
CHAPTER 12

RISK, COST OF CAPITAL, AND CAPITAL BUDGETING

Answers to Concepts Review and Critical Thinking Questions

1. No. The cost of capital depends on the risk of the project, not the source of the money.
2. Interest expense is tax-deductible. There is no difference between pretax and aftertax equity costs.
3. You are assuming that the new project's risk is the same as the risk of the firm as a whole, and that the firm is financed entirely with equity.
4. Two primary advantages of the SML approach are that the model explicitly incorporates the relevant risk of the stock and the method is more widely applicable than is the DCF model, since the SML doesn't make any assumptions about the firm's dividends. The primary disadvantages of the SML method are (1) three parameters (the risk-free rate, the expected return on the market, and beta) must be estimated, and (2) the method essentially uses historical information to estimate these parameters. The risk-free rate is usually estimated to be the yield on very short maturity T-bills and is, hence, observable; the market risk premium is usually estimated from historical risk premiums and, hence, is not observable. The stock beta, which is unobservable, is usually estimated either by determining some average historical beta from the firm and the market's return data, or by using beta estimates provided by analysts and investment firms.
5. The appropriate aftertax cost of debt to the company is the interest rate it would have to pay if it were to issue new debt today. Hence, if the YTM on outstanding bonds of the company is observed, the company has an accurate estimate of its cost of debt. If the debt is privately-placed, the firm could still estimate its cost of debt by (1) looking at the cost of debt for similar firms in similar risk classes, (2) looking at the average debt cost for firms with the same credit rating (assuming the firm's private debt is rated), or (3) consulting analysts and investment bankers. Even if the debt is publicly traded, an additional complication arises when the firm has more than one issue outstanding; these issues rarely have the same yield because no two issues are ever completely homogeneous.
6.
 - a. This only considers the dividend yield component of the required return on equity.
 - b. This is the current yield only, not the promised yield to maturity. In addition, it is based on the book value of the liability, and it ignores taxes.
 - c. Equity is inherently riskier than debt (except, perhaps, in the unusual case where a firm's assets have a negative beta). For this reason, the cost of equity exceeds the cost of debt. If taxes are considered in this case, it can be seen that at reasonable tax rates, the cost of equity does exceed the cost of debt.
7. $R_{\text{Sup}} = .12 + .75(.08) = .1800$ or 18.00%
Both should proceed. The appropriate discount rate does not depend on which company is investing; it depends on the risk of the project. Since Superior is in the business, it is closer to a pure play.

Therefore, its cost of capital should be used. With an 18% cost of capital, the project has an NPV of \$1 million regardless of who takes it.

8. If the different operating divisions were in much different risk classes, then separate cost of capital figures should be used for the different divisions; the use of a single, overall cost of capital would be inappropriate. If the single hurdle rate were used, riskier divisions would tend to receive more funds for investment projects, since their return would exceed the hurdle rate despite the fact that they may actually plot below the SML and, hence, be unprofitable projects on a risk-adjusted basis. The typical problem encountered in estimating the cost of capital for a division is that it rarely has its own securities traded on the market, so it is difficult to observe the market's valuation of the risk of the division. Two typical ways around this are to use a pure play proxy for the division, or to use subjective adjustments of the overall firm hurdle rate based on the perceived risk of the division.
9. The discount rate for the projects should be lower than the rate implied by the security market line. The security market line is used to calculate the cost of equity. The appropriate discount rate for projects is the firm's weighted average cost of capital. Since the firm's cost of debt is generally less than the firm's cost of equity, the rate implied by the security market line will be too high.
10. Beta measures the responsiveness of a security's returns to movements in the market. Beta is determined by the cyclicity of a firm's revenues. This cyclicity is magnified by the firm's operating and financial leverage. The following three factors will impact the firm's beta. (1) Revenues. The cyclicity of a firm's sales is an important factor in determining beta. In general, stock prices will rise when the economy expands and will fall when the economy contracts. As we said above, beta measures the responsiveness of a security's returns to movements in the market. Therefore, firms whose revenues are more responsive to movements in the economy will generally have higher betas than firms with less-cyclical revenues. (2) Operating leverage. Operating leverage is the percentage change in earnings before interest and taxes (EBIT) for a percentage change in sales. A firm with high operating leverage will have greater fluctuations in EBIT for a change in sales than a firm with low operating leverage. In this way, operating leverage magnifies the cyclicity of a firm's revenues, leading to a higher beta. (3) Financial leverage. Financial leverage arises from the use of debt in the firm's capital structure. A levered firm must make fixed interest payments regardless of its revenues. The effect of financial leverage on beta is analogous to the effect of operating leverage on beta. Fixed interest payments cause the percentage change in net income to be greater than the percentage change in EBIT, magnifying the cyclicity of a firm's revenues. Thus, returns on highly-levered stocks should be more responsive to movements in the market than the returns on stocks with little or no debt in their capital structure.

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.

Basic

1. With the information given, we can find the cost of equity using the CAPM. The cost of equity is:

$$R_E = .045 + 1.30 (.12 - .045) = .1425 \text{ or } 14.25\%$$

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2. The pretax cost of debt is the YTM of the company's bonds, so:

$$P_0 = \$1,050 = \$40(\text{PVIFA}_{R\%,24}) + \$1,000(\text{PVIF}_{R\%,24})$$

$$R = 3.683\%$$

$$\text{YTM} = 2 \times 3.683\% = 7.37\%$$

And the aftertax cost of debt is:

$$R_D = .0737(1 - .35) = .0479 \text{ or } 4.79\%$$

3. a. The pretax cost of debt is the YTM of the company's bonds, so:

$$P_0 = \$1,080 = \$50(\text{PVIFA}_{R\%,46}) + \$1,000(\text{PVIF}_{R\%,46})$$

$$R = 4.58\%$$

$$\text{YTM} = 2 \times 4.58\% = 9.16\%$$

- b. The aftertax cost of debt is:

$$R_D = .0916(1 - .35) = .0595 \text{ or } 5.95\%$$

- c. The aftertax rate is more relevant because that is the actual cost to the company.

4. The book value of debt is the total par value of all outstanding debt, so:

$$BV_D = \$20M + 80M = \$100M$$

To find the market value of debt, we find the price of the bonds and multiply by the number of bonds. Alternatively, we can multiply the price quote of the bond times the par value of the bonds. Doing so, we find:

$$MV_D = 1.08(\$20M) + .58(\$80M) = \$68M$$

The YTM of the zero coupon bonds is:

$$P_Z = \$580 = \$1,000(\text{PVIF}_{R\%,7})$$

$$R = 8.09\%$$

So, the aftertax cost of the zero coupon bonds is:

$$R_Z = .0809(1 - .35) = .0526 \text{ or } 5.26\%$$

The aftertax cost of debt for the company is the weighted average of the aftertax cost of debt for all outstanding bond issues. We need to use the market value weights of the bonds. The total aftertax cost of debt for the company is:

$$R_D = .0595(\$21.6/\$68) + .0526(\$46.4/\$68) = .0548 \text{ or } 5.48\%$$

5. Using the equation to calculate the WACC, we find:

$$\text{WACC} = .55(.16) + .45(.09)(1 - .35) = .1143 \text{ or } 11.43\%$$

6. Here we need to use the debt-equity ratio to calculate the WACC. Doing so, we find:

$$\text{WACC} = .18(1/1.60) + .10(.60/1.60)(1 - .35) = .1369 \text{ or } 13.69\%$$

7. Here we have the WACC and need to find the debt-equity ratio of the company. Setting up the WACC equation, we find:

$$\text{WACC} = .1150 = .16(E/V) + .085(D/V)(1 - .35)$$

Rearranging the equation, we find:

$$.115(V/E) = .16 + .085(.65)(D/E)$$

Now we must realize that the V/E is just the equity multiplier, which is equal to:

$$V/E = 1 + D/E$$

$$.115(D/E + 1) = .16 + .05525(D/E)$$

Now we can solve for D/E as:

$$.05975(D/E) = .0450$$

$$D/E = .7531$$

8. a. The book value of equity is the book value per share times the number of shares, and the book value of debt is the face value of the company's debt, so:

$$BV_E = 9.5M(\$5) = \$47.5M$$

$$BV_D = \$75M + 60M = \$135M$$

So, the total value of the company is:

$$V = \$47.5M + 135M = \$182.5M$$

And the book value weights of equity and debt are:

$$E/V = \$47.5/\$182.5 = .2603$$

$$D/V = 1 - E/V = .7397$$

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b. The market value of equity is the share price times the number of shares, so:

$$MV_E = 9.5M(\$53) = \$503.5M$$

Using the relationship that the total market value of debt is the price quote times the par value of the bond, we find the market value of debt is:

$$MV_D = .93(\$75M) + .965(\$60M) = \$127.65M$$

This makes the total market value of the company:

$$V = \$503.5M + 127.65M = \$631.15M$$

And the market value weights of equity and debt are:

$$E/V = \$503.5/\$631.15 = .7978$$

$$D/V = 1 - E/V = .2022$$

c. The market value weights are more relevant.

9. First, we will find the cost of equity for the company. The information provided allows us to solve for the cost of equity using the CAPM, so:

$$R_E = .052 + 1.2(.09) = .1600 \text{ or } 16.00\%$$

Next, we need to find the YTM on both bond issues. Doing so, we find:

$$P_1 = \$930 = \$40(PVIFA_{R\%,20}) + \$1,000(PVIF_{R\%,20})$$

$$R = 4.54\%$$

$$YTM = 4.54\% \times 2 = 9.08\%$$

$$P_2 = \$965 = \$37.5(PVIFA_{R\%,12}) + \$1,000(PVIF_{R\%,12})$$

$$R = 4.13\%$$

$$YTM = 4.13\% \times 2 = 8.25\%$$

To find the weighted average aftertax cost of debt, we need the weight of each bond as a percentage of the total debt. We find:

$$w_{D1} = .93(\$75M)/\$127.65M = .546$$

$$w_{D2} = .965(\$60M)/\$127.65M = .454$$

Now we can multiply the weighted average cost of debt times one minus the tax rate to find the weighted average aftertax cost of debt. This gives us:

$$R_D = (1 - .35)[(.546)(.0908) + (.454)(.0825)] = .0566 \text{ or } 5.66\%$$

Using these costs and the weight of debt we calculated earlier, the WACC is:

$$WACC = .7978(.1600) + .2022(.0566) = .1391 \text{ or } 13.91\%$$

10. *a.* Using the equation to calculate WACC, we find:

$$\begin{aligned} \text{WACC} &= .105 = (1/1.8)(.15) + (.8/1.8)(1 - .35)R_D \\ R_D &= .0750 \text{ or } 7.50\% \end{aligned}$$

- b.* Using the equation to calculate WACC, we find:

$$\begin{aligned} \text{WACC} &= .105 = (1/1.8)R_E + (.8/1.8)(.064) \\ R_E &= .1378 \text{ or } 13.78\% \end{aligned}$$

11. We will begin by finding the market value of each type of financing. We find:

$$\begin{aligned} \text{MV}_D &= 4,000(\$1,000)(1.03) = \$4,120,000 \\ \text{MV}_E &= 90,000(\$57) = \$5,130,000 \end{aligned}$$

And the total market value of the firm is:

$$V = \$4,120,000 + 5,130,000 = \$9,250,000$$

Now, we can find the cost of equity using the CAPM. The cost of equity is:

$$R_E = .06 + 1.10(.08) = .1480 \text{ or } 14.80\%$$

The cost of debt is the YTM of the bonds, so:

$$\begin{aligned} P_0 &= \$1,030 = \$35(\text{PVIFA}_{R\%,40}) + \$1,000(\text{PVIF}_{R\%,40}) \\ R &= 3.36\% \\ \text{YTM} &= 3.36\% \times 2 = 6.72\% \end{aligned}$$

And the aftertax cost of debt is:

$$R_D = (1 - .35)(.0672) = .0437 \text{ or } 4.37\%$$

Now we have all of the components to calculate the WACC. The WACC is:

$$\text{WACC} = .0437(4.12/9.25) + .1480(5.13/9.25) = .1015 \text{ or } 10.15\%$$

Notice that we didn't include the $(1 - t_C)$ term in the WACC equation. We simply used the aftertax cost of debt in the equation, so the term is not needed here.

12. *a.* We will begin by finding the market value of each type of financing. We find:

$$\begin{aligned} \text{MV}_D &= 120,000(\$1,000)(0.93) = \$111,600,000 \\ \text{MV}_E &= 9,000,000(\$34) = \$306,000,000 \end{aligned}$$

And the total market value of the firm is:

$$V = \$111,600,000 + 306,000,000 = \$417,600,000$$

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So, the market value weights of the company's financing is:

$$D/V = \$111,600,000/\$417,600,000 = .2672$$

$$E/V = \$306,000,000/\$417,600,000 = .7328$$

- b. For projects equally as risky as the firm itself, the WACC should be used as the discount rate.

First we can find the cost of equity using the CAPM. The cost of equity is:

$$R_E = .05 + 1.20(.10) = .1700 \text{ or } 17.00\%$$

The cost of debt is the YTM of the bonds, so:

$$P_0 = \$930 = \$42.5(PVIFA_{R\%,30}) + \$1,000(PVIF_{R\%,30})$$

$$R = 4.69\%$$

$$YTM = 4.69\% \times 2 = 9.38\%$$

And the aftertax cost of debt is:

$$R_D = (1 - .35)(.0938) = .0610 \text{ or } 6.10\%$$

Now we can calculate the WACC as:

$$WACC = .1700(.7328) + .0610 (.2672) = .1409 \text{ or } 14.09\%$$

13. a. Projects X, Y and Z.

- b. Using the CAPM to consider the projects, we need to calculate the expected return of each project given its level of risk. This expected return should then be compared to the expected return of the project. If the return calculated using the CAPM is higher than the project expected return, we should accept the project; if not, we reject the project. After considering risk via the CAPM:

$$E[W] = .05 + .60(.12 - .05) = .0920 < .11, \text{ so accept W}$$

$$E[X] = .05 + .90(.12 - .05) = .1130 < .13, \text{ so accept X}$$

$$E[Y] = .05 + 1.20(.12 - .05) = .1340 < .14, \text{ so accept Y}$$

$$E[Z] = .05 + 1.70(.12 - .05) = .1690 > .16, \text{ so reject Z}$$

- c. Project W would be incorrectly rejected; Project Z would be incorrectly accepted.

Intermediate

14. Using the debt-equity ratio to calculate the WACC, we find:

$$\text{WACC} = (.65/1.65)(.055) + (1/1.65)(.15) = .1126 \text{ or } 11.26\%$$

Since the project is riskier than the company, we need to adjust the project discount rate for the additional risk. Using the subjective risk factor given, we find:

$$\text{Project discount rate} = 11.26\% + 2.00\% = 13.26\%$$

We would accept the project if the NPV is positive. The NPV is the PV of the cash outflows plus the PV of the cash inflows. Since we have the costs, we just need to find the PV of inflows. The cash inflows are a growing perpetuity. If you remember, the equation for the PV of a growing perpetuity is the same as the dividend growth equation, so:

$$\text{PV of future CF} = \$3,500,000 / (.1326 - .05) = \$42,385,321$$

The project should only be undertaken if its cost is less than \$42,385,321 since costs less than this amount will result in a positive NPV.

15. We will begin by finding the market value of each type of financing. We will use D1 to represent the coupon bond, and D2 to represent the zero coupon bond. So, the market value of the firm's financing is:

$$\text{MV}_{D1} = 50,000(\$1,000)(1.1980) = \$59,900,000$$

$$\text{MV}_{D2} = 150,000(\$1,000)(.1385) = \$20,775,000$$

$$\text{MV}_P = 120,000(\$112) = \$13,440,000$$

$$\text{MV}_E = 2,000,000(\$65) = \$130,000,000$$

And the total market value of the firm is:

$$V = \$59,900,000 + 20,775,000 + 13,440,000 + 130,000,000 = \$224,115,000$$

Now, we can find the cost of equity using the CAPM. The cost of equity is:

$$R_E = .04 + 1.10(.09) = .1390 \text{ or } 13.90\%$$

The cost of debt is the YTM of the bonds, so:

$$P_0 = \$1,198 = \$40(\text{PVIFA}_{R\%,50}) + \$1,000(\text{PVIF}_{R\%,50})$$

$$R = 3.20\%$$

$$\text{YTM} = 3.20\% \times 2 = 6.40\%$$

And the aftertax cost of debt is:

$$R_{D1} = (1 - .40)(.0640) = .0384 \text{ or } 3.84\%$$

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And the aftertax cost of the zero coupon bonds is:

$$P_0 = \$138.50 = \$1,000(\text{PVIF}_{R\%,60})$$

$$R = 3.35\%$$

$$\text{YTM} = 3.35\% \times 2 = 6.70\%$$

$$R_{D2} = (1 - .40)(.0670) = .0402 \text{ or } 4.02\%$$

Even though the zero coupon bonds make no payments, the calculation for the YTM (or price) still assumes semiannual compounding, consistent with a coupon bond. Also remember that, even though the company does not make interest payments, the accrued interest is still tax deductible for the company.

To find the required return on preferred stock, we can use the preferred stock pricing equation, which is the level perpetuity equation, so the required return on the company's preferred stock is:

$$R_p = D_1 / P_0$$

$$R_p = \$6.50 / \$112$$

$$R_p = .0580 \text{ or } 5.80\%$$

Notice that the required return in the preferred stock is lower than the required on the bonds. This result is not consistent with the risk levels of the two instruments, but is a common occurrence. There is a practical reason for this: Assume Company A owns stock in Company B. The tax code allows Company A to exclude at least 70 percent of the dividends received from Company B, meaning Company A does not pay taxes on this amount. In practice, much of the outstanding preferred stock is owned by other companies, who are willing to take the lower return since it is effectively tax exempt.

Now we have all of the components to calculate the WACC. The WACC is:

$$\text{WACC} = .0384(59.9/224.115) + .0402(20.775/224.115) + .1390(130/224.115)$$

$$+ .0580(13.44/224.115)$$

$$\text{WACC} = .0981 \text{ or } 9.81\%$$

Challenge

16. We can use the debt-equity ratio to calculate the weights of equity and debt. The debt of the company has a weight for long-term debt and a weight for accounts payable. We can use the weight given for accounts payable to calculate the weight of accounts payable and the weight of long-term debt. The weight of each will be:

$$\text{Accounts payable weight} = .20/1.20 = .17$$

$$\text{Long-term debt weight} = 1/1.20 = .83$$

Since the accounts payable has the same cost as the overall WACC, we can write the equation for the WACC as:

$$\text{WACC} = (1/2.3)(.17) + (1.3/2.3)[(.20/1.2)\text{WACC} + (1/1.2)(.09)(1 - .35)]$$

Solving for WACC, we find:

$$\begin{aligned} \text{WACC} &= .0739 + .5652[(.20/1.2)\text{WACC} + .0488] \\ \text{WACC} &= .0739 + (.0942)\text{WACC} + .0276 \\ (.9058)\text{WACC} &= .1015 \\ \text{WACC} &= .1132 \text{ or } 11.32\% \end{aligned}$$

Since the cash flows go to perpetuity, we can calculate the future cash inflows using the equation for the PV of a perpetuity. The NPV is:

$$\begin{aligned} \text{NPV} &= -\$45,000,000 + (\$5,700,000/.1132) \\ \text{NPV} &= -\$45,000,000 + 50,372,552 = \$5,372,552 \end{aligned}$$

17. The \$4 million cost of the land 3 years ago is a sunk cost and irrelevant; the \$6.5 million appraised value of the land is an opportunity cost and is relevant. The relevant market value capitalization weights are:

$$\begin{aligned} \text{MV}_D &= 15,000(\$1,000)(0.92) = \$13,800,000 \\ \text{MV}_E &= 300,000(\$75) = \$22,500,000 \\ \text{MV}_P &= 20,000(\$72) = \$1,440,000 \end{aligned}$$

The total market value of the company is:

$$V = \$13,800,000 + 22,500,000 + 1,440,000 = \$37,740,000$$

Next we need to find the cost of funds. We have the information available to calculate the cost of equity using the CAPM, so:

$$R_E = .05 + 1.3(.08) = .1540 \text{ or } 15.40\%$$

The cost of debt is the YTM of the company's outstanding bonds, so:

$$\begin{aligned} P_0 = \$920 &= \$35(\text{PVIFA}_{R\%,30}) + \$1,000(\text{PVIF}_{R\%,30}) \\ R &= 3.96\% \end{aligned}$$

$$\text{YTM} = 3.96\% \times 2 = 7.92\%$$

And the aftertax cost of debt is:

$$R_D = (1 - .35)(.0792) = .0515 \text{ or } 5.15\%$$

The cost of preferred stock is:

$$R_P = \$5/\$72 = .0694 \text{ or } 6.94\%$$

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- a. The initial cost to the company will be the opportunity cost of the land, the cost of the plant, and the net working capital cash flow, so:

$$CF_0 = -\$6,500,000 - 15,000,000 - 900,000 = -\$22,400,000$$

- b. To find the required return on this project, we first need to calculate the WACC for the company. The company's WACC is:

$$WACC = [(\$22.5/\$37.74)(.1540) + (\$1.44/\$37.74)(.0694) + (\$13.8/\$37.74)(.0515)] = .1133$$

The company wants to use the subjective approach to this project because it is located overseas. The adjustment factor is 2 percent, so the required return on this project is:

$$\text{Project required return} = .1133 + .02 = .1333$$

- c. The annual depreciation for the equipment will be:

$$\$15,000,000/8 = \$1,875,000$$

So, the book value of the equipment at the end of five years will be:

$$BV_5 = \$15,000,000 - 5(\$1,875,000) = \$5,625,000$$

So, the aftertax salvage value will be:

$$\text{Aftertax salvage value} = \$5,000,000 + .35(\$5,625,000 - 5,000,000) = \$5,218,750$$

- d. Using the tax shield approach, the OCF for this project is:

$$OCF = [(P - v)Q - FC](1 - t) + t_c D$$

$$OCF = [(\$10,000 - 9,000)(12,000) - 400,000](1 - .35) + .35(\$15M/8) = \$8,196,250$$

- e. The accounting breakeven sales figure for this project is:

$$Q_A = (FC + D)/(P - v) = (\$400,000 + 1,875,000)/(\$10,000 - 9,000) = 2,275 \text{ units}$$

- f. We have calculated all cash flows of the project. We just need to make sure that in Year 5 we add back the aftertax salvage value, the recovery of the initial NWC, and the aftertax value of the land. The cash flows for the project are:

<u>Year</u>	<u>Flow Cash</u>
0	-\$22,400,000
1	8,196,250
2	8,196,250
3	8,196,250
4	8,196,250
5	18,815,000

Using the required return of 13.33 percent, the NPV of the project is:

$$\begin{aligned} \text{NPV} &= -\$22,400,000 + \$8,196,250(\text{PVIFA}_{13.33\%,4}) + \$18,815,000/1.1333^5 \\ \text{NPV} &= \$11,878,610.78 \end{aligned}$$

And the IRR is:

$$\begin{aligned} \text{NPV} = 0 &= -\$22,400,000 + \$8,196,250(\text{PVIFA}_{\text{IRR}\%,4}) + \$18,815,000/(1 + \text{IRR})^5 \\ \text{IRR} &= 30.87\% \end{aligned}$$