
CHAPTER 5

HOW TO VALUE STOCKS AND BONDS

Answers to Concepts Review and Critical Thinking Questions

1. Bond issuers look at outstanding bonds of similar maturity and risk. The yields on such bonds are used to establish the coupon rate necessary for a particular issue to initially sell for par value. Bond issuers also simply ask potential purchasers what coupon rate would be necessary to attract them. The coupon rate is fixed and simply determines what the bond's coupon payments will be. The required return is what investors actually demand on the issue, and it will fluctuate through time. The coupon rate and required return are equal only if the bond sells exactly at par.
2. Lack of transparency means that a buyer or seller can't see recent transactions, so it is much harder to determine what the best price is at any point in time.
3. The value of any investment depends on the present value of its cash flows; i.e., what investors will actually receive. The cash flows from a share of stock are the dividends.
4. Investors believe the company will eventually start paying dividends (or be sold to another company).
5. In general, companies that need the cash will often forgo dividends since dividends are a cash expense. Young, growing companies with profitable investment opportunities are one example; another example is a company in financial distress. This question is examined in depth in a later chapter.
6. The general method for valuing a share of stock is to find the present value of all expected future dividends. The dividend growth model presented in the text is only valid (i) if dividends are expected to occur forever; that is, the stock provides dividends in perpetuity, and (ii) if a constant growth rate of dividends occurs forever. A violation of the first assumption might be a company that is expected to cease operations and dissolve itself some finite number of years from now. The stock of such a company would be valued by applying the general method of valuation explained in this chapter. A violation of the second assumption might be a start-up firm that isn't currently paying any dividends, but is expected to eventually start making dividend payments some number of years from now. This stock would also be valued by the general dividend valuation method explained in this chapter.
7. The common stock probably has a higher price because the dividend can grow, whereas it is fixed on the preferred. However, the preferred is less risky because of the dividend and liquidation preference, so it is possible the preferred could be worth more, depending on the circumstances.
8. Yes. If the dividend grows at a steady rate, so does the stock price. In other words, the dividend growth rate and the capital gains yield are the same.
9. The three factors are: 1) The company's future growth opportunities. 2) The company's level of risk, which determines the interest rate used to discount cash flows. 3) The accounting method used.

10. Presumably, the current stock value reflects the risk, timing and magnitude of all future cash flows, both short-term and long-term. If this is correct, then the statement is false.

Solutions to Questions and Problems

NOTE: All end-of-chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.

NOTE: Most problems do not explicitly list a par value for bonds. Even though a bond can have any par value, in general, corporate bonds in the United States will have a par value of \$1,000. We will use this par value in all problems unless a different par value is explicitly stated.

Basic

1. The price of a pure discount (zero coupon) bond is the present value of the par. Even though the bond makes no coupon payments, the present value is found using semiannual compounding periods, consistent with coupon bonds. This is a bond pricing convention. So, the price of the bond for each YTM is:

$$a. P = \$1,000 / (1 + .025)^{20} = \$610.27$$

$$b. P = \$1,000 / (1 + .05)^{20} = \$376.89$$

$$c. P = \$1,000 / (1 + .075)^{20} = \$235.41$$

2. The price of any bond is the PV of the interest payment, plus the PV of the par value. Notice this problem assumes an annual coupon. The price of the bond at each YTM will be:

$$a. P = \$40 \left(\{1 - [1 / (1 + .04)]^{40}\} / .04 \right) + \$1,000 [1 / (1 + .04)^{40}]$$

$$P = \$1,000.00$$

When the YTM and the coupon rate are equal, the bond will sell at par.

$$b. P = \$40 \left(\{1 - [1 / (1 + .05)]^{40}\} / .05 \right) + \$1,000 [1 / (1 + .05)^{40}]$$

$$P = \$828.41$$

When the YTM is greater than the coupon rate, the bond will sell at a discount.

$$c. P = \$40 \left(\{1 - [1 / (1 + .03)]^{40}\} / .03 \right) + \$1,000 [1 / (1 + .03)^{40}]$$

$$P = \$1,231.15$$

When the YTM is less than the coupon rate, the bond will sell at a premium.

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We would like to introduce shorthand notation here. Rather than write (or type, as the case may be) the entire equation for the PV of a lump sum, or the PVA equation, it is common to abbreviate the equations as:

$$PVIF_{R,t} = 1 / (1 + r)^t$$

which stands for Present Value Interest Factor, and:

$$PVIFA_{R,t} = (\{1 - [1/(1 + r)]^t\} / r)$$

which stands for Present Value Interest Factor of an Annuity

These abbreviations are short hand notation for the equations in which the interest rate and the number of periods are substituted into the equation and solved. We will use this shorthand notation in the remainder of the solutions key.

3. Here we are finding the YTM of a semiannual coupon bond. The bond price equation is:

$$P = \$970 = \$43(PVIFA_{R\%,20}) + \$1,000(PVIF_{R\%,20})$$

Since we cannot solve the equation directly for R , using a spreadsheet, a financial calculator, or trial and error, we find:

$$R = 4.531\%$$

Since the coupon payments are semiannual, this is the semiannual interest rate. The YTM is the APR of the bond, so:

$$YTM = 2 \times 4.531\% = 9.06\%$$

4. The constant dividend growth model is:

$$P_t = D_t \times (1 + g) / (R - g)$$

So, the price of the stock today is:

$$P_0 = D_0 (1 + g) / (R - g) = \$1.40 (1.06) / (.12 - .06) = \$24.73$$

The dividend at year 4 is the dividend today times the FVIF for the growth rate in dividends and four years, so:

$$P_3 = D_3 (1 + g) / (R - g) = D_0 (1 + g)^4 / (R - g) = \$1.40 (1.06)^4 / (.12 - .06) = \$29.46$$

We can do the same thing to find the dividend in Year 16, which gives us the price in Year 15, so:

$$P_{15} = D_{15} (1 + g) / (R - g) = D_0 (1 + g)^{16} / (R - g) = \$1.40 (1.06)^{16} / (.12 - .06) = \$59.27$$

There is another feature of the constant dividend growth model: The stock price grows at the dividend growth rate. So, if we know the stock price today, we can find the future value for any time in the future we want to calculate the stock price. In this problem, we want to know the stock price in three years, and we have already calculated the stock price today. The stock price in three years will be:

$$P_3 = P_0(1 + g)^3 = \$24.73(1 + .06)^3 = \$29.46$$

And the stock price in 15 years will be:

$$P_{15} = P_0(1 + g)^{15} = \$24.73(1 + .06)^{15} = \$59.27$$

5. We need to find the required return of the stock. Using the constant growth model, we can solve the equation for R . Doing so, we find:

$$R = (D_1 / P_0) + g = (\$3.10 / \$48.00) + .05 = 11.46\%$$

6. Using the constant growth model, we find the price of the stock today is:

$$P_0 = D_1 / (R - g) = \$3.60 / (.13 - .045) = \$42.35$$

7. We know the stock has a required return of 12 percent, and the dividend and capital gains yield are equal, so:

$$\text{Dividend yield} = 1/2(.12) = .06 = \text{Capital gains yield}$$

Now we know both the dividend yield and capital gains yield. The dividend is simply the stock price times the dividend yield, so:

$$D_1 = .06(\$70) = \$4.20$$

This is the dividend next year. The question asks for the dividend this year. Using the relationship between the dividend this year and the dividend next year:

$$D_1 = D_0(1 + g)$$

We can solve for the dividend that was just paid:

$$\$4.20 = D_0 (1 + .06)$$

$$D_0 = \$4.20 / 1.06 = \$3.96$$

8. The price of any financial instrument is the PV of the future cash flows. The future dividends of this stock are an annuity for eight years, so the price of the stock is the PVA, which will be:

$$P_0 = \$12.00(\text{PVIFA}_{10\%,8}) = \$64.02$$

B-104 SOLUTIONS

9. The growth rate of earnings is the return on equity times the retention ratio, so:

$$\begin{aligned} g &= \text{ROE} \times b \\ g &= .14(.60) \\ g &= .084 \text{ or } 8.40\% \end{aligned}$$

To find next year's earnings, we simply multiply the current earnings times one plus the growth rate, so:

$$\begin{aligned} \text{Next year's earnings} &= \text{Current earnings}(1 + g) \\ \text{Next year's earnings} &= \$20,000,000(1 + .084) \\ \text{Next year's earnings} &= \$21,680,000 \end{aligned}$$

Intermediate

10. Here we are finding the YTM of semiannual coupon bonds for various maturity lengths. The bond price equation is:

$$P = C(\text{PVIFA}_{R\%,t}) + \$1,000(\text{PVIF}_{R\%,t})$$

Miller Corporation bond:

$$\begin{aligned} P_0 &= \$40(\text{PVIFA}_{3\%,26}) + \$1,000(\text{PVIF}_{3\%,26}) = \$1,178.77 \\ P_1 &= \$40(\text{PVIFA}_{3\%,24}) + \$1,000(\text{PVIF}_{3\%,24}) = \$1,169.36 \\ P_3 &= \$40(\text{PVIFA}_{3\%,20}) + \$1,000(\text{PVIF}_{3\%,20}) = \$1,148.77 \\ P_8 &= \$40(\text{PVIFA}_{3\%,10}) + \$1,000(\text{PVIF}_{3\%,10}) = \$1,085.30 \\ P_{12} &= \$40(\text{PVIFA}_{3\%,2}) + \$1,000(\text{PVIF}_{3\%,2}) = \$1,019.13 \\ P_{13} &= \$1,000 \end{aligned}$$

Modigliani Company bond:

$$\begin{aligned} Y: P_0 &= \$30(\text{PVIFA}_{4\%,26}) + \$1,000(\text{PVIF}_{4\%,26}) = \$840.17 \\ P_1 &= \$30(\text{PVIFA}_{4\%,24}) + \$1,000(\text{PVIF}_{4\%,24}) = \$847.53 \\ P_3 &= \$30(\text{PVIFA}_{4\%,20}) + \$1,000(\text{PVIF}_{4\%,20}) = \$864.10 \\ P_8 &= \$30(\text{PVIFA}_{4\%,10}) + \$1,000(\text{PVIF}_{4\%,10}) = \$918.89 \\ P_{12} &= \$30(\text{PVIFA}_{4\%,2}) + \$1,000(\text{PVIF}_{4\%,2}) = \$981.14 \\ P_{13} &= \$1,000 \end{aligned}$$

All else held equal, the premium over par value for a premium bond declines as maturity approaches, and the discount from par value for a discount bond declines as maturity approaches. This is called "pull to par." In both cases, the largest percentage price changes occur at the shortest maturity lengths.

Also, notice that the price of each bond when no time is left to maturity is the par value, even though the purchaser would receive the par value plus the coupon payment immediately. This is because we calculate the clean price of the bond.

11. The bond price equation for this bond is:

$$P_0 = \$1,040 = \$42(\text{PVIFA}_{R\%,18}) + \$1,000(\text{PVIF}_{R\%,18})$$

Using a spreadsheet, financial calculator, or trial and error we find:

$$R = 3.887\%$$

This is the semiannual interest rate, so the YTM is:

$$\text{YTM} = 2 \times 3.887\% = 7.77\%$$

The current yield is:

$$\text{Current yield} = \text{Annual coupon payment} / \text{Price} = \$84 / \$1,040 = 8.08\%$$

The effective annual yield is the same as the EAR, so using the EAR equation from the previous chapter:

$$\text{Effective annual yield} = (1 + 0.03887)^2 - 1 = 7.92\%$$

12. The company should set the coupon rate on its new bonds equal to the required return. The required return can be observed in the market by finding the YTM on outstanding bonds of the company. So, the YTM on the bonds currently sold in the market is:

$$P = \$1,095 = \$40(\text{PVIFA}_{R\%,40}) + \$1,000(\text{PVIF}_{R\%,40})$$

Using a spreadsheet, financial calculator, or trial and error we find:

$$R = 3.55\%$$

This is the semiannual interest rate, so the YTM is:

$$\text{YTM} = 2 \times 3.55\% = 7.10\%$$

13. This stock has a constant growth rate of dividends, but the required return changes twice. To find the value of the stock today, we will begin by finding the price of the stock at Year 6, when both the dividend growth rate and the required return are stable forever. The price of the stock in Year 6 will be the dividend in Year 7, divided by the required return minus the growth rate in dividends. So:

$$P_6 = D_6 (1 + g) / (R - g) = D_0 (1 + g)^7 / (R - g) = \$3.00 (1.05)^7 / (.11 - .05) = \$70.36$$

Now we can find the price of the stock in Year 3. We need to find the price here since the required return changes at that time. The price of the stock in Year 3 is the PV of the dividends in Years 4, 5, and 6, plus the PV of the stock price in Year 6. The price of the stock in Year 3 is:

$$P_3 = \$3.00(1.05)^4 / 1.14 + \$3.00(1.05)^5 / 1.14^2 + \$3.00(1.05)^6 / 1.14^3 + \$70.36 / 1.14^3$$

$$P_3 = \$56.35$$

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Finally, we can find the price of the stock today. The price today will be the PV of the dividends in Years 1, 2, and 3, plus the PV of the stock in Year 3. The price of the stock today is:

$$P_0 = \$3.00(1.05) / 1.16 + \$3.00(1.05)^2 / (1.16)^2 + \$3.00(1.05)^3 / (1.16)^3 + \$56.35 / (1.16)^3 \\ = \$43.50$$

14. Here we have a stock that pays no dividends for 10 years. Once the stock begins paying dividends, it will have a constant growth rate of dividends. We can use the constant growth model at that point. It is important to remember that general form of the constant dividend growth formula is:

$$P_t = [D_t \times (1 + g)] / (R - g)$$

This means that since we will use the dividend in Year 10, we will be finding the stock price in Year 9. The dividend growth model is similar to the PVA and the PV of a perpetuity: The equation gives you the PV one period before the first payment. So, the price of the stock in Year 9 will be:

$$P_9 = D_{10} / (R - g) = \$8.00 / (.13 - .06) = \$114.29$$

The price of the stock today is simply the PV of the stock price in the future. We simply discount the future stock price at the required return. The price of the stock today will be:

$$P_0 = \$114.29 / 1.13^9 = \$38.04$$

15. The price of a stock is the PV of the future dividends. This stock is paying four dividends, so the price of the stock is the PV of these dividends using the required return. The price of the stock is:

$$P_0 = \$12 / 1.11 + \$15 / 1.11^2 + \$18 / 1.11^3 + \$21 / 1.11^4 = \$49.98$$

16. With supernormal dividends, we find the price of the stock when the dividends level off at a constant growth rate, and then find the PV of the future stock price, plus the PV of all dividends during the supernormal growth period. The stock begins constant growth in Year 5, so we can find the price of the stock in Year 4, one year before the constant dividend growth begins, as:

$$P_4 = D_4 (1 + g) / (R - g) = \$2.00(1.05) / (.13 - .05) = \$26.25$$

The price of the stock today is the PV of the first four dividends, plus the PV of the Year 4 stock price. So, the price of the stock today will be:

$$P_0 = \$8.00 / 1.13 + \$6.00 / 1.13^2 + \$3.00 / 1.13^3 + \$2.00 / 1.13^4 + \$26.25 / 1.13^4 = \$31.18$$

17. With supernormal dividends, we find the price of the stock when the dividends level off at a constant growth rate, and then find the PV of the future stock price, plus the PV of all dividends during the supernormal growth period. The stock begins constant growth in Year 4, so we can find the price of the stock in Year 3, one year before the constant dividend growth begins as:

$$P_3 = D_3 (1 + g) / (R - g) = D_0 (1 + g_1)^3 (1 + g_2) / (R - g_2) = \$2.80(1.25)^3(1.07) / (.13 - .07) = \$97.53$$

The price of the stock today is the PV of the first three dividends, plus the PV of the Year 3 stock price. The price of the stock today will be:

$$P_0 = 2.80(1.25) / 1.13 + \$2.80(1.25)^2 / 1.13^2 + \$2.80(1.25)^3 / 1.13^3 + \$97.53 / 1.13^3$$

$$P_0 = \$77.90$$

18. Here we need to find the dividend next year for a stock experiencing supernormal growth. We know the stock price, the dividend growth rates, and the required return, but not the dividend. First, we need to realize that the dividend in Year 3 is the current dividend times the FVIF. The dividend in Year 3 will be:

$$D_3 = D_0 (1.30)^3$$

And the dividend in Year 4 will be the dividend in Year 3 times one plus the growth rate, or:

$$D_4 = D_0 (1.30)^3 (1.18)$$

The stock begins constant growth in Year 4, so we can find the price of the stock in Year 4 as the dividend in Year 5, divided by the required return minus the growth rate. The equation for the price of the stock in Year 4 is:

$$P_4 = D_4 (1 + g) / (R - g)$$

Now we can substitute the previous dividend in Year 4 into this equation as follows:

$$P_4 = D_0 (1 + g_1)^3 (1 + g_2) (1 + g_3) / (R - g_3)$$

$$P_4 = D_0 (1.30)^3 (1.18) (1.08) / (.14 - .08) = 46.66D_0$$

When we solve this equation, we find that the stock price in Year 4 is 46.66 times as large as the dividend today. Now we need to find the equation for the stock price today. The stock price today is the PV of the dividends in Years 1, 2, 3, and 4, plus the PV of the Year 4 price. So:

$$P_0 = D_0(1.30)/1.14 + D_0(1.30)^2/1.14^2 + D_0(1.30)^3/1.14^3 + D_0(1.30)^3(1.18)/1.14^4 + 46.66D_0/1.14^4$$

We can factor out D_0 in the equation, and combine the last two terms. Doing so, we get:

$$P_0 = \$70.00 = D_0 \{ 1.30/1.14 + 1.30^2/1.14^2 + 1.30^3/1.14^3 + [(1.30)^3(1.18) + 46.66] / 1.14^4 \}$$

Reducing the equation even further by solving all of the terms in the braces, we get:

$$\$70 = \$33.04D_0$$

$$D_0 = \$70.00 / \$33.04 = \$2.12$$

This is the dividend today, so the projected dividend for the next year will be:

$$D_1 = \$2.12(1.30) = \$2.75$$

B-108 SOLUTIONS

19. We are given the stock price, the dividend growth rate, and the required return, and are asked to find the dividend. Using the constant dividend growth model, we get:

$$P_0 = \$50 = D_0 (1 + g) / (R - g)$$

Solving this equation for the dividend gives us:

$$D_0 = \$50(.14 - .08) / (1.08) = \$2.78$$

20. The price of a share of preferred stock is the dividend payment divided by the required return. We know the dividend payment in Year 6, so we can find the price of the stock in Year 5, one year before the first dividend payment. Doing so, we get:

$$P_5 = \$9.00 / .07 = \$128.57$$

The price of the stock today is the PV of the stock price in the future, so the price today will be:

$$P_0 = \$128.57 / (1.07)^5 = \$91.67$$

21. If the company's earnings are declining at a constant rate, the dividends will decline at the same rate since the dividends are assumed to be a constant percentage of income. The dividend next year will be less than this year's dividend, so

$$P_0 = D_0 (1 + g) / (R - g) = \$5.00(1 - .10) / [(.14 - (-.10))] = \$18.75$$

22. Here we have a stock paying a constant dividend for a fixed period, and an increasing dividend thereafter. We need to find the present value of the two different cash flows using the appropriate quarterly interest rate. The constant dividend is an annuity, so the present value of these dividends is:

$$\begin{aligned} PVA &= C(PVIFA_{R,t}) \\ PVA &= \$1(PVIFA_{2.5\%,12}) \\ PVA &= \$10.26 \end{aligned}$$

Now we can find the present value of the dividends beyond the constant dividend phase. Using the present value of a growing annuity equation, we find:

$$\begin{aligned} P_{12} &= D_{13} / (R - g) \\ P_{12} &= \$1(1 + .005) / (.025 - .005) \\ P_{12} &= \$50.25 \end{aligned}$$

This is the price of the stock immediately after it has paid the last constant dividend. So, the present value of the future price is:

$$\begin{aligned} PV &= \$50.25 / (1 + .025)^{12} \\ PV &= \$37.36 \end{aligned}$$

The price today is the sum of the present value of the two cash flows, so:

$$\begin{aligned} P_0 &= \$10.26 + 37.36 \\ P_0 &= \$47.62 \end{aligned}$$

23. We can find the price of the stock in Year 4 when it begins a constant increase in dividends using the growing perpetuity equation. So, the price of the stock in Year 4, immediately after the dividend payment, is:

$$P_4 = D_4(1 + g) / (R - g)$$

$$P_4 = \$2(1 + .06) / (.16 - .06)$$

$$P_4 = \$21.20$$

The stock price today is the sum of the present value of the two fixed dividends plus the present value of the future price, so:

$$P_0 = \$2 / (1 + .16)^3 + \$2 / (1 + .16)^4 + \$21.20 / (1 + .16)^4$$

$$P_0 = \$14.09$$

24. Here we need to find the dividend next year for a stock with nonconstant growth. We know the stock price, the dividend growth rates, and the required return, but not the dividend. First, we need to realize that the dividend in Year 3 is the constant dividend times the FVIF. The dividend in Year 3 will be:

$$D_3 = D(1.04)$$

The equation for the stock price will be the present value of the constant dividends, plus the present value of the future stock price, or:

$$P_0 = D / 1.12 + D / 1.12^2 + D(1.04) / (.12 - .04) / 1.12^2$$

$$\$30 = D / 1.12 + D / 1.12^2 + D(1.04) / (.12 - .04) / 1.12^2$$

We can factor out D_0 in the equation, and combine the last two terms. Doing so, we get:

$$\$30 = D \{ 1/1.12 + 1/1.12^2 + [(1.04) / (.12 - .04)] / 1.12^2 \}$$

Reducing the equation even further by solving all of the terms in the braces, we get:

$$\$30 = D(12.0536)$$

$$D = \$30 / 12.0536 = \$2.49$$

25. The required return of a stock consists of two components, the capital gains yield and the dividend yield. In the constant dividend growth model (growing perpetuity equation), the capital gains yield is the same as the dividend growth rate, or algebraically:

$$R = D_1/P_0 + g$$

B-110 SOLUTIONS

We can find the dividend growth rate by the growth rate equation, or:

$$\begin{aligned}g &= \text{ROE} \times b \\g &= .11 \times .75 \\g &= .0825 \text{ or } 8.25\%\end{aligned}$$

This is also the growth rate in dividends. To find the current dividend, we can use the information provided about the net income, shares outstanding, and payout ratio. The total dividends paid is the net income times the payout ratio. To find the dividend per share, we can divide the total dividends paid by the number of shares outstanding. So:

$$\begin{aligned}\text{Dividend per share} &= (\text{Net income} \times \text{Payout ratio}) / \text{Shares outstanding} \\ \text{Dividend per share} &= (\$10,000,000 \times .25) / 1,250,000 \\ \text{Dividend per share} &= \$2.00\end{aligned}$$

Now we can use the initial equation for the required return. We must remember that the equation uses the dividend in one year, so:

$$\begin{aligned}R &= D_1/P_0 + g \\ R &= \$2(1 + .0825)/\$40 + .0825 \\ R &= .1366 \text{ or } 13.66\%\end{aligned}$$

26. First, we need to find the annual dividend growth rate over the past four years. To do this, we can use the future value of a lump sum equation, and solve for the interest rate. Doing so, we find the dividend growth rate over the past four years was:

$$\begin{aligned}\text{FV} &= \text{PV}(1 + R)^t \\ \$1.66 &= \$0.90(1 + R)^4 \\ R &= (\$1.66 / \$0.90)^{1/4} - 1 \\ R &= .1654 \text{ or } 16.54\%\end{aligned}$$

We know the dividend will grow at this rate for five years before slowing to a constant rate indefinitely. So, the dividend amount in seven years will be:

$$\begin{aligned}D_7 &= D_0(1 + g_1)^5(1 + g_2)^2 \\ D_7 &= \$1.66(1 + .1654)^5(1 + .08)^2 \\ D_7 &= \$4.16\end{aligned}$$

27. a. We can find the price of the all the outstanding company stock by using the dividends the same way we would value an individual share. Since earnings are equal to dividends, and there is no growth, the value of the company's stock today is the present value of a perpetuity, so:

$$\begin{aligned}P &= D / R \\ P &= \$800,000 / .15 \\ P &= \$5,333,333.33\end{aligned}$$

The price-earnings ratio is the stock price divided by the current earnings, so the price-earnings ratio of each company with no growth is:

$$\begin{aligned} P/E &= \text{Price} / \text{Earnings} \\ P/E &= \$5,333,333.33 / \$800,000 \\ P/E &= 6.67 \text{ times} \end{aligned}$$

- b. Since the earnings have increased, the price of the stock will increase. The new price of the all the outstanding company stock is:

$$\begin{aligned} P &= D / R \\ P &= (\$800,000 + 100,000) / .15 \\ P &= \$6,000,000.00 \end{aligned}$$

The price-earnings ratio is the stock price divided by the current earnings, so the price-earnings with the increased earnings is:

$$\begin{aligned} P/E &= \text{Price} / \text{Earnings} \\ P/E &= \$6,000,000 / \$800,000 \\ P/E &= 7.50 \text{ times} \end{aligned}$$

- c. Since the earnings have increased, the price of the stock will increase. The new price of the all the outstanding company stock is:

$$\begin{aligned} P &= D / R \\ P &= (\$800,000 + 200,000) / .15 \\ P &= \$6,666,666.67 \end{aligned}$$

The price-earnings ratio is the stock price divided by the current earnings, so the price-earnings with the increased earnings is:

$$\begin{aligned} P/E &= \text{Price} / \text{Earnings} \\ P/E &= \$6,666,666.67 / \$800,000 \\ P/E &= 8.33 \text{ times} \end{aligned}$$

28. a. If the company does not make any new investments, the stock price will be the present value of the constant perpetual dividends. In this case, all earnings are paid dividends, so, applying the perpetuity equation, we get:

$$\begin{aligned} P &= \text{Dividend} / R \\ P &= \$7 / .12 \\ P &= \$58.33 \end{aligned}$$

- b. The investment is a one-time investment that creates an increase in EPS for two years. To calculate the new stock price, we need the cash cow price plus the NPVGO. In this case, the NPVGO is simply the present value of the investment plus the present value of the increases in EPS. SO, the NPVGO will be:

$$\begin{aligned} \text{NPVGO} &= C_1 / (1 + R) + C_2 / (1 + R)^2 + C_3 / (1 + R)^3 \\ \text{NPVGO} &= -\$1.75 / 1.12 + \$1.90 / 1.12^2 + \$2.10 / 1.12^3 \\ \text{NPVGO} &= \$1.45 \end{aligned}$$

B-112 SOLUTIONS

So, the price of the stock if the company undertakes the investment opportunity will be:

$$P = \$58.33 + 1.45$$

$$P = \$59.78$$

- c. After the project is over, and the earnings increase no longer exists, the price of the stock will revert back to \$58.33, the value of the company as a cash cow.

29. a. The price of the stock is the present value of the dividends. Since earnings are equal to dividends, we can find the present value of the earnings to calculate the stock price. Also, since we are excluding taxes, the earnings will be the revenues minus the costs. We simply need to find the present value of all future earnings to find the price of the stock. The present value of the revenues is:

$$PV_{\text{Revenue}} = C_1 / (R - g)$$

$$PV_{\text{Revenue}} = \$3,000,000(1 + .05) / (.15 - .05)$$

$$PV_{\text{Revenue}} = \$31,500,000$$

And the present value of the costs will be:

$$PV_{\text{Costs}} = C_1 / (R - g)$$

$$PV_{\text{Costs}} = \$1,500,000(1 + .05) / (.15 - .05)$$

$$PV_{\text{Costs}} = \$15,750,000$$

So, the present value of the company's earnings and dividends will be:

$$PV_{\text{Dividends}} = \$31,500,000 - 15,750,000$$

$$PV_{\text{Dividends}} = \$15,750,000$$

Note that since revenues and costs increase at the same rate, we could have found the present value of future dividends as the present value of current dividends. Doing so, we find:

$$D_0 = \text{Revenue}_0 - \text{Costs}_0$$

$$D_0 = \$3,000,000 - 1,500,000$$

$$D_0 = \$1,500,000$$

Now, applying the growing perpetuity equation, we find:

$$PV_{\text{Dividends}} = C_1 / (R - g)$$

$$PV_{\text{Dividends}} = \$1,500,000(1 + .05) / (.15 - .05)$$

$$PV_{\text{Dividends}} = \$15,750,000$$

This is the same answer we found previously. The price per share of stock is the total value of the company's stock divided by the shares outstanding, or:

$$P = \text{Value of all stock} / \text{Shares outstanding}$$

$$P = \$15,750,000 / 1,000,000$$

$$P = \$15.75$$

- b. The value of a share of stock in a company is the present value of its current operations, plus the present value of growth opportunities. To find the present value of the growth opportunities, we need to discount the cash outlay in Year 1 back to the present, and find the value today of the increase in earnings. The increase in earnings is a perpetuity, which we must discount back to today. So, the value of the growth opportunity is:

$$\begin{aligned} \text{NPVGO} &= C_0 + C_1 / (1 + R) + (C_2 / R) / (1 + R) \\ \text{NPVGO} &= -\$15,000,000 - \$5,000,000 / (1 + .15) + (\$6,000,000 / .15) / (1 + .15) \\ \text{NPVGO} &= \$15,434,782.61 \end{aligned}$$

To find the value of the growth opportunity on a per share basis, we must divide this amount by the number of shares outstanding, which gives us:

$$\begin{aligned} \text{NPVGO}_{\text{Per share}} &= \$15,434,782.61 / \$1,000,000 \\ \text{NPVGO}_{\text{Per share}} &= \$15.43 \end{aligned}$$

The stock price will increase by \$15.43 per share. The new stock price will be:

$$\begin{aligned} \text{New stock price} &= \$15.75 + 15.43 \\ \text{New stock price} &= \$31.18 \end{aligned}$$

30. a. If the company continues its current operations, it will not grow, so we can value the company as a cash cow. The total value of the company as a cash cow is the present value of the future earnings, which are a perpetuity, so:

$$\begin{aligned} \text{Cash cow value of company} &= C / R \\ \text{Cash cow value of company} &= \$110,000,000 / .15 \\ \text{Cash cow value of company} &= \$733,333,333.33 \end{aligned}$$

The value per share is the total value of the company divided by the shares outstanding, so:

$$\begin{aligned} \text{Share price} &= \$733,333,333.33 / 20,000,000 \\ \text{Share price} &= \$36.67 \end{aligned}$$

- b. To find the value of the investment, we need to find the NPV of the growth opportunities. The initial cash flow occurs today, so it does not need to be discounted. The earnings growth is a perpetuity. Using the present value of a perpetuity equation will give us the value of the earnings growth one period from today, so we need to discount this back to today. The NPVGO of the investment opportunity is:

$$\begin{aligned} \text{NPVGO} &= C_0 + C_1 + (C_2 / R) / (1 + R) \\ \text{NPVGO} &= -\$12,000,000 - 7,000,000 + (\$10,000,000 / .15) / (1 + .15) \\ \text{NPVGO} &= \$39,884,057.97 \end{aligned}$$

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- c. The price of a share of stock is the cash cow value plus the NPVGO. We have already calculated the NPVGO for the entire project, so we need to find the NPVGO on a per share basis. The NPVGO on a per share basis is the NPVGO of the project divided by the shares outstanding, which is:

$$\text{NPVGO per share} = \$39,884,057.97 / 20,000,000$$

$$\text{NPVGO per share} = \$1.99$$

This means the per share stock price if the company undertakes the project is:

$$\text{Share price} = \text{Cash cow price} + \text{NPVGO per share}$$

$$\text{Share price} = \$36.67 + 1.99$$

$$\text{Share price} = \$38.66$$

31. a. If the company does not make any new investments, the stock price will be the present value of the constant perpetual dividends. In this case, all earnings are paid as dividends, so, applying the perpetuity equation, we get:

$$P = \text{Dividend} / R$$

$$P = \$5 / .14$$

$$P = \$35.71$$

- b. The investment occurs every year in the growth opportunity, so the opportunity is a growing perpetuity. So, we first need to find the growth rate. The growth rate is:

$$g = \text{Retention Ratio} \times \text{Return on Retained Earnings}$$

$$g = 0.25 \times 0.40$$

$$g = 0.10 \text{ or } 10\%$$

Next, we need to calculate the NPV of the investment. During year 3, twenty-five percent of the earnings will be reinvested. Therefore, \$1.25 is invested ($\$5 \times .25$). One year later, the shareholders receive a 40 percent return on the investment, or \$0.50 ($\$1.25 \times .40$), in perpetuity. The perpetuity formula values that stream as of year 3. Since the investment opportunity will continue indefinitely and grows at 10 percent, apply the growing perpetuity formula to calculate the NPV of the investment as of year 2. Discount that value back two years to today.

$$\text{NPVGO} = [(\text{Investment} + \text{Return} / R) / (R - g)] / (1 + R)^2$$

$$\text{NPVGO} = [(-\$1.25 + \$0.50 / .14) / (0.14 - 0.1)] / (1.14)^2$$

$$\text{NPVGO} = \$44.66$$

The value of the stock is the PV of the firm without making the investment plus the NPV of the investment, or:

$$P = \text{PV}(\text{EPS}) + \text{NPVGO}$$

$$P = \$35.71 + \$44.66$$

$$P = \$80.37$$

Challenge

32. To find the capital gains yield and the current yield, we need to find the price of the bond. The current price of Bond P and the price of Bond P in one year is:

$$P: P_0 = \$100(\text{PVIFA}_{8\%,5}) + \$1,000(\text{PVIF}_{8\%,5}) = \$1,079.85$$

$$P_1 = \$100(\text{PVIFA}_{8\%,4}) + \$1,000(\text{PVIF}_{8\%,4}) = \$1,066.24$$

$$\text{Current yield} = \$100 / \$1,079.85 = 9.26\%$$

The capital gains yield is:

$$\text{Capital gains yield} = (\text{New price} - \text{Original price}) / \text{Original price}$$

$$\text{Capital gains yield} = (\$1,066.24 - 1,079.85) / \$1,079.85 = -1.26\%$$

The current price of Bond D and the price of Bond D in one year is:

$$D: P_0 = \$60(\text{PVIFA}_{8\%,5}) + \$1,000(\text{PVIF}_{8\%,5}) = \$920.15$$

$$P_1 = \$60(\text{PVIFA}_{8\%,4}) + \$1,000(\text{PVIF}_{8\%,4}) = \$933.76$$

$$\text{Current yield} = \$60 / \$920.15 = 6.52\%$$

$$\text{Capital gains yield} = (\$933.76 - 920.15) / \$920.15 = +1.48\%$$

All else held constant, premium bonds pay high current income while having price depreciation as maturity nears; discount bonds do not pay high current income but have price appreciation as maturity nears. For either bond, the total return is still 8%, but this return is distributed differently between current income and capital gains.

33. a. The rate of return you expect to earn if you purchase a bond and hold it until maturity is the YTM. The bond price equation for this bond is:

$$P_0 = \$1,150 = \$80(\text{PVIFA}_{R\%,10}) + \$1,000(\text{PVIF}_{R\%,10})$$

Using a spreadsheet, financial calculator, or trial and error we find:

$$R = \text{YTM} = 5.97\%$$

- b. To find our HPY, we need to find the price of the bond in two years. The price of the bond in two years, at the new interest rate, will be:

$$P_2 = \$80(\text{PVIFA}_{4.97\%,8}) + \$1,000(\text{PVIF}_{4.97\%,8}) = \$1,196.41$$

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To calculate the HPY, we need to find the interest rate that equates the price we paid for the bond with the cash flows we received. The cash flows we received were \$80 each year for two years, and the price of the bond when we sold it. The equation to find our HPY is:

$$P_0 = \$1,150 = \$80(PVIFA_{R\%,2}) + \$1,196.41(PVIF_{R\%,2})$$

Solving for R , we get:

$$R = \text{HPY} = 8.89\%$$

The realized HPY is greater than the expected YTM when the bond was bought because interest rates dropped by 1 percent; bond prices rise when yields fall.

- 34.** The price of any bond (or financial instrument) is the PV of the future cash flows. Even though Bond M makes different coupon payments, to find the price of the bond, we just find the PV of the cash flows. The PV of the cash flows for Bond M is:

$$\begin{aligned} P_M &= \$1,200(PVIFA_{5\%,16})(PVIF_{5\%,12}) + \$1,500(PVIFA_{5\%,12})(PVIF_{5\%,28}) + \$20,000(PVIF_{5\%,40}) \\ P_M &= \$13,474.20 \end{aligned}$$

Notice that for the coupon payments of \$1,500, we found the PVA for the coupon payments, and then discounted the lump sum back to today.

Bond N is a zero coupon bond with a \$20,000 par value; therefore, the price of the bond is the PV of the par, or:

$$P_N = \$20,000(PVIF_{5\%,40}) = \$2,840.91$$

- 35.** We are asked to find the dividend yield and capital gains yield for each of the stocks. All of the stocks have a 15 percent required return, which is the sum of the dividend yield and the capital gains yield. To find the components of the total return, we need to find the stock price for each stock. Using this stock price and the dividend, we can calculate the dividend yield. The capital gains yield for the stock will be the total return (required return) minus the dividend yield.

$$W: P_0 = D_0(1 + g) / (R - g) = \$4.50(1.10) / (.15 - .10) = \$99.00$$

$$\text{Dividend yield} = D_1/P_0 = 4.50(1.10)/99.00 = 5\%$$

$$\text{Capital gains yield} = .15 - .05 = 10\%$$

$$X: P_0 = D_0(1 + g) / (R - g) = \$4.50 / (.15 - 0) = \$30.00$$

$$\text{Dividend yield} = D_1/P_0 = 4.50/30.00 = 15\%$$

$$\text{Capital gains yield} = .15 - .15 = 0\%$$

$$Y: P_0 = D_0(1 + g) / (R - g) = \$4.50(1 - .05) / (.15 + .05) = \$21.38$$

$$\text{Dividend yield} = D_1/P_0 = 4.50(0.95)/21.38 = 20\%$$

$$\text{Capital gains yield} = .15 - .20 = -5\%$$

$$Z: P_2 = D_2(1 + g) / (R - g) = D_0(1 + g_1)^2(1 + g_2)/(R - g) = \$4.50(1.20)^2(1.12)/(.15 - .12) = \$241.92$$

$$P_0 = \$4.50(1.20) / (1.15) + \$4.50(1.20)^2 / (1.15)^2 + \$241.92 / (1.15)^2 = \$192.52$$

$$\text{Dividend yield} = D_1/P_0 = \$4.50(1.20)/\$192.52 = 2.8\%$$

$$\text{Capital gains yield} = .15 - .028 = 12.2\%$$

In all cases, the required return is 15%, but the return is distributed differently between current income and capital gains. High-growth stocks have an appreciable capital gains component but a relatively small current income yield; conversely, mature, negative-growth stocks provide a high current income but also price depreciation over time.

36. a. Using the constant growth model, the price of the stock paying annual dividends will be:

$$P_0 = D_0(1 + g) / (R - g) = \$3.00(1.06)/(.14 - .06) = \$39.75$$

- b. If the company pays quarterly dividends instead of annual dividends, the quarterly dividend will be one-fourth of annual dividend, or:

$$\text{Quarterly dividend: } \$3.00(1.06)/4 = \$0.795$$

To find the equivalent annual dividend, we must assume that the quarterly dividends are reinvested at the required return. We can then use this interest rate to find the equivalent annual dividend. In other words, when we receive the quarterly dividend, we reinvest it at the required return on the stock. So, the effective quarterly rate is:

$$\text{Effective quarterly rate: } 1.14^{.25} - 1 = .0333$$

The effective annual dividend will be the FVA of the quarterly dividend payments at the effective quarterly required return. In this case, the effective annual dividend will be:

$$\text{Effective } D_1 = \$0.795(\text{FVIFA}_{3.33\%,4}) = \$3.34$$

Now, we can use the constant growth model to find the current stock price as:

$$P_0 = \$3.34/ (.14 - .06) = \$41.78$$

Note that we can not simply find the quarterly effective required return and growth rate to find the value of the stock. This would assume the dividends increased each quarter, not each year.

37. a. If the company does not make any new investments, the stock price will be the present value of the constant perpetual dividends. In this case, all earnings are paid dividends, so, applying the perpetuity equation, we get:

$$P = \text{Dividend} / R$$

$$P = \$6 / .14$$

$$P = \$42.86$$

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- b. The investment occurs every year in the growth opportunity, so the opportunity is a growing perpetuity. So, we first need to find the growth rate. The growth rate is:

$$g = \text{Retention Ratio} \times \text{Return on Retained Earnings}$$

$$g = 0.30 \times 0.12$$

$$g = 0.036 \text{ or } 3.60\%$$

Next, we need to calculate the NPV of the investment. During year 3, 30 percent of the earnings will be reinvested. Therefore, \$1.80 is invested ($\$6 \times .30$). One year later, the shareholders receive a 12 percent return on the investment, or \$0.216 ($\$1.80 \times .12$), in perpetuity. The perpetuity formula values that stream as of year 3. Since the investment opportunity will continue indefinitely and grows at 3.6 percent, apply the growing perpetuity formula to calculate the NPV of the investment as of year 2. Discount that value back two years to today.

$$\text{NPVGO} = [(\text{Investment} + \text{Return} / R) / (R - g)] / (1 + R)^2$$

$$\text{NPVGO} = [(-\$1.80 + \$0.216 / .14) / (0.14 - 0.036)] / (1.14)^2$$

$$\text{NPVGO} = -\$1.90$$

The value of the stock is the PV of the firm without making the investment plus the NPV of the investment, or:

$$P = \text{PV}(\text{EPS}) + \text{NPVGO}$$

$$P = \$42.86 - 1.90$$

$$P = \$40.95$$

- c. Zero percent! There is no retention ratio which would make the project profitable for the company. If the company retains more earnings, the growth rate of the earnings on the investment will increase, but the project will still not be profitable. Since the return of the project is less than the required return on the company stock, the project is never worthwhile. In fact, the more the company retains and invests in the project, the less valuable the stock becomes.
38. Here we have a stock with supernormal growth but the dividend growth changes every year for the first four years. We can find the price of the stock in Year 3 since the dividend growth rate is constant after the third dividend. The price of the stock in Year 3 will be the dividend in Year 4, divided by the required return minus the constant dividend growth rate. So, the price in Year 3 will be:

$$P_3 = \$3.50(1.20)(1.15)(1.10)(1.05) / (.13 - .05) = \$69.73$$

The price of the stock today will be the PV of the first three dividends, plus the PV of the stock price in Year 3, so:

$$P_0 = \$3.50(1.20)/(1.13) + \$3.50(1.20)(1.15)/1.13^2 + \$3.50(1.20)(1.15)(1.10)/1.13^3 + \$69.73/1.13^3$$

$$P_0 = \$59.51$$

39. Here we want to find the required return that makes the PV of the dividends equal to the current stock price. The equation for the stock price is:

$$P = \$3.50(1.20)/(1 + R) + \$3.50(1.20)(1.15)/(1 + R)^2 + \$3.50(1.20)(1.15)(1.10)/(1 + R)^3 + [\$3.50(1.20)(1.15)(1.10)(1.05)/(R - .05)]/(1 + R)^3 = \$98.65$$

We need to find the roots of this equation. Using spreadsheet, trial and error, or a calculator with a root solving function, we find that:

$$R = 9.85\%$$

40. In this problem, growth is occurring from two different sources: The learning curve and the new project. We need to separately compute the value from the two difference sources. First, we will compute the value from the learning curve, which will increase at 5 percent. All earnings are paid out as dividends, so we find the earnings per share are:

$$\begin{aligned} \text{EPS} &= \text{Earnings}/\text{total number of outstanding shares} \\ \text{EPS} &= (\$10,000,000 \times 1.05) / 10,000,000 \\ \text{EPS} &= \$1.05 \end{aligned}$$

From the NPVGO mode:

$$\begin{aligned} P &= E/(k - g) + \text{NPVGO} \\ P &= \$1.05/(0.10 - 0.05) + \text{NPVGO} \\ P &= \$21 + \text{NPVGO} \end{aligned}$$

Now we can compute the NPVGO of the new project to be launched two years from now. The earnings per share two years from now will be:

$$\begin{aligned} \text{EPS}_2 &= \$1.00(1 + .05)^2 \\ \text{EPS}_2 &= \$1.1025 \end{aligned}$$

Therefore, the initial investment in the new project will be:

$$\begin{aligned} \text{Initial investment} &= .20(\$1.1025) \\ \text{Initial investment} &= \$0.22 \end{aligned}$$

The earnings per share of the new project is a perpetuity, with an annual cash flow of:

$$\begin{aligned} \text{Increased EPS from project} &= \$5,000,000 / 10,000,000 \text{ shares} \\ \text{Increased EPS from project} &= \$0.50 \end{aligned}$$

So, the value of all future earnings in year 2, one year before the company realizes the earnings, is:

$$\begin{aligned} \text{PV} &= \$0.50 / .10 \\ \text{PV} &= \$5.00 \end{aligned}$$

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Now, we can find the NPVGO per share of the investment opportunity in year 2, which will be:

$$\begin{aligned} \text{NPVGO}_2 &= -\$0.22 + 5.00 \\ \text{NPVGO}_2 &= \$4.78 \end{aligned}$$

The value of the NPVGO today will be:

$$\begin{aligned} \text{NPVGO} &= \$4.78 / (1 + .10)^2 \\ \text{NPVGO} &= \$3.95 \end{aligned}$$

Plugging in the NPVGO model we get;

$$\begin{aligned} P &= \$21 + 3.95 \\ P &= \$24.95 \end{aligned}$$

Note that you could also value the company and the project with the values given, and then divide the final answer by the shares outstanding. The final answer would be the same.

CHAPTER 5, APPENDIX

THE TERM STRUCTURE OF INTEREST RATES, SPOT RATES, AND YIELD TO MATURITY

Solutions to Questions and Problems

NOTE: All end-of-chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.

1. a. The present value of any coupon bond is the present value of its coupon payments and face value. Match each cash flow with the appropriate spot rate. For the cash flow that occurs at the end of the first year, use the one-year spot rate. For the cash flow that occurs at the end of the second year, use the two-year spot rate. Doing so, we find the price of the bond is:

$$\begin{aligned}P &= C_1 / (1 + r_1) + (C_2 + F) / (1 + r_2)^2 \\P &= \$60 / (1.08) + (\$60 + 1,000) / (1.10)^2 \\P &= \$931.59\end{aligned}$$

- b. The yield to the maturity is the discount rate, y , which sets the cash flows equal to the price of the bond. So, the YTM is:

$$\begin{aligned}P &= C_1 / (1 + y) + (C_2 + F) / (1 + y)^2 \\ \$931.59 &= \$60 / (1 + y) + (\$60 + 1,000) / (1 + y)^2 \\ y &= .0994 \text{ or } 9.94\%\end{aligned}$$

2. The present value of any coupon bond is the present value of its coupon payments and face value. Match each cash flow with the appropriate spot rate.

$$\begin{aligned}P &= C_1 / (1 + r_1) + (C_2 + F) / (1 + r_2)^2 \\P &= \$50 / (1.11) + (\$50 + 1,000) / (1.08)^2 \\P &= \$945.25\end{aligned}$$

3. Apply the forward rate formula to calculate the one-year rate over the second year.

$$\begin{aligned}(1 + r_1)(1 + f_2) &= (1 + r_2)^2 \\ (1.07)(1 + f_2) &= (1.085)^2 \\ f_2 &= .1002 \text{ or } 10.02\%\end{aligned}$$

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4. a. We apply the forward rate formula to calculate the one-year forward rate over the second year. Doing so, we find:

$$\begin{aligned}(1 + r_1)(1 + f_2) &= (1 + r_2)^2 \\ (1.04)(1 + f_2) &= (1.055)^2 \\ f_2 &= .0702 \text{ or } 7.02\%\end{aligned}$$

- b. We apply the forward rate formula to calculate the one-year forward rate over the third year. Doing so, we find:

$$\begin{aligned}(1 + r_2)^2(1 + f_3) &= (1 + r_3)^3 \\ (1.055)^2(1 + f_3) &= (1.065)^3 \\ f_3 &= .0853 \text{ or } 8.53\%\end{aligned}$$

5. The spot rate for year 1 is the same as forward rate for year 1, or 4.5 percent. To find the two year spot rate, we can use the forward rate equation:

$$\begin{aligned}(1 + r_1)(1 + f_2) &= (1 + r_2)^2 \\ r_2 &= [(1 + r_1)(1 + f_2)]^{1/2} - 1 \\ r_2 &= [(1.045)(1.06)]^{1/2} - 1 \\ r_2 &= .0525 \text{ or } 5.25\%\end{aligned}$$

6. Based upon the expectation hypotheses, strategy 1 and strategy 2 will be in equilibrium at:

$$(1 + f_1)(1 + f_2) = (1 + r_2)^2$$

That is, if the expected spot rate for 2 years is equal to the product of successive one year forward rates. If the spot rate in year 2 is higher than implied by f_2 then strategy 1 is best. If the spot rate in year 2 is lower than implied by f_2 , strategy 1 is best.