Chapter 5
Stocks and Their Valuation
ANSWERS TO END-OF-CHAPTER QUESTIONS

5-1  a. A proxy is a document giving one person the authority to act for another, typically the power to vote shares of common stock. If earnings are poor and stockholders are dissatisfied, an outside group may solicit the proxies in an effort to overthrow management and take control of the business, known as a proxy fight. A takeover is an action whereby a person or group succeeds in ousting a firm’s management and taking control of the company. The preemptive right gives the current shareholders the right to purchase any new shares issued in proportion to their current holdings. The preemptive right may or may not be required by state law. When granted, the preemptive right enables current owners to maintain their proportionate share of ownership and control of the business. It also prevents the sale of shares at low prices to new stockholders which would dilute the value of the previously issued shares. Classified stock is sometimes created by a firm to meet special needs and circumstances. Generally, when special classifications of stock are used, one type is designated “Class A”, another as “Class B”, and so on. Class A might be entitled to receive dividends before dividends can be paid on Class B stock. Class B might have the exclusive right to vote. Founders’ shares are stock owned by the firm’s founders that have sole voting rights but restricted dividends for a specified number of years.

b. Some companies are so small that their common stocks are not actively traded; they are owned by only a few people, usually the companies’ managers. Such firms are said to be closely held corporations. In contrast, the stocks of most larger companies are owned by a large number of investors, most of whom are not active in management. Such companies are said to be publicly owned corporations.

c. The secondary market deals with trading in previously issued, or outstanding, shares of established, publicly owned companies. The company receives no new money when sales are made in the secondary market. The primary market handles additional shares sold by established, publicly owned companies. Companies can raise additional capital by selling in this market. Going public is the act of selling stock to the public at large by a closely held corporation or its principal stockholders, and this market is often termed the initial public offering (IPO) market.

d. Intrinsic value ($P_0$) is the present value of the expected future cash flows. The market price ($P_0$) is the price at which an asset can be sold.
e. The required rate of return on common stock, denoted by \( r_s \), is the minimum acceptable rate of return considering both its riskiness and the returns available on other investments. The expected rate of return, denoted by \( \hat{r}_s \), is the rate of return expected on a stock given its current price and expected future cash flows. If the stock is in equilibrium, the required rate of return will equal the expected rate of return. The realized (actual) rate of return, denoted by \( r_r \), is the rate of return that was actually realized at the end of some holding period. Although expected and required rates of return must always be positive, realized rates of return over some periods may be negative.

f. The capital gains yield results from changing prices and is calculated as \( \frac{P_1 - P_0}{P_0} \), where \( P_0 \) is the beginning-of-period price and \( P_1 \) is the end-of-period price. For a constant growth stock, the capital gains yield is \( g \), the constant growth rate. The dividend yield on a stock can be defined as either the end-of-period dividend divided by the beginning-of-period price, or the ratio of the current dividend to the current price. Valuation formulas use the former definition. The expected total return, or expected rate of return, is the expected capital gains yield plus the expected dividend yield on a stock. The expected total return on a bond is the yield to maturity.

g. Normal, or constant, growth occurs when a firm’s earnings and dividends grow at some constant rate forever. One category of nonconstant growth stock is a “supernormal” growth stock which has one or more years of growth above that of the economy as a whole, but at some point the growth rate will fall to the “normal” rate. This occurs, generally, as part of a firm’s normal life cycle. A zero growth stock has constant earnings and dividends; thus, the expected dividend payment is fixed, just as a bond’s coupon payment. Since the company is presumed to continue operations indefinitely, the dividend stream is a perpetuity. A perpetuity is a security on which the principal never has to be repaid.
h. Equilibrium is the condition under which the expected return on a security is just equal to its required return, \( \hat{r} = r \), and the price is stable. The Efficient Markets Hypothesis (EMH) states (1) that stocks are always in equilibrium and (2) that it is impossible for an investor to consistently “beat the market.” In essence, the theory holds that the price of a stock will adjust almost immediately in response to any new developments. In other words, the EMH assumes that all important information regarding a stock is reflected in the price of that stock. Financial theorists generally define three forms of market efficiency: weak-form, semistrong-form, and strong-form. Weak-form efficiency assumes that all information contained in past price movements is fully reflected in current market prices. Thus, information about recent trends in a stock’s price is of no use in selecting a stock. Semistrong-form efficiency states that current market prices reflect all publicly available information. Therefore, the only way to gain abnormal returns on a stock is to possess inside information about the company’s stock. Strong-form efficiency assumes that all information pertaining to a stock, whether public or inside information, is reflected in current market prices. Thus, no investors would be able to earn abnormal returns in the stock market.

i. Preferred stock is a hybrid—it is similar to bonds in some respects and to common stock in other respects. Preferred dividends are similar to interest payments on bonds in that they are fixed in amount and generally must be paid before common stock dividends can be paid. If the preferred dividend is not earned, the directors can omit it without throwing the company into bankruptcy. So, although preferred stock has a fixed payment like bonds, a failure to make this payment will not lead to bankruptcy. Most preferred stocks entitle their owners to regular fixed dividend payments.

5-2 True. The value of a share of stock is the PV of its expected future dividends. If the two investors expect the same future dividend stream, and they agree on the stock’s riskiness, then they should reach similar conclusions as to the stock’s value.

5-3 A perpetual bond is similar to a no-growth stock and to a share of preferred stock in the following ways:

1. All three derive their values from a series of cash inflows—coupon payments from the perpetual bond, and dividends from both types of stock.

2. All three are assumed to have indefinite lives with no maturity value \( M \) for the perpetual bond and no capital gains yield for the stocks.

Mini Case: 5 - 3
5-1  
$D_0 = 1.50; \ g_{1-3} = 5\%; \ g_n = 10\%; \ D_1 \text{ through } D_5 = \ ?$

$D_1 = D_0 (1 + g_1) = 1.50 (1.05) = 1.5750.$
$D_2 = D_0 (1 + g_1) (1 + g_2) = 1.50 (1.05)^2 = 1.6538.$
$D_3 = D_0 (1 + g_1) (1 + g_2) (1 + g_3) = 1.50 (1.05)^3 = 1.7364.$
$D_4 = D_0 (1 + g_1) (1 + g_2) (1 + g_3) (1 + g_4) = 1.50 (1.05)^3 (1.10) = 1.9101.$
$D_5 = D_0 (1 + g_1) (1 + g_2) (1 + g_3) (1 + g_4) (1 + g_n)^2 = 1.50 (1.05)^3 (1.10)^2 = 2.1011.$

5-2  
$D_1 = 0.50; \ g = 7\%; \ r_s = 15\%; \ P^\hat{\ } = \ ?$

$P^\hat{\ } = \frac{D_1}{\frac{r_s}{g} - 1} = \frac{0.50}{0.15 - 0.07} = 6.25.$

5-3  
$P_0 = 20; \ D_0 = 1.00; \ g = 10\%; \ P^\hat{\ } = \ ?; \ r_s = \ ?$

$P^\hat{\ } = P_0 (1 + g) = 20 (1.10) = 22.$

$\hat{\ r_s} = \frac{\frac{D_1}{P_0} + g}{\frac{1.00 (1.10)}{20} + 0.10} = \frac{1.10}{20} + 0.10 = 15.50\%. \ \hat{\ r_s} = 15.50\%.$

5-4  
$D_{ps} = 5.00; \ V_{ps} = 60; \ r_{ps} = \ ?$

$r_{ps} = \frac{D_{ps}}{V_{ps}} = \frac{5.00}{60.00} = 8.33\%.$
Step 1: Calculate the required rate of return on the stock:

\[ r_s = r_{RF} + (r_M - r_{RF})b = 7.5\% + (4\%)1.2 = 12.3\%. \]

Step 2: Calculate the expected dividends:

\[ D_0 = $2.00 \]
\[ D_1 = D_0(1.20) = $2.40 \]
\[ D_2 = D_0(1.20)^2 = $2.88 \]
\[ D_3 = D_0(1.07) = $3.08 \]

Step 3: Calculate the PV of the expected dividends:

\[ PV_{Div} = \frac{D_1}{1.123} + \frac{D_2}{(1.123)^2} = \frac{2.40}{1.123} + \frac{2.88}{1.123^2} = $2.14 + $2.28 = $4.42. \]

Step 4: Calculate \( \hat{P}_2 \):

\[ \hat{P}_2 = \frac{D_3}{r_s - g} = \frac{3.08}{0.123 - 0.07} = $58.11. \]

Step 5: Calculate the PV of \( \hat{P}_2 \):

\[ PV = \frac{58.11}{1.123^2} = $46.08. \]

Step 6: Sum the PVs to obtain the stock’s price:

\[ \hat{P}_0 = 4.42 + 46.08 = $50.50. \]

Alternatively, using a financial calculator, input the following:

CF\(_0\) = 0, CF\(_1\) = 2.40, and CF\(_2\) = 60.99 (2.88 + 58.11) and then enter I = 12.3 to solve for NPV = $50.50.

5-6 The problem asks you to determine the constant growth rate, given the following facts: \( P_0 = $80, \ D_1 = $4, \) and \( r_s = 14\% \). Use the constant growth rate formula to calculate g:

\[ r_s = \frac{D_1}{P_0} + g \]
\[ \frac{4}{80} + g \]
\[ g = 0.09 = 9\%. \]
The problem asks you to determine the value of $P^*_3$, given the following facts: $D_1 = $2, $b = 0.9$, $r_{RF} = 5.6\%$, $R_{PM} = 6\%$, and $P_0 = $25. Proceed as follows:

Step 1: Calculate the required rate of return:
\[ r_s = r_{RF} + (r_{PM} - r_{RF})b = 5.6\% + (6\%)0.9 = 11\%. \]

Step 2: Use the constant growth rate formula to calculate $g$:
\[ \frac{r_s}{r_s - g} = \frac{D_1}{P_0} + g \]
\[ 0.11 = \frac{2}{25} + g \]
\[ g = 0.03 = 3\%. \]

Step 3: Calculate $P^*_3$:
\[ P^*_3 = P_0(1 + g)^3 = $25(1.03)^3 = $27.3182 \approx $27.32. \]

Alternatively, you could calculate $D_4$ and then use the constant growth rate formula to solve for $P^*_3$:
\[ D_4 = D_1(1 + g)^3 = $2.00(1.03)^3 = $2.1855. \]
\[ P^*_3 = $2.1855/(0.11 - 0.03) = $27.3188 = $27.32. \]

5-8 $V_{ps} = D_{ps}/r_{ps}$; therefore, $r_{ps} = D_{ps}/V_{ps}$.

a. $r_{ps} = $8/$60 = 13.3\%.$

b. $r_{ps} = $8/$80 = 10\%.$

c. $r_{ps} = $8/$100 = 8\%.$

d. $r_{ps} = $8/$140 = 5.7\%.$

5-9 $P^*_0 = \frac{D_1}{r_s - g} = \frac{D_0(1+g)}{r_s - g} = \frac{$5[1 + (-0.05)]}{0.15 - (-0.05)} = \frac{$5(0.95)}{0.15 + 0.05} = \frac{$4.75}{0.20} = $23.75.$
Mini Case:

5-10

a. \( r_i = r_{RF} + (r_M - r_{RF})b_i. \)

\[ r_C = 9\% + (13\% - 9\%) 0.4 = 10.6\%. \quad r_D = 9\% + (13\% - 9\%)-0.5 = 7\%. \]

Note that \( r_D \) is below the risk-free rate. But since this stock is like an insurance policy because it “pays off” when something bad happens (the market falls), the low return is not unreasonable.

b. In this situation, the expected rate of return is as follows:

\[ \hat{r}_c = \frac{D_i}{P_c} + g = \frac{1.50}{25} + 4\% = 10\%. \]

However, the required rate of return is 10.6 percent. Investors will seek to sell the stock, dropping its price to the following:

\[ \hat{P}_c = \frac{\$1.50}{0.106 - 0.04} = \$22.73. \]

At this point, \( \hat{r}_c = \frac{\$1.50}{\$22.73} + 4\% = 10.6\%, \) and the stock will be in equilibrium.

5-11

\[ D_0 = \$1, \quad r_S = 7\% + 6\% = 13\%, \quad g_1 = 50\%, \quad g_2 = 25\%, \quad g_n = 6\%. \]

\[
\begin{array}{ccccccc}
| & k_s = 13\% & | & g_1 = 50\% & | & g_2 = 25\% & | & g_1 = 6\% |\\
| & 0 & | & 1.50 & | & 1.875 & | & 1.9875 |\\
| & 1.327 & | & + 28.393 = 1.9875/(0.13 - 0.06) & | & = 30.268 |\\
| & 23.704 & | & \$25.03 |
\end{array}
\]
5-12 Calculate the dividend stream and place them on a time line. Also, calculate the price of the stock at the end of the supernormal growth period, and include it, along with the dividend to be paid at \( t = 5 \), as \( CF_5 \). Then, enter the cash flows as shown on the time line into the cash flow register, enter the required rate of return as \( I = 15 \), and then find the value of the stock using the NPV calculation. Be sure to enter \( CF_0 = 0 \), or else your answer will be incorrect.

\[
\begin{align*}
D_0 &= 0; \quad D_1 = 0, \quad D_2 = 0, \quad D_3 = 1.00 \\
D_4 &= 1.00(1.5) = 1.5; \quad D_5 = 1.00(1.5)^2 = 2.25; \quad D_6 = 1.00(1.5)^2(1.08) = 2.43.
\end{align*}
\]

\[\hat{P}_5 = \frac{D_6}{r_s - g} = \frac{2.43}{0.15 - 0.08} = 34.71. \]

This is the price of the stock at the end of Year 5.

\[
\begin{align*}
CF_0 &= 0; \quad CF_{1-2} = 0; \quad CF_3 = 1.0; \quad CF_4 = 1.5; \quad CF_5 = 36.96; \quad I = 15\%.
\end{align*}
\]

With these cash flows in the CFLO register, press NPV to get the value of the stock today: \( NPV = 19.89 \).

5-13 a. \( V_{ps} = \frac{D_{ps}}{r_{ps}} = \frac{10}{0.08} = 125 \).

b. \( V_{ps} = \frac{10}{0.12} = 83.33 \).

\[ g = 5\% \]
Mini Case: 5 - 9

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a. $D₁ = 2(1.05) = 2.10$.  $D₂ = 2(1.05)^2 = 2.21$.  $D₃ = 2(1.05)^3 = 2.32$.

b. $PV = 2.10(0.8929) + 2.21(0.7972) + 2.32(0.7118) = 5.29$.

Calculator solution: Input 0, 2.10, 2.21, and 2.32 into the cash flow register, input I = 12, PV = ?  PV = $5.29.

c. $34.73(0.7118) = 24.72$.

Calculator solution: Input 0, 0, 0, and 34.73 into the cash flow register, I = 12, PV = ?  PV = $24.72.

d. $24.72 + 5.29 = 30.01 = Maximum price you should pay for the stock.

e. $\hat{P}_0 = \frac{D₀(1+g)}{r_s-g} = \frac{D₁}{r_s-g} = \frac{2.10}{0.12-0.05} = 30.00$.

f. The value of the stock is not dependent upon the holding period.  The value calculated in Parts a through d is the value for a 3-year holding period.  It is equal to the value calculated in Part e except for a small rounding error.  Any other holding period would produce the same value of $\hat{P}_0$; that is, $\hat{P}_0 = 30.00$.

5-15  a. $g = \frac{1.1449}{1.07} - 1.0 = 7\%$.

Calculator solution: Input N = 1, PV = -1.07, PMT = 0, FV = 1.1449, I = ?  I = 7.00%.

b. $1.07/21.40 = 5\%$.

c. $\hat{r}_s = D₁/P₀ + g = 1.07/21.40 + 7\% = 5\% + 7\% = 12\%$. 

5-16 a. 1. \( \hat{P}_0 = \frac{2(1 - 0.05)}{0.15 + 0.05} = \frac{1.90}{0.20} = 9.50 \). 
2. \( \hat{P}_0 = \frac{2}{0.15} = 13.33 \). 
3. \( \hat{P}_0 = \frac{2(1.05)}{0.15 - 0.05} = \frac{2.10}{0.10} = 21.00 \). 
4. \( \hat{P}_0 = \frac{2(1.10)}{0.15 - 0.10} = \frac{2.20}{0.05} = 44.00 \).

b. 1. \( \hat{P}_0 = \frac{2.30}{0} = \text{Undefined} \).
2. \( \hat{P}_0 = \frac{2.40}{-0.05} = -48 \), which is nonsense.

These results show that the formula does not make sense if the required rate of return is equal to or less than the expected growth rate.

c. No.
a. End of Year: 

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<td>(g)</td>
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<td>12%</td>
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<tr>
<td>(D_0)</td>
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<td>(D_1)</td>
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\[
D_t = D_0(1 + g)^t \\
D_1 = 1.75(1.15)^1 = 2.01. \\
D_2 = 1.75(1.15)^2 = 1.75(1.3225) = 2.31. \\
D_3 = 1.75(1.15)^3 = 1.75(1.5209) = 2.66. \\
D_4 = 1.75(1.15)^4 = 1.75(1.7490) = 3.06. \\
D_5 = 1.75(1.15)^5 = 1.75(2.0114) = 3.52. \\
\]

b. Step 1

\[ PV \text{ of dividends} = \sum_{t=1}^{5} \frac{D_t}{(1 + r_s)^t}. \]

\[
PV \ D_1 = \$2.01(PVIF_{12\%,1}) = \$2.01(0.8929) = \$1.79 \\
PV \ D_2 = \$2.31(PVIF_{12\%,2}) = \$2.31(0.7972) = \$1.84 \\
PV \ D_3 = \$2.66(PVIF_{12\%,3}) = \$2.66(0.7118) = \$1.89 \\
PV \ D_4 = \$3.06(PVIF_{12\%,4}) = \$3.06(0.6355) = \$1.94 \\
PV \ D_5 = \$3.52(PVIF_{12\%,5}) = \$3.52(0.5674) = \$2.00 \\
\]

\[ PV \text{ of dividends} = \$9.46 \]

Step 2

\[
\hat{P}_5 = \frac{D_6}{r_s - g_n} = \frac{D_6(1 + g_n)}{r_s - g_n} = \frac{3.52(1.05)}{0.12 - 0.05} = \frac{3.70}{0.07} = \$52.80. \\
\]

This is the price of the stock 5 years from now. The PV of this price, discounted back 5 years, is as follows:

\[ PV \text{ of } \hat{P}_5 = \$52.80(PVIF_{12\%,5}) = \$52.80(0.5674) = \$29.96. \]

Step 3

The price of the stock today is as follows:

\[ \hat{P}_0 = PV \text{ dividends Years 1 through 5} + PV \text{ of } \hat{P}_5 = $9.46 + $29.96 = $39.42. \]

This problem could also be solved by substituting the proper values into the following equation:

\[
\hat{P}_0 = \sum_{t=1}^{5} \frac{D_t(1 + g_s)^t}{(1 + r_s)^t} + \left( \frac{D_s}{r_s - g_n} \right) \left( \frac{1}{1 + r_s} \right)^5. \\
\]

Calculator solution: Input 0, 2.01, 2.31, 2.66, 3.06, 56.32 (3.52 + 52.80) into the cash flow register, input I = 12, PV = ?  PV = $39.43.

c. First Year

\[ D_1/P_0 = \frac{2.01}{39.42} = 5.10\% \]

Mini Case: 5 - 11
Capital gains yield = 6.90*
Expected total return = 12.00%

Sixth Year
\[
\frac{D_6}{P_5} = \frac{3.70}{52.80} = 7.00\%
\]
Capital gains yield = 5.00
Expected total return = 12.00%

*We know that \( r \) is 12 percent, and the dividend yield is 5.10 percent; therefore, the capital gains yield must be 6.90 percent.

The main points to note here are as follows:

1. The total yield is always 12 percent (except for rounding errors).

2. The capital gains yield starts relatively high, then declines as the supernormal growth period approaches its end. The dividend yield rises.

3. After \( t=5 \), the stock will grow at a 5 percent rate. The dividend yield will equal 7 percent, the capital gains yield will equal 5 percent, and the total return will be 12 percent.
5-18 a. Part 1. Graphical representation of the problem:

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D₁ = D₀(1 + gₚ) = $1.6(1.20) = $1.92.
D₂ = D₀(1 + gₚ)² = $1.60(1.20)² = $2.304.

\[ \hat{P}_₂ = \frac{D₃}{r_s - gₚ} = \frac{D₂(1 + gₚ)}{r_s - gₚ} = \frac{2.304 (1.06)}{0.10 - 0.06} = 61.06. \]

\[ \hat{P}_₀ = PV(D₁) + PV(D₂) + PV(\hat{P}_₂) \]
\[ = \frac{D₁}{(1+r_s)} + \frac{D₂}{(1+r_s)^2} + \frac{\hat{P}_₂}{(1+r_s)^2} \]
\[ = $1.92(0.9091) + $2.304(0.8264) + $61.06(0.8264) = $54.11. \]

Calculator solution: Input 0, 1.92, 63.364(2.304 + 61.06) into the cash flow register, input I = 10, PV = ? PV = $54.11.

Part 2.

Expected dividend yield: \( \frac{D₁}{P₀} = \frac{1.92}{54.11} = 3.55\% \).

Capital gains yield: First, find \( \hat{P}_₁ \) which equals the sum of the present values of \( D₂ \) and \( \hat{P}_₂ \), discounted for one year.

\[ \hat{P}_₁ = D₂(PVIF₁₀\%, 1) + \hat{P}_₂(PVIF₁₀\%, 1) = \frac{2.304 + 61.06}{(1.10)^1} = 57.60. \]

Calculator solution: Input 0, 63.364(2.304 + 61.06) into the cash flow register, input I = 10, PV = ? PV = $57.60.

Second, find the capital gains yield:

\[ \frac{\hat{P}_₁ - P₀}{P₀} = \frac{57.60 - 54.11}{54.11} = 6.45\%. \]

Dividend yield = 3.55%
Capital gains yield = 6.45
10.00\% = rₛ.
b. Due to the longer period of supernormal growth, the value of the stock will be higher for each year. Although the total return will remain the same, $r_s = 10\%$, the distribution between dividend yield and capital gains yield will differ: The dividend yield will start off lower and the capital gains yield will start off higher for the 5-year supernormal growth condition, relative to the 2-year supernormal growth state. The dividend yield will increase and the capital gains yield will decline over the 5-year period until dividend yield = 4% and capital gains yield = 6%.

c. Throughout the supernormal growth period, the total yield will be 10 percent, but the dividend yield is relatively low during the early years of the supernormal growth period and the capital gains yield is relatively high. As we near the end of the supernormal growth period, the capital gains yield declines and the dividend yield rises. After the supernormal growth period has ended, the capital gains yield will equal $g_n = 6\%$. The total yield must equal $r_s = 10\%$, so the dividend yield must equal $10\% - 6\% = 4\%$.

d. Some investors need cash dividends (retired people) while others would prefer growth. Also, investors must pay taxes each year on the dividends received during the year, while taxes on capital gains can be delayed until the gain is actually realized.

5-19 a. $r_s = r_{RF} + (r_M - r_{RF})b = 11\% + (14\% - 11\%)1.5 = 15.5\%$.
   $\hat{P}_0 = D_1/(r_s - g) = $2.25/(0.155 - 0.05) = $21.43.

b. $r_s = 9\% + (12\% - 9\%)1.5 = 13.5\%$. = $2.25/(0.135 - 0.05) = $26.47.

c. $r_s = 9\% + (11\% - 9\%)1.5 = 12.0\%$. = $2.25/(0.12 - 0.05) = $32.14.

d. New data given: $r_{RF} = 9\%$; $r_M = 11\%$; $g = 6\%$, $b = 1.3$.
   $r_s = r_{RF} + (r_M - r_{RF})b = 9\% + (11\% - 9\%)1.3 = 11.6\%$.
   = $D_1/(r_s - g) = $2.27/(0.116 - 0.06) = $40.54.