield
Par Bond			
Premium Bond			
Discount Bond			

Price pattern when approaching maturity

- What happen to TU bonds when it's approaching maturity

Yield-to-maturity	7 percent	10 percent	13 percent
Price 30-year left			
Price 20-yaer left			
Price 10-year left			



Relationship between coupon rate, current yield, and YTM

- Coupon rate – measures the coupon rate or the percentage of par paid out annually as interest
- Yield-to-maturity (YTM) measures expected rate of return for bond held to maturity
- Current yield – measures current income rate

Type of bonds	Definition
Par bond	Coupon rate = Current yield = Yield-to-maturity
Premium bond	
Discount bond	

Example

- Consider the following semi-annual bond:
  - $1000 par value
  - 7 years until maturity
  - 9% coupon rate
  - Price is $1,080.55
  - What is the bond's yield to maturity?

Example

- Consider a 5-year, $1,000 bond with a 5% coupon rate and semiannual coupons. Suppose the yield to maturity has increased to 6.3%. What price is the bond trading for now?

- Suppose the yield to maturity has increased to 10%. What is the bond new price?

Interest Rate Changes and Bond Prices

- There is an inverse relationship between interest rates and bond prices.
  - As interest rates and bond yields rise, bond prices fall.
  - As interest rates and bond yields fall, bond prices rise.
- The sensitivity of a bond's price to changes in interest rates is measured by the bond's **duration**.
  - Bonds with high durations are highly sensitive to interest rate changes.
  - Bonds with low durations are less sensitive to interest rate changes.

Bond examples

- Compute the price of these bond (All face value of 1,000 baht)
  - Bond A: Coupon 10%, 10-year to maturity
  - Bond B: Coupon 10%, 15-year to maturity
  - Bond C: Coupon 15%, 10-year to maturity

	At YTM = 10%	At YTM = 8%	At YTM = 12%
Bond A			
Bond B			
Bond C			

Example

The Interest Rate Sensitivity of Bonds

Problem

Consider a 15-year zero-coupon bond and a 30-year coupon bond with 10% annual coupons. By what percentage will the price of each bond change if its yield to maturity increases from 5% to 6%?

Example

- The University of Pennsylvania sold $300 million of 100-year bonds with a yield to maturity of 4.67%. Assuming the bonds were sold at par and pay an annual coupon, by what percentage will the price of the bond change if its yield to maturity decreases by 1%? Increases by 2%?

Reading bid-ask

Treasury Bonds

Maturity	Coupon	Bid	Asked
2016 May 15	7.250	126:07	126:12
2017 Feb 15	4.625	110:21	110:23
2017 May 15	4.500	109:21	109:22
2018 Feb 15	3.500	101:29	101:31
2018 May 15	3.875	104:12	104:13
2019 Feb 15	8.875	143:14	143:18
2020 Feb 15	8.500	142:12	142:16
2020 May 15	8.750	144:30	145:02
2021 Aug 15	8.125	140:31	141:03
2021 Nov 15	8.000	140:00	140:05
2023 Feb 15	7.125	132:02	132:06
2023 Aug 15	6.250	123:02	123:06
2025 Aug 15	6.875	131:13	131:17
2026 Feb 15	6.000	121:06	121:10
2027 Feb 15	6.625	129:09	129:13
2027 Aug 15	6.375	126:17	126:21
2028 Aug 15	5.500	115:22	115:27
2029 Feb 15	5.250	112:12	112:17
2030 May 15	6.250	126:22	126:27
2031 Feb 15	5.375	114:23	114:28
2036 Feb 15	4.500	102:18	102:23

Bond quote

- If you buy a bond between coupon payment days, the price you pay is usually more than the price you are quoted.
- The standard convention in the bond market is to quote prices net of "accrued interest" meaning that accrued interest is deducted to arrive at the quoted price.
- The quoted price is called the clean price.
- The price you actually pay includes interest called dirty price.

Example

- You buy a bond with a 12 percent annual coupon, payable semi-annually. On the day you buy, the next coupon is due in four months. You actually paid \$1,080. What is the dirty price? What is the clean price?

Reference

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