Chapter 6 -- Interest Rates

- Interest rates
- The determinants of interest rates
- Term structure of interest rates and yield curves
- What determines the shape of yield curves
- Other factors

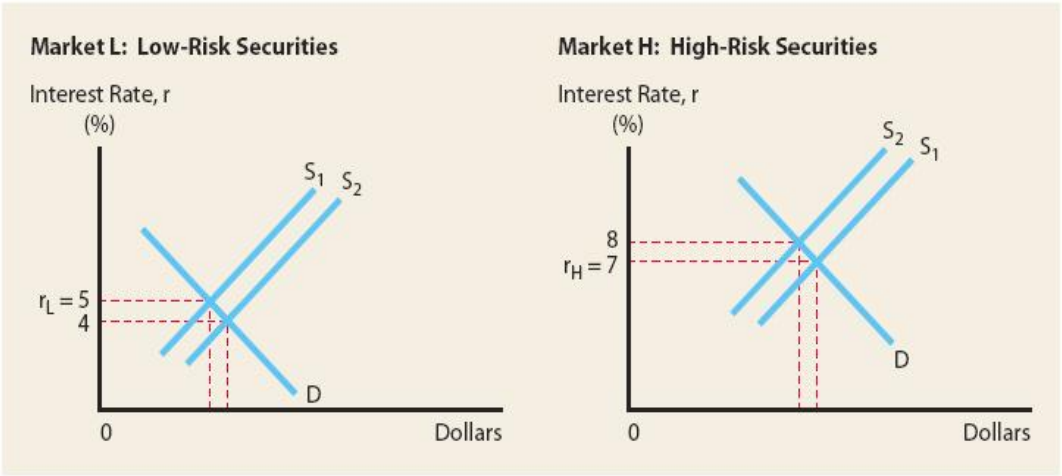
- Interest rates

  Cost of borrowing money

  Factors that affect cost of money:

  Production opportunities
  Time preference for consumption
  Risk
  Inflation

FIGURE 6-1 Interest Rates as a Function of Supply and Demand for Funds



- The determinants of interest rates

  The quoted (nominal) interest rate on a debt security is composed of a real risk-free rate, r*, plus several risk premiums

  Risk premium: additional return to compensate for additional risk

Quoted nominal return = r = r* + IP + DRP + MRP + LP
where, r = the quoted, or nominal rate on a given security
r* = real risk-free rate
IP = inflation premium (the average expected rate of inflation over the life time of the security)
DRP = default risk premium
MRP = maturity risk premium
LP = liquidity premium

and r* + IP = r_{RF} = nominal risk-free rate (T-bill rate)

Examples (online)

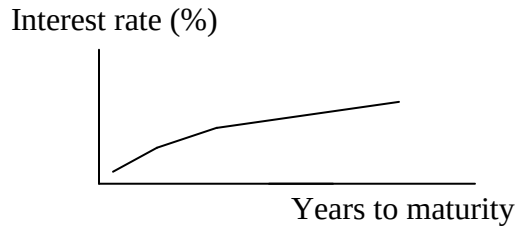
- Term structure of interest rates and yield curves

  Term structure of interest rates: the relationship between yields and maturities

  Yield curve: a graph showing the relationship between yields and maturities

  Normal yield curve (upward sloping)
  Abnormal yield curve (downward sloping)
  Humped yield curve (interest rates on medium-term maturities are higher than both short-term and long-term maturities)

Term to maturity	Interest rate
1 year	0.4%
5 years	2.4%
10 years	3.7%
30 years	4.6%



- What determines the shape of yield curves

  Term structure theories
  (1) Expectation theory: the shape of the yield curve depends on investor's expectations about future interest rates (inflation rates)

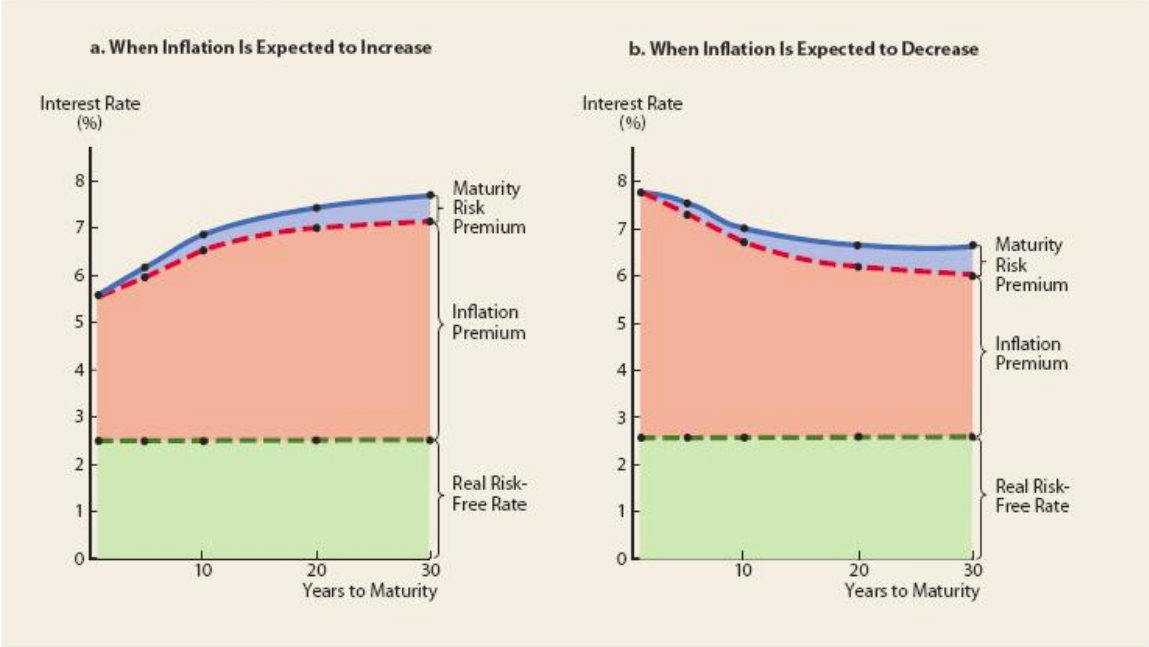
  Forward rate: a future interest rate implied in the current interest rates

  For example, a one-year T-bond yields 5% and a two-year T-bond yields 5.5%, then the investors expect to yield 6% for the T-bond in the second year.

  $(1+5.5\%)^2 = (1+5\%)(1+X)$, solve for X(forward rate) = 6.00238%

  Approximation: (5.5%)*2 - 5% = 6%

FIGURE 6-5 Illustrative Treasury Yield Curves



	WITH INFLATION EXPECTED TO INCREASE					WITH INFLATION EXPECTED TO DECREASE			
Maturity	r*	IP	MRP	Yield	Maturity	r*	IP	MRP	Yield
1 year	2.50%	3.00%	0.00%	5.50%	1 year	2.50%	5.00%	0.00%	7.50%
5 years	2.50	3.40	0.18	6.08	5 years	2.50	4.60	0.18	7.28
10 years	2.50	4.00	0.28	6.78	10 years	2.50	4.00	0.28	6.78
20 years	2.50	4.50	0.42	7.42	20 years	2.50	3.50	0.42	6.42
30 years	2.50	4.67	0.53	7.70	30 years	2.50	3.33	0.53	6.36

(2) Liquidity preference theory: other things constant, investors prefer to make short-term loans, therefore, they would like to lend short-term funds at lower rates

Implication: keeping other things constant, we should observe normal yield curves

- Other factors

  Fed policy: money supply and interest rates
  Increase in money supply lowers short-term interest rates and stimulates the economy but may lead to inflation in the future

  Government budget deficit or surpluses: if government runs a huge deficit and the debt must be covered by additional borrowing, which increases the demand for funds and thus pushes up interest rates

International perspective: trade deficit, country risk, exchange rate risk

Business activity: during recession, demand for funds decreases; during expansion, demand for funds rises

- **Exercise**

  ST-1, ST-2, and ST-3
  Problems: 2, 3, 5, 7, 9, 10*, 11, and 12*

  Problem 10: expected inflation this year = 3% and it will be a constant but above 3% in year 2 and thereafter; r* = 2%; if the yield on a 3-year T-bond equals the 1-year T-bond yield plus 2%, what inflation rate is expected after year 1, assuming MRP = 0 for both bonds?

  Answer: yield on 1-year bond, r_1 = 3% + 2% = 5%; yield on 3-year bond, r_3 = 5% + 2% = 7% = r* + IP_3; so IP_3 = 5%;
  IP_3 = (3% + x + x) / 3 = 5%, x = 6%

  Problem 12: Given r* = 2.75%, inflation rates will be 2.5% in year 1, 3.2% in year 2, and 3.6% thereafter. If a 3-year T-bond yields 6.25% and a 5-year T-bond yields 6.8%, what is MRP_5 - MRP_3 (For T-bonds, DRP = 0 and LP = 0)?

  Answer: IP_3 = (2.5%+3.2%+3.6%)/3=3.1%; IP_5 = (2.5%+3.2%+3.6%*3)/5=3.3%;
  Yield on 3-year bond, r_3=2.75%+3.1%+MRP_3=6.25%, so MRP_3=0.4%;
  Yield on 5-year bond, r_5=2.75%+3.3%+MRP_5=6.8%, so MRP_5=0.75%;
  Therefore, MRP_5 - MRP_3 = 0.35%

  Example: given the following interest rates for T-bonds, AA-rated corporate bonds, and BBB-rated corporate bonds, assuming all bonds are liquid in the market. (c)

Years to maturity	T-bonds	AA-rated bonds	BBB-rate bonds
1 year	5.5%	6.7%	7.4%
5 years	6.1	7.4	8.1
10 years	6.8	8.2	9.1

  The differences in interest rates among these bonds are caused primarily by

  a. Inflation risk premium
  b. Maturity risk premium
  c. Default risk premium
  d. Liquidity risk premium

Chapter 7 -- Bond Valuation

- Who issues bonds
- Characteristics of bonds
- Bond valuation
- Important relationships in bond pricing
- Bond rating
- Bond markets

- Who issues bonds

  Bond: a long-term debt

  Treasury bonds: issued by the federal government, no default risk

  Municipal bonds (munis): issued by state and local governments with some default risk - tax benefit (returns are tax exempt)

  Corporate bonds: issued by corporations with different levels of default risk
  Mortgage bonds: backed by fixed assets (first vs. second)
  Debenture: not secured by a mortgage on specific property
  Subordinated debenture: have claims on assets after the senior debt has been paid off

  Zero coupon bonds: no interest payments (coupon rate is zero)

  Junk bonds: high risk, high yield bonds

  Eurobonds: bonds issued outside the U.S. but pay interest and principal in U.S. dollars

  International bonds

- Characteristics of bonds

  Claim on assets and income

  Par value (face value, M): the amount that is returned to the bondholder at maturity, usually it is $1,000

  Maturity date: a specific date on which the bond issuer returns the par value to the bondholder

  Coupon interest rate: the percentage of the par value of the bond paid out annually to the bondholder in the form of interest

Coupon payment (INT): annual interest payment

Fixed rate bonds vs. floating rate bonds

Zero coupon bond: a bond that pays no interest but sold at a discount below par

For example, a 6-year zero-coupon bond is selling at $675. The face value is $1,000. What is the expected annual return? (I/YR = 6.77%)

						1000
0	1	2	3	4	5	6
-675						

PV = -675, FV = 1,000, N = 6, PMT = 0, solve for I/YR = 6.77%

Indenture: a legal agreement between the issuing firm and the bondholder

Call provision: gives the issuer the right to redeem (retire) the bonds under specified terms prior to the normal maturity date

Convertible bonds: can be exchanged for common stock at the option of the bondholder

Putable bonds: allows bondholders to sell the bond back to the company prior to maturity at a prearranged price

Income bonds: pay interest only if it is earned

Sinking fund provision: requires the issuer to retire a portion of the bond issue each year

Indexed bonds: interest payments are based on an inflation index

Required rate of return: minimum return that attracts the investor to buy a bond; It serves as the discount rate (I/YR) in bond valuation

- Bond valuation

  Market value vs. intrinsic (fair) value

  Market value: the actual market price, determined by the market conditions

  Intrinsic value: the fair or fundamental value

(1) Intrinsic value: present value of expected future cash flows, fair value

					M
	INT	INT	INT		INT
0	1	2	3	...	N

$V_B = \sum_{t=1}^{N} \frac{INT}{(1+r_d)^t} + \frac{M}{(1+r_d)^N}$, where INT is the annual coupon payment, M is the face value, and r_d is the required rate of return on the bond

Annual and semiannual coupon payments using a financial calculator

Example: a 10-year bond carries a 6% coupon rate and pays interest annually. The required rate of return of the bond is 8%. What should be the fair value of the bond?
Answer: PMT = 60, FV = 1,000, I/YR = 8% (input 8), N = 10, solve for
PV = -$865.80

What should be the fair value if the bond pays semiannual interest?
Answer: PMT = 30, FV = 1,000, I/YR = 4% (input 4), N = 20, solve for
PV = -$864.10

Should you buy the bond if the market price of the bond is $910.00?
No, because the fair value is less than the market price (the bond in the market is over-priced)

Discount bond: a bond that sells below its par value

Premium bond: a bond that sell above its par value

(2) Yield to maturity (YTM): the return from a bond if it is held to maturity

Example: a 10-year bond carries a 6% coupon rate and pays interest semiannually. The market price of the bond is $910.00. What should be YTM for the bond?
Answer: PMT = 30, FV = 1,000, PV = -$910.00, N = 20, solve for I/YR = 3.64%
YTM = 3.64%*2 = 7.28%

(3) Yield to call: the return from a bond if it is held until called

Example: a 10-year bond carries a 6% coupon rate and pays interest semiannually. The market price of the bond is $910.00. The bond can be called after 5 years at a call price of $1,050. What should be YTC for the bond?
Answer: PMT = 30, FV = 1,050, PV = -$910.00, N = 10, solve for I/YR = 4.55%
YTC = 4.55%*2 = 9.10%

(4) Current yield (CY) = annual coupon payment / current market price

Example: a 10-year bond carries a 6% coupon rate and pays interest semiannually. The market price of the bond is $910.00. What is CY for the bond?
Answer: CY = 60/910 = 6.59%

- Important relationships in bond pricing

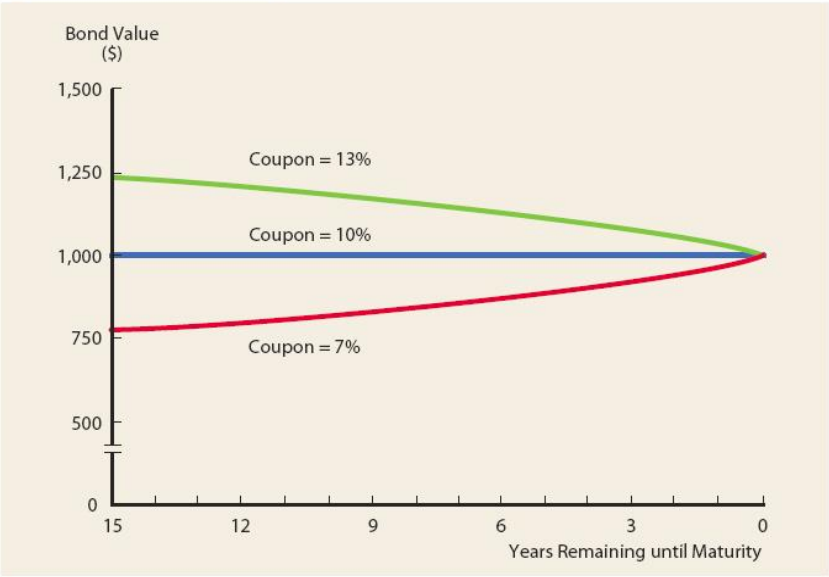
(1) The value of a bond is inversely related to changes in the investor's present required rate of return (current interest rate); or
As interest rates increase, the value of a bond decreases

Interest rate risk: the variability in a bond value caused by changing interest rates
Interest rate price risk: an increase in interest rates causes a decrease in bond value
Interest reinvestment risk: a decrease in interest rates leads to a decline in reinvestment income from a bond

(2) If the required rate of return (or discount rate) is higher than the coupon rate, the value of the bond will be less than the par value; and
If the required rate of return (or discount rate) is less than the coupon rate, the value of the bond will be higher than the par value

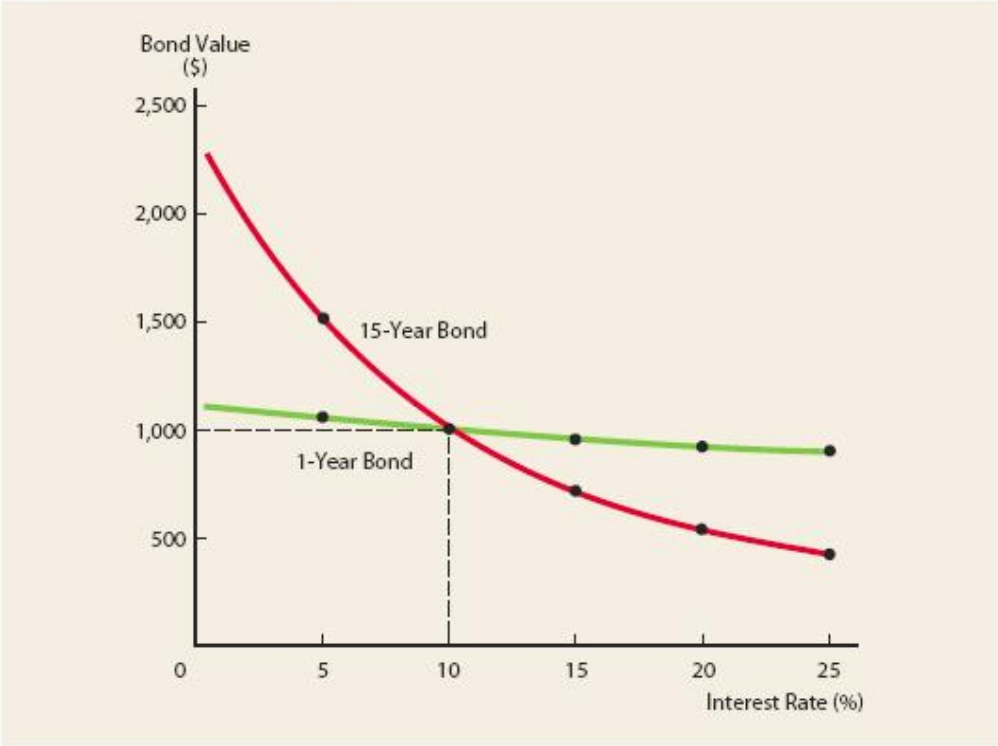
(3) As the maturity date approaches, the market value of a bond approaches its par value

FIGURE 7-2 Time Paths of 7%, 10%, and 13% Coupon Bonds When the Market Rate Remains Constant at 10%



(4) Long-term bonds have greater interest rate risk than short-term bonds

FIGURE 7-3 Values of Long- and Short-Term 10% Annual Coupon Bonds at Different Market Interest Rates



Current Market Interest Rate, r_d	VALUE OF 1-Year Bond	VALUE OF 15-Year Bond
5%	$1,047.62	$1,518.98
10	1,000.00	1,000.00
15	956.52	707.63
20	916.67	532.45
25	880.00	421.11

Note: Bond values were calculated using a financial calculator assuming annual, or once-a-year, compounding.

(5) The sensitivity of a bond's value to changing interest rates depends not only on the length of time to maturity, but also on the pattern of cash flows provided by the bond (or coupon rates)

- Bond rating

  Importance: firm's credit

  Moody's and S&P provide bond ratings

  AAA
  AA
  A
  BBB } Investment-grade bonds

  BB
  B } Junk bonds

  .

Table 7-2 Moody's and S&P Bond Ratings

	INVESTMENT GRADE				JUNK BONDS			
Moody's	Aaa	Aa	A	Baa	Ba	B	Caa	C
S&P	AAA	AA	A	BBB	BB	B	CCC	C

Note: Both Moody's and S&P use "modifiers" for bonds rated below triple A. S&P uses a plus and minus system. Thus, A+ designates the strongest A-rated bonds; A-, the weakest. Moody's uses a 1, 2, or 3 designation, with 1 denoting the strongest and 3 denoting the weakest; thus, within the double-A category, Aa1 is the best, Aa2 is average, and Aa3 is the weakest.

Criteria to consider
Financial ratios: for example, debt ratio and interest coverage ratio
Qualitative factors: for example, contract terms, subordinated issues, etc.
Other factors: for example, profitability ratios and firm size

- Bond markets

  OTC markets
  Quotes: quoted as a % of par value of $100

  Invoice price (dirty price) = quoted price (clear price) + accrued interest

  0 ——————————— 182 days

  62 days ↑ 120 days remaining until next coupon

  Suppose annual coupon is $60 ($30 in 6 months) and the quoted price is 95.500,

  Invoice price = 955 + (62/182)*30 = $965.22 = 955.00 + 10.22
  where $955 is the quoted price and $10.22 is the accrued interest

- **Exercise**

  ST-1 and ST-2

  Problems: 5, 8, 9, 10, 13, and 15*

  Problem 15: bond X has 20 years to maturity, a 9% annual coupon, and a $1,000 face value. The required rate of return is 10%. Suppose you want to buy the bond and you plan to hold the bond for 5 years. You expect that in 5 years, the yield to maturity on a 15-year bond with similar risk will be priced to yield 8.5%. How much would you like to pay for the bond today?

							1,000
	90	…	90	90	…	90	90
0	1	…	5	6	…	19	20

PV_5 =1,041.52 (I/YR=8.5%, PMT=90, N=15, FV=1,000)

PV_0 = 987.87 (I/YR=10%, PMT=90, N=5, FV=1,041.52)

Answer:

Step 1: figure out what should be the fair value of the bond after 5 years (PV_5)

Step 2: figure out what should be the fair value of the bond now (PV_0)

Chapter 8 -- Risk and Rates of Return

- Investment returns
- Risk
- Expected rate of return and standard deviation
- Diversification
- Beta coefficient - market risk
- Return on a portfolio and portfolio beta
- Relationship between risk and rates of return

- Investment returns

  Dollar return vs. rate of return

  If you invested $1,000 and received $1,100 in return, then
  your dollar return = 1,100 - 1,000 = $100 and
  your rate of return = (1,100 - 1,000) / 1,000 = 10%

- Risk

  The chance that some unfavorable event will occur

  Stand-alone risk vs. market risk
  Stand-alone risk: risk of holding one asset measured by standard deviation
  Market risk: risk of holding a well-diversified portfolio measured by beta

- Expected rate of return and standard deviation

  Probability distribution: a list of possible outcomes with a probability assigned to each outcome

  Expected rate of return: the rate of return expected to be realized

Table 8-1 Probability Distributions and Expected Returns

	A	B	C	D	E	F	G
3							
4							
5		Martin Products			U.S. Water		
6–10	Economy, Which Affects Demand	Probability of This Demand Occurring	Rate of Return If This Demand Occurs	Product (2)×(3)	Probability of This Demand Occurring	Rate of Return If This Demand Occurs	Product (5)×(6)
11	(1)	(2)	(3)	(4)	(5)	(6)	(7)
12	Strong	0.30	80%	24%	0.30	15%	4.5%
13	Normal	0.40	10	4	0.40	10	4.0
14	Weak	0.30	-60	-18	0.30	5	1.5
15		1.00	Expected return =	10%	1.00	Expected return =	10.0%
16							

Variance and standard deviation: statistical measures of variability (risk)

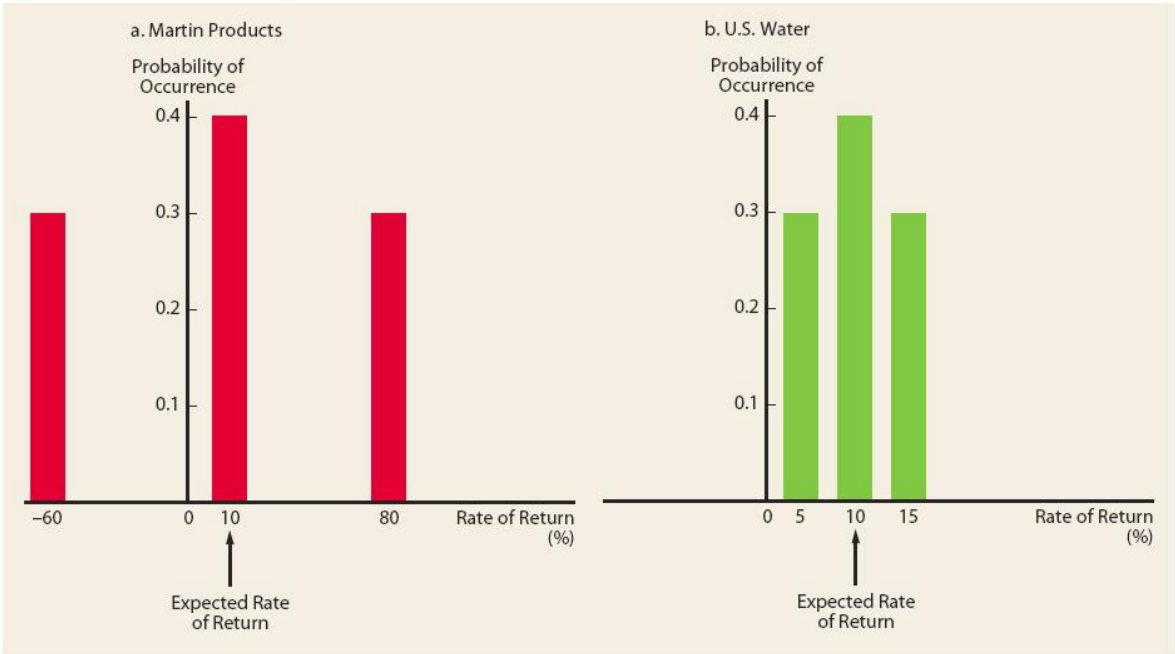
Expected rate of return = $\hat{r} = \sum_{i=1}^{N} P_i r_i$

Variance = $\sigma^2 = \sum_{i=1}^{N} P_i (r_i - \hat{r})^2$ and Standard deviation = $\sigma = \sqrt{\sigma^2}$

Coefficient of variation (CV) = standard deviation / expected rate of return, which measures the risk per unit of expected return

Example: probability distribution for Martin Products vs. U.S. Water

FIGURE 8-2 Probability Distributions of Martin Products' and U.S. Water's Rates of Return

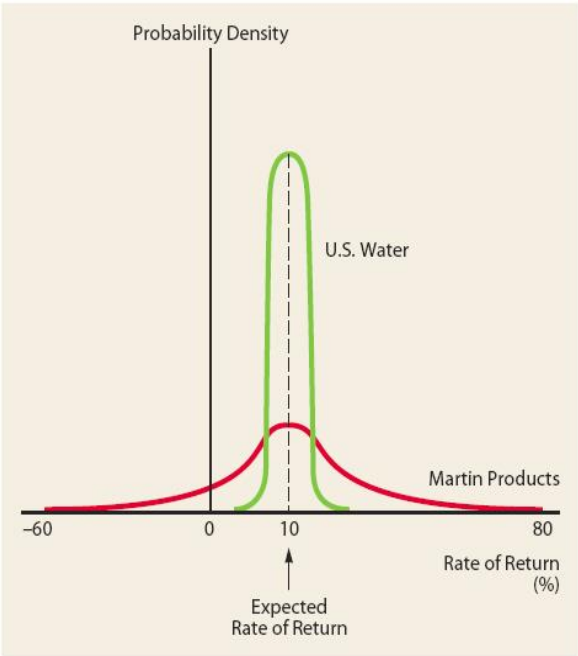


Example: calculation of standard deviation (risk) for Martin Products

Table 8-2 Calculating Martin Products' Standard Deviation

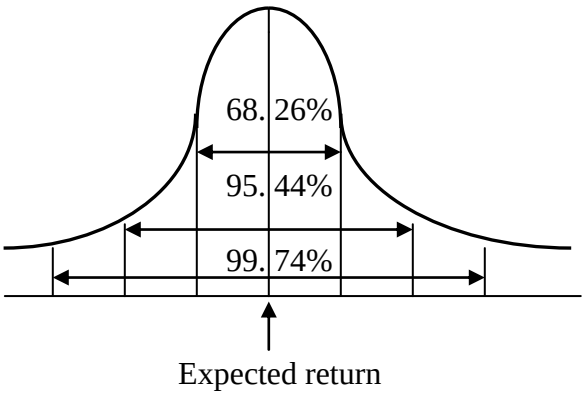
	A	B	C	D	E	F
19						
20						
21						
22	Economy,	Probability	Rate of	Deviation:		
23	Which	of This	Return	Actual -		
24	Affects	Demand	If This	10%		Squared
25	Demand	Occurring	Demand	Expected	Deviation	Deviation
26	(1)	(2)	Occurs (3)	Return (4)	Squared (5)	x Prob. (6)
27	Strong	0.30	80%	70%	0.4900	0.1470
28	Normal	0.40	10	0	0.0000	0.0000
29	Weak	0.30	-60	-70	0.4900	0.1470
30		1.00			Σ = Variance:	0.2940
31					Standard deviation = square root of variance: σ =	0.5422
32					Standard deviation expressed as a percentage: σ =	54.22%

FIGURE 8-3 Continuous Probability Distributions of Martin Products' and U.S. Water's Rates of Return



Note: The assumptions regarding the probabilities of various outcomes have been changed from those in Figure 8-2. There the probability of obtaining exactly 10% was 40%; here it is *much smaller* because there are many possible outcomes instead of just three. With continuous distributions, it is more appropriate to ask what the probability is of obtaining at least some specified rate of return than to ask what the probability is of obtaining exactly that rate. This topic is covered in detail in statistics courses.

Using historical data to estimate average return and standard deviation
Stock returns: expected vs. realized



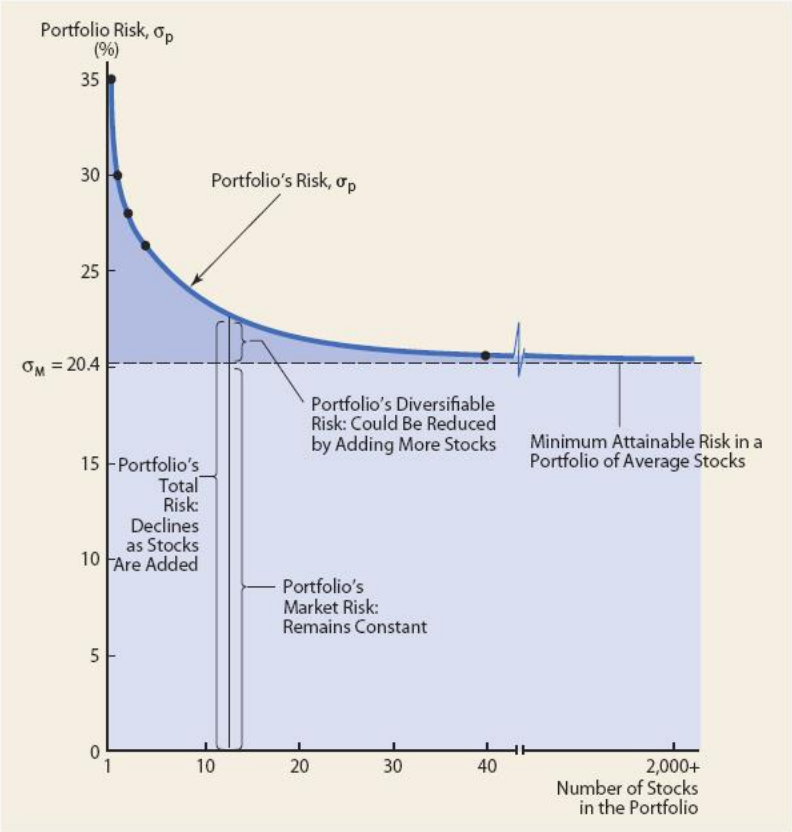
Using Excel to calculate mean and standard deviation with historical data

Risk premium: the difference between the expected/required rate of return on a given security and that on a risk-free asset

- Diversification

  As you increase the number of securities in your portfolio, the portfolio total risk decreases

FIGURE 8-6 Effects of Portfolio Size on Risk for a Portfolio of Randomly Selected Stocks



Note: This graph assumes that stocks in the portfolio are randomly selected from the universe of large, publicly-traded stocks listed on the NYSE.

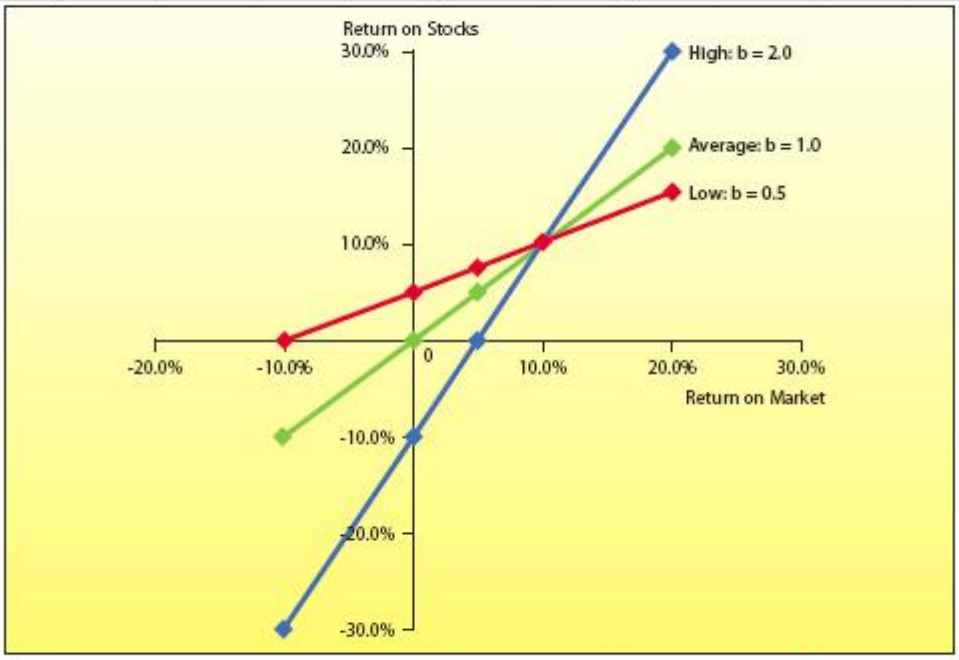
Total risk = firm's specific risk + market risk
Total risk = diversifiable risk + nondiversifiable risk
Total risk = unsystematice risk + systematic risk

- Beta coefficient - market risk

  Sensitivity of an asset (or a portfolio) with respect to the market or the extent to which a given stock's returns move up and down with the stock market

  Plot historical returns for a firm along with the market returns (S&P 500 index, for example) and estimate the best-fit line. The estimated slope of the line is the estimated beta coefficient of the stock, or the market risk of the stock.

FIGURE 8-7 Betas: Relative Volatility of Stocks H, A, and L



Year	r_M	r_H	r_A	r_L
1	10.0%	10.0%	10.0%	10.0%
2	20.0	30.0	20.0	15.0
3	-10.0	-30.0	-10.0	0.0
4	0.0	-10.0	0.0	5.0
5	5.0	0.0	5.0	7.5

Calculating beta:

1. Rise-Over-Run. Divide the vertical axis change that results from a given change on the horizontal axis (i.e., the change in the stock's return divided by the changes in the market return). For Stock H, when the market rises from –10% to +20%, or by 30%, the stock's return goes from –30% to +30%, or by 60%. Thus, beta H by the rise-over-run method is 60/30 = 2.0. In the same way, we find beta A to be 1.0 and beta L to be 0.5. This procedure is easy in our example because all of the points lie on a straight line; but if the points were scattered around the trend line, we could not calculate an exact beta.

2. Financial Calculator. Financial calculators have a built-in function that can be used to calculate beta. The procedure differs somewhat from calculator to calculator. See our tutorial on the text's web site for instructions on several calculators.

3. Excel. Excel's Slope function can be used to calculate betas. Here are the functions for our three stocks:

$Beta_H$	2.0	=SLOPE(C163:C164,B163:B164)
$Beta_A$	1.0	=SLOPE(D163:D164,B163:B164)
$Beta_L$	0.5	=SLOPE(E163:E164,B163:B164)

- Return on a portfolio and portfolio beta

  Expected return on a portfolio: the weighted average of the expected returns on the assets held in the portfolio

$$\hat{r}_p = \sum_{i=1}^{N} w_i \hat{r}_i$$

For example, the expected rate of return on stock A is 10% and the expected rate of return on stock B is 14%. If you invest 40% of your money in stock A and 60% of your money in stock B to form your portfolio then the expected rate of return on your portfolio will be 12.4% = (0.4)*10% + (0.6)*14%*

Portfolio beta: weighted average of individual securities' betas in the portfolio

$$b_p = \sum_{i=1}^{N} w_i b_i$$

For example, if the beta for stock A is 0.8 and the beta for stock B is 1.2, with the weights given above, the beta for your portfolio is 1.04 = (0.4)*0.8 + (0.6)*1.2

- Relationship between risk and rates of return

  Required rate of return: the minimum rate of return necessary to attract an investor to purchase or hold a security

  Market risk premium: the additional return over the risk-free rate needed to compensate investors for assuming an average amount (market) of risk

  $$RP_M = r_M - r_{RF}$$

  For example, if the required rate of return on the market is 11% and the risk-free rare is 6% then the market risk premium will be 5%

  Risk premium for a stock: the additional return over the risk-free rate needed to compensate investors for assuming the risk of that stock

  $$RP_i = r_i - r_{RF}$$

  For example, if the required rate of return on a stock is 15% and the risk-free rare is 6% then the risk premium for that stock will be 9%

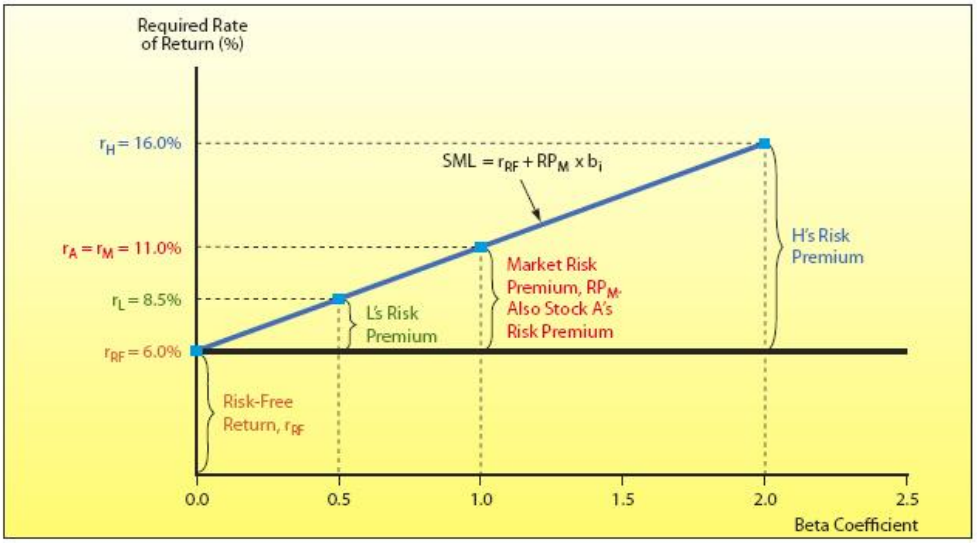
  Capital Asset Pricing Model (CAPM)

  $$r_i = r_{RF} + (r_M - r_{RF})b_i$$

  where r_i is the required rate of return on stock i; r_{RF} is the risk-free rate; $(r_m - r_{RF})$ is the market risk premium; b_i is the market risk for stock *i*, and $(r_m - r_{RF})\,b_i$ is the risk premium of stock *i*

Security market line (SML): a line that shows the relationship between the required return of an asset and the market risk

FIGURE 8-8 The Security Market Line (SML)



Key Inputs	
r_{RF}	6.0%
r_M	11.0
$RP_M = r_M - r_{RF}$	5.0

$r_i = r_{RF} + RP_M(b_i)$

	Beta	r_i
Riskless asset:	0.0	6.00%
Stock L:	0.5	8.50
Stock A:	1.0	11.00
Stock H:	2.0	16.00

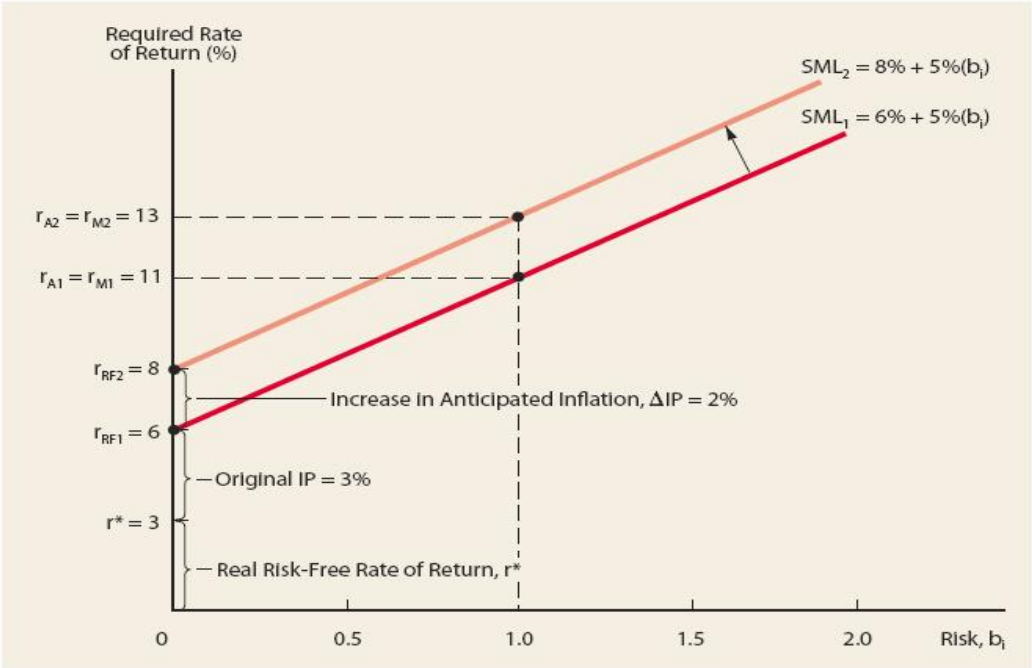
Overvalued vs. undervalued securities
If the actual return lies above the SML, the security is undervalued
If the actual return lies below the SML, the security is overvalued

Example: a stock has a beta of 0.8 and an expected rate of return of 11%. The expected rate of return on the market is 12% and the risk-free rate is 4%. Should you buy the stock?

Answer: required rate of return for the stock (using CAPM) is
4% + (12% - 4%)*(0.8) = 10.4% < 11% (expected rate of return)
The stock is under-valued

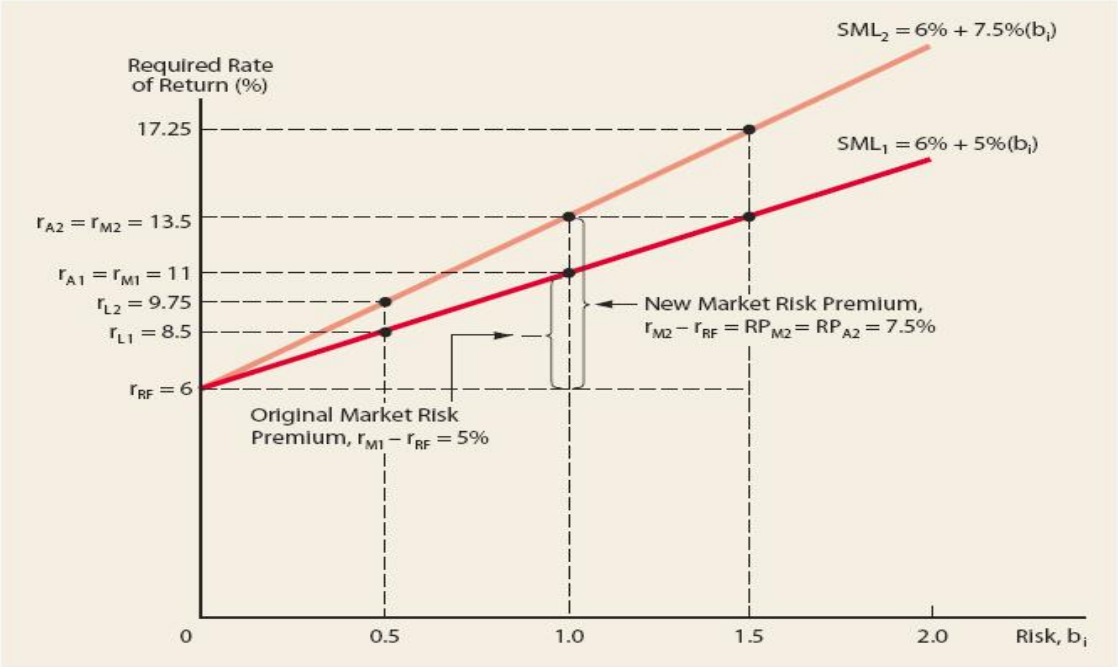
The impact of inflation: a parallel shift in SML

FIGURE 8-9 Shift in the SML Caused by an Increase in Expected Inflation



Change in risk aversion: the slope of SML gets steeper

FIGURE 8-10 Shift in the SML Caused by Increased Risk Aversion



Change in beta: changes the required rate of return

Some concerns about beta and the CAPM and multivariable models

- **Exercise**

  ST-1 and ST-3
  Problems: 1, 2, 3, 7, 8, 9, and 13*

  Problem 13: given the information about stocks X, Y, and Z below (X, Y, and Z are positively but not perfectly correlated), assuming stock market equilibrium:

Stock	Expected Return	Standard Deviation	Beta
X	9.00%	15%	0.8
Y	10.75%	15%	1.2
Z	12.50%	15%	1.6

  Fund Q has one-third of its funds invested in each of the three stocks; r_{RF} is 5.5%

  a. What is the market risk premium?
  Applying CAPM to stock X and use the formula $r_i = r_{RF} + (r_M - r_{RF})b_i$
  9.00% = 5.50% + ($r_M - r_{RF}$)*0.8, solve for r_M - r_{RF} = 4.375%

  b. What is the beta of Fund Q?
  b_Q = (1/3)*(0.8) + (1/3)*(1.2) + (1/3)*(1.6) = 1.20

  c. What is the expected (required) rate of return on Fund Q?
  Applying CAPM to Fund Q, r_Q = 5.50% + (4.375%)*1.2 = 10.75%

  d. What would be the standard deviation of Fund Q (>15%, =15%, or <15%)?
  It should be less than 15% due to diversification (positive but not perfect)

Chapter 9 -- Stock Valuation

- Characteristics of common stock
- Common stock valuation
- Valuing a corporation
- Preferred stock

- Characteristics of common stock

  Ownership in a corporation: control of the firm

  Claim on income: residual claim on income
  Claim on assets: residual claim on assets

  Commonly used terms: voting rights, proxy, proxy fight, takeover, preemptive right, classified stock, and limited liability

- Common stock valuation

  Stock price vs. intrinsic value: a revisit

  Growth rate g: expected rate of growth in dividends
  g = ROE * retention ratio
  Retention ratio = 1 - dividend payout ratio
  The growth rate, g plays an important role in stock valuation

  The general dividend discount model: $\hat{P}_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1+r_s)^t}$

  Rationale: estimate the intrinsic value for the stock and compare it with the market price to determine if the stock in the market is over-priced or under-priced

  (1) Zero growth model (the dividend growth rate, g = 0)
  It is a perpetuity model: $\hat{P}_0 = \frac{D}{r_s}$

  For example, if D = \$2.00 and r_s = 10%, then $\hat{P}_0 = \$20$

  If the market price (P_0) is \$22, what should you do?

  You should not buy it because the stock is over-priced

(2) Constant growth model (the dividend growth rate, g = constant)

$$\hat{P}_0 = \frac{D_1}{r_s - g} = \frac{D_0 * (1+g)}{r_s - g}$$

For example, if D_0 = \$2.00, g = 5%, r_s = 10%, then $\hat{P}_0 = \frac{2*(1+5\%)}{0.10-0.05} = \$42$

If the market price (P_0) is \$40, what should you do?

You should buy it because the stock is under-priced

Common stock valuation: estimate the expected rate of return given the market price for a constant growth stock

Expected return = expected dividend yield + expected capital gains yield

$$\hat{r}_s = \frac{D_1}{P_0} + g = \frac{D_0 * (1+g)}{P_0} + g$$

In the above example,

$$\hat{r}_s = \frac{D_0 * (1+g)}{P_0} + g = \frac{2.00*(1+0.05)}{40} + 0.05 = 0.0525 + 0.05 = 10.25\%$$

where 5.25% is the expected dividend yield and 5% is the expected capital gains yield (stock price will increase at 5% per year)

What would be the expected dividend yield and capital gains yield under the zero growth model?

Expected capital gains yield, g = 0 (price will remain constant)
Expected dividend yield = D/P_0

(3) Non-constant growth model: part of the firm's cycle in which it grows much faster for the first N years and gradually return to a constant growth rate

Apply the constant growth model at the end of year N and then discount all expected future cash flows to the present

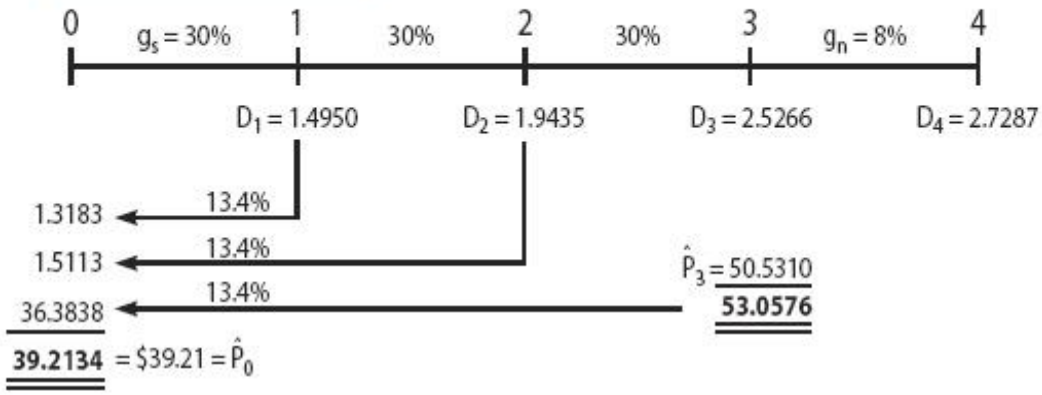
D_0	D_1	D_2	…	D_N	D_{N+1}	
0	1	2	…	N	N+1	…

Non-constant growth, g_s | Constant growth, g_n

Horizon value $\hat{P}_N = \frac{D_{N+1}}{r_s - g_n}$

For example $N = 3$ $g_s = 30\%$, $g_n = 8\%$, $D_0 = \$1.15$, and $r_s = 13.4\%$

FIGURE 9-4 Finding the Value of a Nonconstant Growth Stock



Notes to Figure 9-4:

Step 1. Calculate the dividends expected at the end of each year during the nonconstant growth period. Calculate the first dividend, $D_1 = D_0(1 + g_s) = \$1.15(1.30) = \$1.4950$. Here g_s is the growth rate during the 3-year nonconstant growth period, 30%. Show the \$1.4950 on the time line as the cash flow at Time 1. Calculate $D_2 = D_1(1 + g_s) = \$1.4950(1.30) = \$1.9435$, then $D_3 = D_2(1 + g_s) = \$1.9435(1.30) = \$2.5266$. Show these values on the time line as the cash flows at Times 2 and 3. Note that D_0 is used only to calculate D_1.

Step 2. The price of the stock is the PV of dividends from Time 1 to infinity; so in theory, we could project each future dividend, with the normal growth rate, $g_n = 8\%$, used to calculate D_4 and subsequent dividends. However, we know that after D_3 has been paid at Time 3, the stock becomes a constant growth stock. Therefore, we can use the constant growth formula to find $\hat{P}_3$, which is the PV of the dividends from Time 4 to infinity as evaluated at Time 3.

First, we determine $D_4 = \$2.5266(1.08) = \$2.7287$ for use in the formula; then we calculate $\hat{P}_3$ as follows:

$$\hat{P}_3 = \frac{D_4}{r_s - g_n} = \frac{\$2.7287}{0.134 - 0.08} = \$50.5310$$

We show this \$50.5310 on the time line as a second cash flow at Time 3. The \$50.5310 is a Time 3 cash flow in the sense that the stockholder could sell the stock for \$50.5310 at Time 3 and in the sense that \$50.5310 is the present value of the dividend cash flows from Time 4 to infinity. Note that the total cash flow at Time 3 consists of the sum of $D_3 + \hat{P}_3 = \$2.5266 + \$50.5310 = \$53.0576$.

Step 3. Now that the cash flows have been placed on the time line, we can discount each cash flow at the required rate of return, $r_s = 13.4\%$. We could discount each cash flow by dividing by $(1.134)^t$, where $t = 1$ for Time 1, $t = 2$ for Time 2, and $t = 3$ for Time 3. This produces the PVs shown to the left below the time line; and the sum of the PVs is the value of the nonconstant growth stock, \$39.21.

With a financial calculator, you can find the PV of the cash flows as shown on the time line with the cash flow (CFLO) register of your calculator. Enter 0 for CF_0 because you receive no cash flow at Time 0, $CF_1 = 1.495$, $CF_2 = 1.9435$, and $CF_3 = 2.5266 + 50.5310 = 53.0576$. Then enter I/YR = 13.4 and press the NPV key to find the value of the stock, \$39.21.

$D_4 = 2.7287$, $\hat{P}_3 = 53.0576$, and $\hat{P}_0 = 39.2134$

- Valuing a corporation

  It is similar to valuing a stock

  V = present value of expected future free cash flows

  FCF = EBIT*(1-T) + depreciation and amortization – (capital expenditures + Δ in net working capital)

  The discount rate should be the WACC (weighted average cost of capital)

- Preferred stock

  A hybrid security because it has both common stock and bond features

  Claim on assets and income: has priority over common stocks but after bonds

  Cumulative feature: all past unpaid dividends should be paid before any dividend can be paid to common stock shareholders

  Valuation of preferred stock

  Intrinsic value = $V_p = D_p / r_p$ and Expected return = $\hat{r}_P = \frac{D_P}{P_P}$

  Example: if a preferred stock pays $2 per share annual dividend and has a required rate of return of 10%, then the fair value of the stock should be $20

- **Exercises**

  ST-1, ST-2, and ST-3

  Problems: 10, 11, and 13*

  Problem 13: given D_1 = $2.00, beta = 0.9, risk-free rate = 5.6%, market risk premium = 6%, current stock price = $25, and the market is in equilibrium

  Question: what should be the stock price in 3 years ($\hat{P}_3$)?

  Answer: required return = expected return = 5.6% + 6%*0.9 = 11%

  Expected dividend yield = D_1/P_0 = 2/25 = 8%

  Expected capital gains yield = g = 11% - 8% = 3%

  Expected stock price after 3 years $\hat{P}_3 = 25*(1+3\%)^3$ = $27.32

  Or $D_4 = D_1*(1+g)^3 = 2*(1+3\%)^3$ = $2.1855 and then apply the constant growth model

  $$\hat{P}_3 = \frac{D_4}{r_s - g} = \frac{2.1855}{0.11 - 0.03} = \$27.32$$

Chapter 10 -- Cost of Capital

- Capital components
- Cost of debt
- Cost of preferred stock
- Cost of retained earnings
- Cost of new common stock
- Weighted average cost of capital (WACC)
- Adjusting the cost of capital for risk

- Capital components

  Debt: debt financing
  Preferred stock: preferred stock financing
  Equity: equity financing (internal vs. external)
  Internal: retained earnings
  External: new common stock
  Weighted average cost of capital (WACC)

- Cost of debt

  Recall the bond valuation formula
  Replace V_B by the net price of the bond and solve for I/YR
  I/YR = r_d (cost of debt before tax)

  Net price = market price - flotation cost

  If we ignore flotation costs which are generally small, we can just use the actual market price to calculate r_d

  Cost of debt after tax = cost of debt before tax (1-T) = r_d (1-T)

  Example: if a firm can issue a 10-year 8% coupon bond with a face value of $1,000 to raise money. The firm pays interest semiannually. The net price for each bond is $950. What is the cost of debt before tax? If the firm's marginal tax rate is 40%, what is the cost of debt after tax?

  Answer: PMT = -40, FV = -1,000, N = 20, PV = 950, solve for I/YR = 4.38%
  Cost of debt before tax = r_d = 8.76%

  Cost of debt after tax = r_d*(1-T) = 8.76*(1-0.4) = 5.26%

- Cost of preferred stock

  Recall the preferred stock valuation formula

  Replace V_p by the net price and solve for r_p (cost of preferred stock)

  Net price = market price - flotation cost

  If we ignore flotation costs, we can just use the actual market price to calculate r_p

  $$r_P = \frac{D_P}{P_P}$$

  Example: a firm can issue preferred stock to raise money. The net price is $40 and the firm pays $4.00 dividend per year. What is the cost of preferred stock?

  Answer: 4/40 = 10%

- Cost of retained earnings

  CAPM approach

  $$r_i = r_{RF} + (r_M - r_{RF})b_i$$

  DCF approach

  $$\hat{r}_s = \frac{D_1}{P_0} + g = \frac{D_0(1+g)}{P_0} + g$$

  Bond yield plus risk premium approach

  r_s = bond yield + risk premium

  When must a firm use external equity financing?

  $$\text{Retained earning breakpoint} = \frac{\text{R/E}}{\text{\% of equity}}$$

  It is the dollar amount of capital beyond which new common stock must be issued

  For example, suppose the target capital structure for XYZ is 40% debt, 10% preferred stock and 50% equity. If the firm's net income is $5,000,000 and the dividend payout ratio is 40% (i.e., the firm pays out $2,000,000 as cash dividend and retains $3,000,000), then the retained earning breakpoint will be

  $$\frac{3{,}000{,}000}{50\%} = \$6{,}000{,}000,$$

  which means that if XYZ needs to raise more than $6,000,000 it has to issue new common stock

- Cost of new common stock

  $r_e = \frac{D_1}{P_0(1-F)} + g = \frac{D_0(1+g)}{P_0(1-F)} + g$, where F is the flotation cost

- Weighted average cost of capital (WACC)

  Target capital structure: the percentages (weights) of debt, preferred stock, and common equity that will maximize the firm's stock price

  WACC = $w_d r_d (1\text{-}T) + w_p r_p + w_c (r_s \text{ or } r_e)$

  Comprehensive example

  Rollins Corporation is constructing its MCC schedule. Its target capital structure is 20% debt, 20% preferred stock, and 60% common equity. Its bonds have a 12% coupon, paid semiannually, a current maturity of 20 years, and a net price of $960. The firm could sell, at par, $100 preferred stock that pays a $10 annual dividend, but flotation costs of 5% would be incurred. Rollins' beta is 1.5, the risk-free rate is 4%, and the market return is 12%. Rollins is a constant growth firm which just paid a dividend of $2.00, sells for $27.00 per share, and has a growth rate of 8%. Flotation cost on new common stock is 6%, and the firm's marginal tax rate is 40%.

  a) What is Rollins' component cost of debt before and after tax?

  Answer: Cost of debt before tax = 12.55%
  Cost of debt after tax = 7.53%

  b) What is Rollins' cost of preferred stock?

  Answer: Cost of P/S = 10.53%

  c) What is Rollins' cost of R/E using the CAPM approach?

  Answer: Cost of R/E = 16%

  d) What is the firm's cost of R/E using the DCF approach?

  Answer: Cost of R/E = 16%

  e) What is Rollins WACC if it uses debt, preferred stock, and R/E to raise money?

  Answer: WACC (R/E) = 13.21%

  f) What is Rollins' WACC once it starts using new common stock financing?

  Answer: Cost of N/C = 16.51%
  WACC (N/C) = 13.52%

- Adjusting the cost of capital for risk

FIGURE 10-1 Risk and the Cost of Capital

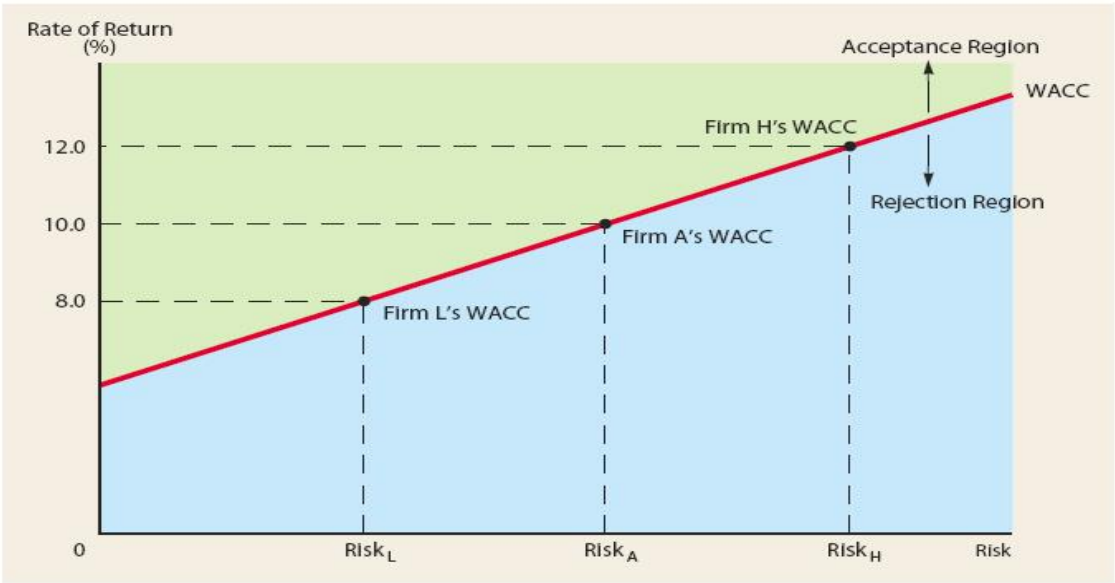
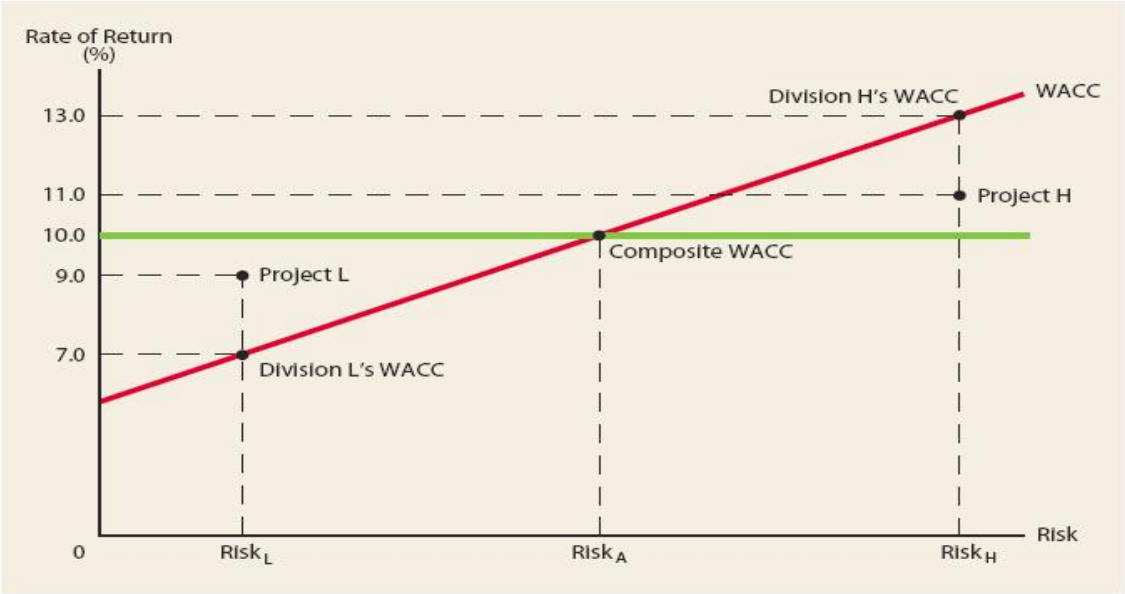


FIGURE 10-2 Divisional Cost of Capital



- **Exercise**

  ST-1 and ST-2

  Problems: 6, 7, 8, and 10