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

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)

<table>
<thead>
<tr>
<th>Term to maturity</th>
<th>Interest rate</th>
<th>Interest rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year</td>
<td>0.4%</td>
<td></td>
</tr>
<tr>
<td>5 years</td>
<td>2.4%</td>
<td></td>
</tr>
<tr>
<td>10 years</td>
<td>3.7%</td>
<td></td>
</tr>
<tr>
<td>30 years</td>
<td>4.6%</td>
<td></td>
</tr>
</tbody>
</table>

- 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.

  \[
  (1+5.5\%)^2 = (1+5\%)(1+X), \text{ solve for } X(\text{forward rate}) = 6.00238\%
  \]

  Approximation: \((5.5\%)^2 - 5\% = 6\%\)
(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)

<table>
<thead>
<tr>
<th>Years to maturity</th>
<th>T-bonds</th>
<th>AA-rated bonds</th>
<th>BBB-rate bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year</td>
<td>5.5%</td>
<td>6.7%</td>
<td>7.4%</td>
</tr>
<tr>
<td>5 years</td>
<td>6.1%</td>
<td>7.4%</td>
<td>8.1%</td>
</tr>
<tr>
<td>10 years</td>
<td>6.8%</td>
<td>8.2%</td>
<td>9.1%</td>
</tr>
</tbody>
</table>

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
  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%)

\[
\begin{array}{cccccc}
0 & 1 & 2 & 3 & 4 & 5 & 6 \\
-675 & & & & & & 1000 \\
\end{array}
\]

\[
PV = -675, FV = 1,000, N = 6, PMT = 0, \text{ solve for I/YR } = 6.77\%
\]

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

\[
V_B = \sum_{t=1}^{N} \frac{INT}{(1 + r_d)^t} + \frac{M}{(1 + r_d)^N},
\]
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 sells 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

![Graph showing bond values vs interest rates with 1-Year and 15-Year bonds]

<table>
<thead>
<tr>
<th>Current Market Interest Rate, $r_d$</th>
<th>VALUE OF 1-Year Bond</th>
<th>VALUE OF 15-Year Bond</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
<td>$1,047.62</td>
<td>$1,518.98</td>
</tr>
<tr>
<td>10</td>
<td>1,000.00</td>
<td>1,000.00</td>
</tr>
<tr>
<td>15</td>
<td>956.52</td>
<td>707.63</td>
</tr>
<tr>
<td>20</td>
<td>916.67</td>
<td>532.45</td>
</tr>
<tr>
<td>25</td>
<td>880.00</td>
<td>421.11</td>
</tr>
</tbody>
</table>

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
\[
\begin{align*}
\text{AAA} & \quad \text{AA} & \quad \text{A} & \quad \text{BBB} \\
\text{BB} & \quad \text{B} & & \\
\end{align*}
\]
\text{Investment-grade bonds}
\text{Junk bonds}

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 \quad 182 \text{ days}
  62 \text{ days} \quad 120 \text{ 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
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?

\[
\begin{array}{ccccccc}
 & 90 & \ldots & 90 & 90 & \ldots & 90 & 90 \\
0 & 1 & \ldots & 5 & 6 & \ldots & 19 & 20 \\
\end{array}
\]

\[ PV_5 = 1,041.52 \text{ (I/YR=8.5\%, PMT=90, N=15, FV=1,000)} \]

\[ PV_0 = 987.87 \text{ (I/YR=10\%, PMT=90, N=5, FV=1,041.52)} \]

Answer:
Step 1: figure out what should be the fair value of the bond after 5 years (PV₅)
Step 2: figure out what should be the fair value of the bond now (PV₀)
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>
<thead>
<tr>
<th>Table 8-1</th>
<th>Probability Distributions and Expected Returns</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td><strong>Economy, Which</strong></td>
<td><strong>Probability of This</strong></td>
</tr>
<tr>
<td><strong>Affects</strong></td>
<td><strong>Demand Occurring</strong></td>
</tr>
<tr>
<td><strong>Demand</strong></td>
<td>(2)</td>
</tr>
<tr>
<td>(1)</td>
<td>Strong</td>
</tr>
<tr>
<td>Normal</td>
<td>0.40</td>
</tr>
<tr>
<td>Weak</td>
<td>0.30</td>
</tr>
<tr>
<td>1.00</td>
<td><strong>Expected return =</strong></td>
</tr>
</tbody>
</table>
Variance and standard deviation: statistical measures of variability (risk)

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

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

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
</tr>
<tr>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
<td>30</td>
</tr>
<tr>
<td>Economy, Affects Demand</td>
<td>Probability of/This Demand Occurring</td>
<td>Rate of Return If This Demand Occurs</td>
<td>Deviation: Actual Return - 10%</td>
<td>Deviation Squared</td>
<td>Squared Deviation x Prob.</td>
</tr>
<tr>
<td>Strong</td>
<td>0.30</td>
<td>80%</td>
<td>70%</td>
<td>0.4900</td>
<td>0.1470</td>
</tr>
<tr>
<td>Normal</td>
<td>0.40</td>
<td>10</td>
<td>0</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>Weak</td>
<td>0.30</td>
<td>-60</td>
<td>-70</td>
<td>0.4900</td>
<td>0.1470</td>
</tr>
<tr>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>( \Sigma = \text{Variance} = 0.2940 )</td>
</tr>
</tbody>
</table>

Standard deviation = square root of variance; \( \sigma = 0.5422 \)

Standard deviation expressed as a percentage; \( \sigma = 54.22\% \)
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

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.
- **Diversification**
  
  As you increase the number of securities in your portfolio, the portfolio total risk decreases

\[
\text{Total risk} = \text{firm’s specific risk} + \text{market risk}
\]
\[
\text{Total risk} = \text{diversifiable risk} + \text{nondiversifiable risk}
\]
\[
\text{Total risk} = \text{unsystematic risk} + \text{systematic risk}
\]

- **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.
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

\[ r_p = \sum_{i=1}^{N} w_i \hat{r}_i \]
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

  \[ R_{P_M} = r_M - r_{RF} \]

  For example, if the required rate of return on the market is 11% and the risk-free rate 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

  \[ R_{P_i} = r_i - r_{RF} \]

  For example, if the required rate of return on a stock is 15% and the risk-free rate 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

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

\[ 4\% + (12\% - 4\%) \times (0.8) = 10.4\% < 11\% \] (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:

<table>
<thead>
<tr>
<th>Stock</th>
<th>Expected Return</th>
<th>Standard Deviation</th>
<th>Beta</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>9.00%</td>
<td>15%</td>
<td>0.8</td>
</tr>
<tr>
<td>Y</td>
<td>10.75%</td>
<td>15%</td>
<td>1.2</td>
</tr>
<tr>
<td>Z</td>
<td>12.50%</td>
<td>15%</td>
<td>1.6</td>
</tr>
</tbody>
</table>

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 \( r_i = r_{RF} + (r_M - r_{RF})b_i \)
   \[ 9.00\% = 5.50\% + (r_M - r_{RF}) \cdot 0.8, \text{ solve for } r_M - r_{RF} = 4.375\% \]

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, \( r_Q = 5.50\% + (4.375\%) \cdot 1.2 = 10.75\% \)

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
  $g = \text{ROE} \times \text{retention ratio}$
  Retention ratio = $1 - \text{dividend payout ratio}$
  The growth rate, $g$ plays an important role in stock valuation

  The general dividend discount model:
  $$P_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1 + r_s)^t}$$

  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: $P_0 = \frac{D}{r_s}$

  For example, if $D = 2.00$ and $r_s = 10\%$, then $P_0 = 20$

  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, \( g = \text{constant} \))

\[
P_0 = \frac{D_1}{r_s - g} = \frac{D_0 \times (1 + g)}{r_s - g}
\]

For example, if \( D_0 = 2.00, \ g = 5\%, \ r_s = 10\% \), then \( P_0 = \frac{2 \times (1 + 5\%)}{0.10 - 0.05} = 42 \)

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

\[
r_s = \frac{D_1}{P_0} + g = \frac{D_0 \times (1 + g)}{P_0} + g
\]

In the above example,

\[
r_s = \frac{D_0 \times (1 + g)}{P_0} + g = \frac{2.00 \times (1 + 0.05)}{40} + 0.05 = 0.0525 + 0.05 = 10.25\%
\]

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

\[
\begin{array}{ccccccc}
D_0 & D_1 & D_2 & \ldots & D_N & D_{N+1} & \ldots \\
0 & 1 & 2 & \ldots & N & N+1 & \ldots \\
\end{array}
\]

Non-constant growth, \( g_s \)  \hspace{1cm} \text{Constant growth,}  \hspace{0.2cm} g_n \hspace{1cm} \text{Horizon value} \hspace{0.2cm} 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

<table>
<thead>
<tr>
<th>Year</th>
<th>Dividend Growth Rate</th>
<th>Dividend</th>
<th>Stock Growth Rate</th>
<th>Dividend Price</th>
<th>Market Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>30%</td>
<td>1.4950</td>
<td>8%</td>
<td>1.9435</td>
<td>36.3838</td>
</tr>
<tr>
<td>2</td>
<td>30%</td>
<td>2.5266</td>
<td>8%</td>
<td>3.3653</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8%</td>
<td>2.7287</td>
<td></td>
<td>3.3653</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 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 \( D_4 \) is used only to calculate \( D_3 \).

**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.

\[
D_4 = 2.7287, \hat{P}_3 = 53.0576, \text{ and } \hat{P}_0 = 39.2134
\]
• Valuing a corporation
  It is similar to valuing a stock

\[ V = \text{present value of expected future free cash flows} \]

\[ \text{FCF} = \text{EBIT*(1-T) + depreciation and amortization} - \text{(capital expenditures + \Delta in net working capital)} \]

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 = \[ V_p = \frac{D_p}{r_p} \]

and

Expected return = \[ r_p = \frac{D_p}{P_p} \]

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 \( (P_3) \)?

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 \( P_3 = 25*(1+3\%)^3 = $27.32 \)

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

\[ P_3 = \frac{D_4}{r_s - g} = \frac{2.1855}{0.11-0.03} = $27.32 \]
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: \( \text{PMT} = -40, \text{FV} = -1,000, N = 20, \text{PV} = 950 \), 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
   \[
   r_s = \frac{D_i}{P_0} + g = \frac{D_0(1 + g)}{P_0} + g
   \]

   Bond yield plus risk premium approach
   \( r_s = \) bond yield + risk premium

   When must a firm use external equity financing?

   \[
   \text{R/E}
   \]
   Retained earning breakpoint = \( \frac{\text{Retained earnings}}{\text{% of equity}} \)

   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

\[ r_c = \frac{D_1}{P_0(1-F)} + g = \frac{D_0(1+g)}{P_0(1-F)} + g \], 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

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

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%
\[ WACC \text{ (N/C)} = 13.52\% \]
- 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