# Chapter 11
## The Cost of Capital

### LEARNING OBJECTIVES (Slide 11-2)

1. Understand the different kinds of financing available to a company: debt financing, equity financing, and hybrid equity financing.

2. Understand the debt and equity components of the weighted average cost of capital (WACC) and explain the tax implications on debt financing and the adjustment to the WACC.

3. Calculate the weights of the components using book values or market values.

4. Explain how the capital budgeting models use WACC.

5. Determine a project's beta and its implications in capital budgeting problems.

6. Select optimal project combinations from a company’s portfolio of acceptable projects.

### IN A NUTSHELL...

This chapter clarifies the mystery of the hurdle rate or discount rate that was heretofore assumed as a given. Companies can finance their capital requirements by issuing different types of debt, preferred stock and common stock. After describing the salient features of each type of capital component, the author explains the methodology that can be used to determine a firm’s weighted average cost of capital (WACC). In particular, the tax implications, weighting procedures, and methods to calculate component costs are explained with examples. The use of the WACC as the hurdle rate when doing capital budgeting problems, and the process by which a firm can use the WACC to form optimal combinations of projects, are covered last.

### LECTURE OUTLINE

#### 11.1 The Cost of Capital: A Starting Point (Slides 11-3 to 11-6)

There are primarily 3 broad sources of financing that companies can avail of for raising capital: debt, common stock (equity), and preferred stock (hybrid equity).

Figure 11.1 (shown below) displays the three sources and their main suppliers.

<table>
<thead>
<tr>
<th>Debt financing, $R_d$</th>
<th>Equity financing, $R_e$</th>
<th>Hybrid equity financing, $R_{ps}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial banks</td>
<td>Common stockholders</td>
<td>Preferred stockholders</td>
</tr>
<tr>
<td>Nonbank lenders</td>
<td>Retained earnings</td>
<td></td>
</tr>
<tr>
<td>Suppliers</td>
<td>(internal funds of the firm)</td>
<td></td>
</tr>
<tr>
<td>Bond holders</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![FIGURE 11.1 Component sources of capital.](image)
Each capital component has its own risk and return profile and therefore its own rate of return required by investors to provide funds to the firm.

Firms estimate their weighted average cost of capital (WACC) by multiplying each component weight by the component cost and summing up the products.

The WACC is essentially the minimum acceptable rate of return that the firm should earn on its investments of average risk, in order to be profitable.

In other words, the WACC should be used as the discount rate when computing NPV, or as the criterion that must be exceeded when using IRR for making capital budgeting decisions.

Example 1: Measuring weighted average cost of a mortgage

Jim wants to refinance his home by taking out a single mortgage and paying off all the other sub-prime and prime mortgages that he took on while the going was good. Listed below are the balances and rates owed on each of his outstanding home-equity loans and mortgages:

<table>
<thead>
<tr>
<th>Lender</th>
<th>Balance</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Cut-Throat Bank</td>
<td>$150,000</td>
<td>7.5%</td>
</tr>
<tr>
<td>Second Considerate Bank</td>
<td>$35,000</td>
<td>8.5%</td>
</tr>
<tr>
<td>Third Pawn Mortgage Co.</td>
<td>$15,000</td>
<td>9.5%</td>
</tr>
</tbody>
</table>

Below what rate would it make sense for Jim to consolidate all these loans and refinance the whole amount?

Jim’s weighted average cost of borrowing = Proportion of each loan * Rate

\[
(150,000/200,000) \times 0.075 + (35,000/200,000) \times 0.085 + (15,000/200,000) \times 0.095
\]

\[
= (0.75 \times 0.075) + (0.175 \times 0.085) + (0.075 \times 0.095) = 0.07825 \text{ or } 7.825\%
\]

Jim’s average cost of financing his home is 7.825%. Any rate below 7.825% would be beneficial.

11.2 Components of the Weighted Average Cost of Capital

(Slides 11-7 to 11-22)

In order to determine a firm’s WACC we need to know how to calculate the relative weights and costs of the debt, preferred stock, and common stock of a firm.

11.2 (A) Debt Component: The cost of debt (\(R_d\)) is the rate that firms have to pay when they borrow money from banks, finance companies, and other lenders.

It is essentially measured by calculating the yield to maturity (\(YTM\)) on a firm’s outstanding bonds, as covered in Chapter 6.

Although best solved for by using a financial calculator or spreadsheet, the \(YTM\) can also be figured out as follows:
The YTM on outstanding bonds, based on the bonds’ current selling price, tells us what investors require for lending the firm their money in current market conditions.

However, if a firm were to go ahead and issue new debt, which is what typically happens when firms expand or grow, it would also have to pay some transactions costs to the investment bankers, and thereby receive lower net proceeds from each bond. The lower the amount the firm gets to keep from the sale, the higher its costs are going to be.

Accordingly, to correctly estimate the cost of debt for inclusion in the WACC calculation, we must adjust the market price by the amount of commissions that would have to be paid when issuing new debt, and then calculate the YTM.

Example 2: Calculating the cost of debt

Kellogg’s wants to raise an additional $3,000,000 of debt as part of the capital that would be needed to expand their operations into the Morning Foods sector. They were informed by their investment banking consultant that they would have to pay a commission of 3.5% of the selling price on new issues. Their CFO is in the process of estimating the corporation’s cost of debt for inclusion into the WACC equation. The company currently has an 8%, AA-rated, non-callable bond issue outstanding, which pays interest semi-annually, will mature in 17 years, has a $1000 face value, and is currently trading at $1075. Calculate the appropriate cost of debt for the firm.

First determine the net proceeds on each bond = Selling price –Commission

= $1075 – (.035*1075) = $1037.38

Using a financial calculator we enter:

<table>
<thead>
<tr>
<th>Key</th>
<th>N</th>
<th>I/Y</th>
<th>PV</th>
<th>PMT</th>
<th>FV</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>?</td>
<td>-1037.38</td>
<td>40</td>
<td>1000</td>
<td></td>
</tr>
</tbody>
</table>

Output

7.60%

The appropriate cost of debt for Kellogg’s is 7.6%.

Note: It is important to stress the point that it is the net proceeds and not the market price that determines the appropriate cost of new debt.

11.2 (B) Preferred Stock Component: Since preferred stock holders receive a constant dividend with no maturity point, its cost ($R_p$) can be estimated by dividing the annual dividend by the net proceeds (after floatation cost) per share of preferred stock

$$R_p = \frac{D_p}{\text{Net price}}$$
Example 3: Cost of Preferred Stock

Kellogg’s will also be issuing new preferred stock worth $1 million. They will pay a dividend of $4 per share which has a market price of $40. The floatation cost on preferred will amount to $2 per share. What is their cost of preferred stock?

Net price on preferred stock = $38; Dividend on preferred = $4
Cost of preferred = Rp = $4/$38 = 10.53%

11.2 (C) Equity Component: The cost of equity ($R_e$) is essentially the rate of return that investors are demanding or expecting to make on money invested in a company’s common stock.

The cost of equity can be estimated by using either the SML approach (covered in Chapter 8) or the Dividend Growth Model (covered in Chapter 7).

The Security Market Line Approach: calculates the cost of equity as a function of the risk-free rate ($r_f$) the market risk-premium [$E(r_m)-r_f$], and beta ($\beta_i$). That is,

$$R_e = r_f + [E(r_m) - r_f] \beta_i$$  \hspace{1cm} (11.5)

Example 4: Calculating Cost of Equity with the SML equation

Remember Kellogg’s from the earlier 2 examples? Well, to reach their desired capital structure their CEO has decided to utilize all of their expected retained earnings in the coming quarter. Kellogg’s beta is estimated at 0.65 by Value Line. The risk-free rate is currently 4%, and the expected return on the market is 15%. How much should the CEO put down as one estimate of the company’s cost of equity?

$$R_e = r_f + [E(r_m) - r_f] \beta_i$$

$$R_e = 4\% + [15\% - 4\%] 0.65$$

$$R_e = 4\% + 7.15\% = 11.15\%$$

The Dividend Growth Approach to $R_e$: The Gordon Model, introduced in Chapter 7, is used to calculate the price of a constant growth stock.

However, with some algebraic manipulation it can be transformed into Equation 11.6, which calculates the cost of equity, as shown below:

$$R_e = \frac{\text{Div}_0 (1 + g)}{P_0} + g$$  \hspace{1cm} (11.6)

where $\text{Div}_0$ = last paid dividend per share;
$P_0$ = Current market price per share; and
$g$ = constant growth rate of dividend.

For newly issued common stock, the price must be adjusted for floatation cost (commission paid to investment banker) as shown in Equation 11.7 below:

$$R_e = \frac{\text{Div}_0 (1 + g)}{P_0(1 - F)} + g$$  \hspace{1cm} (11.7)
Where \( F \) is the floatation cost in percent.

### Example 5: Applying the Dividend Growth Model to calculate \( R_e \)

Kellogg’s common stock is trading at $45.57 and its dividends are expected to grow at a constant rate of 6%. The company paid a dividend last year of $2.27. If the company issues stock they will have to pay a floatation cost per share equal to 5% of selling price. Calculate Kellogg’s cost of equity with and without floatation costs.

Cost of equity without floatation cost:

\[
R_e = \frac{\text{Div}_0 (1 + g)}{P_0} + g
\]

\[
R_e = \frac{\text{Div}_0 (1 + g)}{P_0} + g \Rightarrow (\frac{2.27*(1.06)}{45.57}) + .06 \Rightarrow 11.28% 
\]

Cost of equity with floatation cost:

\[
R_e = \frac{\text{Div}_0 (1 + g)}{P_0 (1 - F)} + g
\]

\[
R_e = \frac{\text{Div}_0 (1 + g)}{P_0 (1 - F)} + g \Rightarrow \frac{2.27*(1.06)}{(45.57*(0.95))} + .06 \Rightarrow 11.56% 
\]

Depending on the availability of data, either of the two models, or both, can be used to estimate \( R_e \).

With two values, the average can be used as the cost of equity. For example, in Kellogg’s case we have \((11.15% + 11.28%) / 2 \Rightarrow 11.22% \) (without floatation costs)

or \((11.15% + 11.56%) / 2 \Rightarrow 11.36% \)

#### 11.2 (D) Retained Earnings

Although, housed within a firm, does have a cost, i.e. the opportunity cost for the shareholders not being able to invest the money themselves.

The cost of retained earnings can be calculated by using either of the above two approaches, without including floatation cost.

#### 11.2 (E) The Debt Component and Taxes

Since interest expenses are tax deductible, the cost of debt, must be adjusted for taxes, as shown below, prior to including it in the WACC calculation:

\[
\text{After-tax cost of debt} = R_d * (1 - T_c)
\]

So if the YTM (with floatation cost) = 7.6%, and the company’s marginal tax rate is 30%, the after-tax cost of debt \( \Rightarrow 7.6% * (1 - 0.3) \Rightarrow 5.32% \);

#### 11.3 Weighting the Components:

**Book Value or Market Value?**

(Slides 11-23 to 11-29)

As explained earlier, in order to calculate the WACC of a firm, each component’s cost is multiplied by its proportion in the capital mix and then summed up.
There are two ways to determine the proportion or weights of each capital component, using book value, or using market values.

11.3 (A) Book Value: weights can be determined by taking the balance sheet values for debt, preferred stock, and common stock, adding them up, and dividing each by the total.

11.3 (B) Adjusted Weighted Average Cost of Capital: Equation 11.9 can be used to combine all the weights and component costs into a single average cost which can be used as the firm’s discount or hurdle rate:

$$WACC_{adj} = \frac{E}{V} \times R_e + \frac{PS}{V} \times R_p + \frac{D}{V} \times R_d \times (1-T_c)$$

11.3 (C) Market Value: weights are determined by taking the current market prices of the firm’s outstanding securities and multiplying them by the number outstanding, to get the total value; and then dividing each by the total market value to get the proportion or weight of each.

If possible, market value weights should be used since they are a better representation of a company’s current capital structure, which would be relevant for raising new capital.

Example 6: Calculating capital component weights

Kellogg’s CFO is in the process of determining the firm’s WACC and needs to figure out the weights of the various types of capital sources. Accordingly, he starts by collecting information from the balance sheet and the capital markets, and makes up the Table shown below:

<table>
<thead>
<tr>
<th>Component</th>
<th>Balance Sheet Value</th>
<th>Number outstanding</th>
<th>Current Market Price</th>
<th>Market Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt</td>
<td>$150,000,000</td>
<td>150,000</td>
<td>$1,075</td>
<td>$161,250,000</td>
</tr>
<tr>
<td>Preferred Stock</td>
<td>$45,000,000</td>
<td>1,500,000</td>
<td>$40</td>
<td>$60,000,000</td>
</tr>
<tr>
<td>Common Stock</td>
<td>$180,000,000</td>
<td>4,500,000</td>
<td>$45.57</td>
<td>$205,065,000</td>
</tr>
</tbody>
</table>

What should he do next?

1) Calculate the total book value and total market value of the capital

2) Divide each component’s book value and market value by their respective totals.

⇒ Total Book Value = $375,000,000; Total Market Value = $426,315,000

⇒ Book Value Weights:  Debt = 150m/375m=40%; P/S=$45m/$375m=12%; C/S = 180m/375m=48%;
⇒ Market Value Weights: Debt = 161.25m/426.32m=38%; P/S = 60m/426.32=14%; C/S = 205.07m/$426.32m=48%

(Rounded to nearest whole number)
He should use the market value weights as they represent a more current picture of the firm’s capital structure.

### Example 7: Calculating Adjusted WACC

Using the market value weights and the component costs determined earlier, calculate Kellogg’s adjusted WACC.

<table>
<thead>
<tr>
<th>Capital Component</th>
<th>Weight</th>
<th>After-tax Cost%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt</td>
<td>.38</td>
<td>7.6%*(1-0.3) = 5.32% ( R_d (1-T_c) )</td>
</tr>
<tr>
<td>Preferred Stock</td>
<td>.14</td>
<td>10.53% ( R_p )</td>
</tr>
<tr>
<td>Common Stock</td>
<td>.48</td>
<td>11.36%* ( R_e )</td>
</tr>
</tbody>
</table>

*using average of SML and DGM (with flotation cost)

\[
WACC = 0.38*5.32% + 0.14*10.53% + 0.48*11.36% \approx 8.94%
\]

### 11.4 Using the Weighted Average Cost of Capital in a Budgeting Decision (Slides 11-30 to 11-35)

Once a firm’s WACC has been determined, it can be used either as the discount rate to calculate the NPV of the project’s expected cash flow or as the hurdle rate which must be exceeded by the project’s IRR.

Table 11.1 presents the incremental cash flow of a $5 million project being considered by a firm whose WACC is 12%.

| TABLE 11.1 Incremental Cash Flow of a $5 Million Project |
|-------------|-----------|-----------|-----------|-----------|
| Category     | \( T_0 \) | \( T_1 \) | \( T_2 \) | \( T_3 \) |
| Investment   | $-4,400,000 | $2,000,000 | $2,000,000 | $2,640,000 |
| Net working capital | $-600,000 | $2,000,000 | $2,000,000 | $2,640,000 |
| Operating cash flow | $2,000,000 | $2,000,000 | $2,000,000 | $2,640,000 |
| Salvage      | $40,000  | $2,000,000 | $2,000,000 | $2,640,000 |
| Total incremental cash flow | $-5,000,000 | $2,000,000 | $2,000,000 | $2,640,000 |

Using a discount rate of 12%, the project’s NPV would be determined as follows:

\[
NPV = -CF_0 + \frac{CF_1}{(1 + WACC)^1} + \frac{CF_2}{(1 + WACC)^2} + \frac{CF_3}{(1 + WACC)^3}
\]

\[
= -$5,000,000 + \frac{$2,000,000}{(1 + 0.12)^1} + \frac{$2,000,000}{(1 + 0.12)^2} + \frac{$2,640,000}{(1 + 0.12)^3}
\]

\[
= -$5,000,000 + $1,785,714 + $1,594,388 + $1,879,100 = $259,202
\]

Since the NPV > 0 this would be an acceptable project.
Alternatively, the IRR could be determined using a financial calculator\(\Rightarrow 14.85\%\)
Again, since IRR\(>12\%\), this would be an acceptable project.

### 11.4 (A) Individual Weighted Average Cost of Capital for Individual Projects

Using the WACC for evaluating projects assumes that the project is of average risk. If projects have varying risk levels, using the same discount rate could lead to incorrect decisions.

Figure 11.3 illustrates such a situation with 4 projects, whose \(IRR\)s range from 8\% to 11\%, but the risk levels also go from low\(\Rightarrow\)moderate\(\Rightarrow\)high\(\Rightarrow\)very high.

With a WACC of 9.5\%, only Projects 3 and 4, with IRRs of 10\% and 11\% respectively would be accepted.

However, Projects 1 and 2 could have been profitable lower risk projects that are being rejected in favor of higher risk projects, merely because the risk levels have not been adequately adjusted for.

To adjust for risk, we would need to get individual project discount rates based on each project’s beta.

Using a risk-free rate of 3\%; a market risk premium of 9\%; a before-tax cost of 10\%, a tax rate of 30\%; equally-weighted debt and equity levels, and varying project betas we can compute each project’s hurdle rate as follows:

#### TABLE 11.2 Decision on Projects with and without Risk

<table>
<thead>
<tr>
<th>Project</th>
<th>IRR</th>
<th>Hurdle Rate without Risk</th>
<th>Decision with Risk</th>
<th>Hurdle Rate with Risk</th>
<th>Decision with Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8%</td>
<td>9.5%</td>
<td>Reject</td>
<td>7.7%</td>
<td>Accept</td>
</tr>
<tr>
<td>2</td>
<td>9%</td>
<td>9.5%</td>
<td>Reject</td>
<td>8.6%</td>
<td>Accept</td>
</tr>
<tr>
<td>3</td>
<td>10%</td>
<td>9.5%</td>
<td>Accept</td>
<td>10.4%</td>
<td>Reject</td>
</tr>
<tr>
<td>4</td>
<td>11%</td>
<td>9.5%</td>
<td>Accept</td>
<td>13.1%</td>
<td>Reject</td>
</tr>
</tbody>
</table>

Table 11.2 summarizes how the decisions made with and without adjusting for varying project risk could lead to incorrect decisions.
Note that under the risk-adjusted approach, Project 1 (IRR=8%>7.7%) and Project 2 (IRR=9%>8.6%) should be accepted, while Project 3 (IRR=10%<10.4%) and Project 4 (IRR=11%<13.1%) should be rejected as shown in Figure 11.4.

11.5 Selecting Appropriate Betas for Projects (Slide 11-36)

We have determined that it is important to adjust the discount rate used when evaluating projects of varying risk, based on their individual betas.

However, since project betas are not easily available, it is more of an art than a science.

There are two approaches generally used:

1. Pure play betas: i.e. matching the project with a company that has a similar single focus, and using that company’s beta.

2. Subjective modification of the company’s average beta: i.e. adjusting the beta up or down to reflect different levels of risk.

11.6 Constraints on Borrowing and Selecting Projects for the Portfolio (Slides 11-37 to 11-39)

Firms often have capital constraints that prevent them from funding all potentially profitable projects that come their way.

Capital rationing is a process whereby the managers can select projects based on their costs and expected profitability, while fulfilling capital constraints.

The process requires the rank ordering of projects based on either their NPV or IRRs along with their costs and then choosing the combination which has the highest combined return or NPV while using up as much of the limited capital budget.

Example 8: Selecting Projects with Capital Constraints

The XYZ Company’s managers are reviewing various projects that are being presented by unit managers for possible funding. They have an upper limit of $5,750,000 for this forthcoming year. The cost and NPV of each project has been estimated and is presented below. Which combination of projects would be best for them to invest in?

<table>
<thead>
<tr>
<th>Project</th>
<th>Cost</th>
<th>NPV</th>
</tr>
</thead>
</table>

### Questions

1. **From what sources can a company raise capital? Do these different sources of capital all charge the same rate? Why or why not?**

   A company can borrow from owners, preferred stockholders, banks, non-bank lenders, suppliers, and the company itself. They all have different lending rates. These lenders all charge different rates because they all have different risk exposures and different supply and demand schedules for their lending funds.

2. **Why is the yield to maturity on a bond the appropriate cost of debt financing?**

   The yield-to-maturity is the cost of the bond and implies the return the investor is demanding based on his or her willingness to buy the bond at the current price. It is also the price of the loan from the borrower’s perspective.

3. **What are the two different ways to estimate the cost of equity for a firm?**

   The two ways to estimate the cost of equity are the dividend model and the security market line. If you have sufficient information you can use the average of the two models or pick the one that seems most appropriate. Usually the most appropriate model is the security market line because it can handle the potential other investment opportunities of the lender. Lender’s pick across a wide variety of stocks and the security market line determines the appropriate rate for the level of risk of the investment.

4. **Should retained earnings reinvested in the company have a zero cost of capital because it generates the funds internally and the company does not need to pay itself for borrowing money? If not, why?**

   These funds should not have a zero cost. The funds have an opportunity cost (the shareholders could be paid this money via dividends instead of reinvesting in the
company). Therefore there is a cost associated with using these funds and thus a zero cost of capital is inappropriate.

5. **When calculating the cost of capital, why is it that the company only adjusts the cost of debt for taxes?**

Interest expense for debt loans is a deductible expense of the firm and is part of the income statement used for determining the taxable income of a company. Payment of dividends to owners is not a business expense but considered a return of permanent capital to investors. Thus it does not appear on the income statement. So only debt has a tax impact and thus only debt is adjusted for taxes in the cost of capital.

6. **What are the two ways to estimate the percentage (weights) of funds that a company has received from lenders and owners? Which is more appropriate?**

The two methods are book value and market value for estimating the components (weights) of the cost of capital. The preferred choice is market value.

7. **Why not use a single WACC for all company projects?**

If all projects are assigned the same discount rate we can make some poor decisions on which projects to accept and which to reject. We will tend to pick high risk projects and reject low risk projects.

8. **What are the types of errors a manager can make if he or she does not assign individual WACCs to each potential project?**

By assigning the same discount rate to every project, a manager will tend to reject low risk projects, despite their positive NPV if assigned the appropriate discount rate for the level of risk, and accept high risk projects despite their negative NPV if assigned the appropriate discount rate for the level of risk.

9. **Why is selecting a beta for a project more of an art than a science?**

It is more of an art than a science because we are trying to forecast future cash flow and its relative riskiness. The future is full of uncertainty and therefore it is more difficult of a model to accurately handle or forecast the uncertainty surrounding future events.

10. **If the capital budget is constrained by the amount of funds available for potential projects, what mistake might a manager make if he or she just lists the potential projects by highest to lowest NPV and picks the projects moving down the list until the funds are exhausted?**

By simply ranking projects by their NPVs and then going from top to bottom we are not guaranteed the highest total NPV with constrained funding. Top to bottom selecting may leave unused investment dollars that could be used by dropping a large cost NPV project for two smaller NPV projects that together have a larger NPV than the large cost project.

---

**Prepping for Exams**

1. d
2. a
3. d
4. c
5. c
6. c
7. d
8. c
9. d
10. d

**Problems**

1. **WACC.** Eric has another get-rich-quick idea but needs funding to support it. He chooses an all-debt funding scenario. Eric will borrow $2,000 from Wendy, who will charge Eric 6% on the loan. He will also borrow $1,500 from Bebe, who will charge 8% on the loan and $800 from Shelly, who will charge 14% on the loan. What is the weighted average cost of capital for Eric?

**ANSWER**

Total funds borrowed = $2,000 + $1,500 + $800 = $4,300
WACC = ($2,000 / $4,300) × 0.06 + ($1,500 / $4,300) × 0.08 + ($800 / $4,300) × 0.14
WACC = 0.4651 × 0.06 + 0.3488 × 0.08 + 0.1860 × 0.14
WACC = 0.0279 + 0.0279 + 0.0260 = 0.0819 or 8.19%

2. **WACC.** Grey’s Pharmaceuticals has a new project that will require funding of $4 million. The company has decided to pursue an all-debt scenario. Grey’s has made an agreement with four lenders for the needed financing. These lenders will advance the following amounts and interest rates:

<table>
<thead>
<tr>
<th>Lender</th>
<th>Amount</th>
<th>Interest Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stevens</td>
<td>$1,500,00</td>
<td>11%</td>
</tr>
<tr>
<td>Yang</td>
<td>$1,200,000</td>
<td>9%</td>
</tr>
<tr>
<td>Shepherd</td>
<td>$1,000,000</td>
<td>7%</td>
</tr>
<tr>
<td>Bailey</td>
<td>$300,000</td>
<td>8%</td>
</tr>
</tbody>
</table>

What is the weighted average cost of capital for the $4,000,000?

**ANSWER**

WACC = ($1.5 / $4) × 0.11 + ($1.2 / $4) × 0.09 + ($1 / $4) × 0.07 + ($0.3 / $4) × 0.08
WACC = 0.375 × 0.11 + 0.3 × 0.09 + 0.25 × 0.07 + 0.075 × 0.08
WACC = 0.04125 + 0.0270 + 0.0175 + 0.0060 = 0.09175 = 9.175%
3. **Cost of debt.** Kenny Enterprises has just issued a bond with a par value of $1000, twenty years to maturity, and an 8% coupon rate with semiannual payments. What is the cost of debt for Kenny Enterprises if the bond sells at the following prices? What do you notice about the price and the cost of debt?
   a. $920
   b. $1,000
   c. $1,080
   d. $1,173

**ANSWER**

a. If the bond sells for $920 we have:

\[
920 = \frac{1,000}{1 + (\text{YTM}/2)^{40}} + \frac{40}{1 - 1/(1 + (\text{YTM}/2))^{40}}/\text{YTM}/2
\]

And solving via a calculator we have: set P/Y = 2; C/Y = 2

<table>
<thead>
<tr>
<th>INPUTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
</tr>
<tr>
<td>?</td>
</tr>
<tr>
<td>-920</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>1000</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>I/Y</td>
</tr>
<tr>
<td>PV</td>
</tr>
<tr>
<td>PMT</td>
</tr>
<tr>
<td>FV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.86%</td>
</tr>
</tbody>
</table>

b. If the bond sells for $1000 we have:

\[
1000 = \frac{1,000}{1 + (\text{YTM}/2)^{40}} + \frac{40}{1 - 1/(1 + (\text{YTM}/2))^{40}}/\text{YTM}/2
\]

And solving via a calculator we have: set P/Y = 2; C/Y = 2

<table>
<thead>
<tr>
<th>INPUTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
</tr>
<tr>
<td>?</td>
</tr>
<tr>
<td>-1000</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>1000</td>
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</table>

<table>
<thead>
<tr>
<th>Variables</th>
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<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>I/Y</td>
</tr>
<tr>
<td>PV</td>
</tr>
<tr>
<td>PMT</td>
</tr>
<tr>
<td>FV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.00%</td>
</tr>
</tbody>
</table>

c. If the bond sells for $1080 we have:

\[
1080 = \frac{1,000}{1 + (\text{YTM}/2)^{40}} + \frac{40}{1 - 1/(1 + (\text{YTM}/2))^{40}}/\text{YTM}/2
\]

And solving via a calculator we have: set P/Y = 2; C/Y = 2

<table>
<thead>
<tr>
<th>INPUTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
</tr>
<tr>
<td>?</td>
</tr>
<tr>
<td>-1080</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>1000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>I/Y</td>
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<tr>
<td>PV</td>
</tr>
<tr>
<td>PMT</td>
</tr>
<tr>
<td>FV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.24%</td>
</tr>
</tbody>
</table>

d. If the bond sells for $1173 we have:

\[
1173 = \frac{1,000}{1 + (\text{YTM}/2)^{40}} + \frac{40}{1 - 1/(1 + (\text{YTM}/2))^{40}}/\text{YTM}/2
\]

And solving via a calculator we have: set P/Y = 2; C/Y = 2

<table>
<thead>
<tr>
<th>INPUTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
</tr>
<tr>
<td>?</td>
</tr>
<tr>
<td>-1173</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>1000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>I/Y</td>
</tr>
<tr>
<td>PV</td>
</tr>
<tr>
<td>PMT</td>
</tr>
<tr>
<td>FV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.45%</td>
</tr>
</tbody>
</table>

We note that as the price of the bond increases (proceeds from the sale) the lower is the cost of debt. This inverse relationship exists between price and the cost of debt since the future cash flows of the bond are fixed at issue; and thus buyers willing to pay more for the fixed stream of cash flows are lending money at a lower rate to the company.
4. **Cost of debt.** Dunder-Mifflin, Inc. (DMI) is selling 600,000 bonds to raise money for the publication of new magazines in the coming year. The bonds will pay a coupon rate of 12% on semiannual payments. The bond's par value is $100, and the bond will mature in thirty years. What is the cost of debt to DMI if the bonds raise

a. $45,000,000?
b. $54,000,000?
c. $66,000,000?
d. $75,000,000?

**ANSWER**

a. The price of a individual bond is $45,000,000 / 600,000 = $75 so,
\[
75 = \frac{100}{1 + (\text{YTM}/2)^{60}} + 6 \times \frac{1 - 1/(1 + (\text{YTM}/2)^{60})}{(\text{YTM}/2)}
\]
And solving via a calculator we have: set P/Y = 2; C/Y =2

<table>
<thead>
<tr>
<th>INPUTS</th>
<th>Variables</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 ?</td>
<td>N I/Y PV PMT FV</td>
<td>16.05%</td>
</tr>
</tbody>
</table>

b. The price of a individual bond is $54,000,000 / 600,000 = $90 so,
\[
90 = \frac{100}{1 + (\text{YTM}/2)^{60}} + 6 \times \frac{1 - 1/(1 + (\text{YTM}/2)^{60})}{(\text{YTM}/2)}
\]
And solving via a calculator we have: set P/Y = 2; C/Y =2

<table>
<thead>
<tr>
<th>INPUTS</th>
<th>Variables</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 ?</td>
<td>N I/Y PV PMT FV</td>
<td>13.36%</td>
</tr>
</tbody>
</table>

c. The price of a individual bond is $66,000,000 / 600,000 = $110 so,
\[
110 = \frac{100}{1 + (\text{YTM}/2)^{60}} + 6 \times \frac{1 - 1/(1 + (\text{YTM}/2)^{60})}{(\text{YTM}/2)}
\]
And solving via a calculator we have: set P/Y = 2; C/Y =2

<table>
<thead>
<tr>
<th>INPUTS</th>
<th>Variables</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 ?</td>
<td>N I/Y PV PMT FV</td>
<td>10.87%</td>
</tr>
</tbody>
</table>

d. The price of a individual bond is $75,000,000 / 600,000 = $125 so,
\[
125 = \frac{100}{1 + (\text{YTM}/2)^{60}} + 6 \times \frac{1 - 1/(1 + (\text{YTM}/2)^{60})}{(\text{YTM}/2)}
\]
And solving via a calculator we have: set P/Y = 2; C/Y =2

<table>
<thead>
<tr>
<th>INPUTS</th>
<th>Variables</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 ?</td>
<td>N I/Y PV PMT FV</td>
<td>9.47%</td>
</tr>
</tbody>
</table>

5. **Cost of debt with fees.** Kenny Enterprises will issue the same debt in Problem 3 but now will use an investment banker that charges $25 per bond for their services. What is the new cost of debt for Kenny Enterprises at a market price of

a. $920?
b. $1,000?
c. $1,080?
d. $1,173?

**ANSWER**

a. If the bond sells for $920 and Kenny pays $25 per bond the net proceeds are $895

\[ $895 = \frac{1,000}{1 + (\text{YTM}/2)^40} + 40 \times \left(1 - \frac{1}{1 + (\text{YTM}/2)^40}\right)/(\text{YTM}/2) \]

And solving via a calculator we have: set P/Y = 2; C/Y =2

<table>
<thead>
<tr>
<th>INPUTS</th>
<th>40</th>
<th>?</th>
<th>-895</th>
<th>40</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>N</td>
<td>I/Y</td>
<td>PV</td>
<td>PMT</td>
<td>FV</td>
</tr>
<tr>
<td>OUTPUT</td>
<td>9.15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. If the bond sells for $1000 and Kenny pays $25 per bond the net proceeds are $975

\[ $975 = \frac{1,000}{1 + (\text{YTM}/2)^40} + 40 \times \left(1 - \frac{1}{1 + (\text{YTM}/2)^40}\right)/(\text{YTM}/2) \]

And solving via a calculator we have: set P/Y = 2; C/Y =2

<table>
<thead>
<tr>
<th>INPUTS</th>
<th>40</th>
<th>?</th>
<th>-975</th>
<th>40</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>N</td>
<td>I/Y</td>
<td>PV</td>
<td>PMT</td>
<td>FV</td>
</tr>
<tr>
<td>OUTPUT</td>
<td>8.26%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

c. If the bond sells for $1080 and Kenny pays $25 per bond the net proceeds are $1055

\[ $1055 = \frac{1,000}{1 + (\text{YTM}/2)^40} + 40 \times \left(1 - \frac{1}{1 + (\text{YTM}/2)^40}\right)/(\text{YTM}/2) \]

And solving via a calculator we have: set P/Y = 2; C/Y =2

<table>
<thead>
<tr>
<th>INPUTS</th>
<th>40</th>
<th>?</th>
<th>-1055</th>
<th>40</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>N</td>
<td>I/Y</td>
<td>PV</td>
<td>PMT</td>
<td>FV</td>
</tr>
<tr>
<td>OUTPUT</td>
<td>7.47%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

d. If the bond sells for $1173 and Kenny pays $25 per bond the net proceeds are $1148

\[ $1148 = \frac{1,000}{1 + (\text{YTM}/2)^40} + 40 \times \left(1 - \frac{1}{1 + (\text{YTM}/2)^40}\right)/(\text{YTM}/2) \]

And solving via a calculator we have: set P/Y = 2; C/Y =2

<table>
<thead>
<tr>
<th>INPUTS</th>
<th>40</th>
<th>?</th>
<th>-1148</th>
<th>40</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>N</td>
<td>I/Y</td>
<td>PV</td>
<td>PMT</td>
<td>FV</td>
</tr>
<tr>
<td>OUTPUT</td>
<td>6.65%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. **Cost of debt with fees.** In Problem 4, Dunder-Mifflin, Inc. hires an investment banker for the sale of the 600,000 bonds. The investment banker charges a fee of 2% on each bond sold. What is the cost of debt to DMI if the proceeds below are before the banker's fees are deducted?

a. $45,000,000?

b. $54,000,000?

c. $66,000,000 ?

d. $75,000,000?

**ANSWER**

a. The price of an individual bond is $45,000,000 / 600,000 = $75 and the fee is 2% so the net proceeds are $75 × (1 - .02) = $73.50 and the cost of debt is

\[ $73.50 = \frac{100}{1 + (\text{YTM}/2)^{60}} + 6 \times (1 - 1/(1 + (\text{YTM}/2)^{60}))/(\text{YTM}/2) \]
And solving via a calculator we have: set \( P/Y = 2; \ C/Y = 2 \)

| INPUTS | 60 | ? | -73.50 | 6 | 100 |
| Variables | N | I/Y | PV | PMT | FV |
| OUTPUT | 16.38% |

b. The price of a individual bond is \( \$54,000,000 / 600,000 = \$90 \) and the fee is 2% so the net proceeds are \( \$90 \times (1 - 0.02) = \$88.20 \) and the cost of debt is

\[
\$88.20 = \frac{\$100}{(1 + (YTM/2))^{60}} + \frac{\$6 \times (1 - 1/(1 + (YTM/2))^{60})}{(YTM/2)}
\]

And solving via a calculator we have: set \( P/Y = 2; \ C/Y = 2 \)

| INPUTS | 60 | ? | -88.20 | 6 | 100 |
| Variables | N | I/Y | PV | PMT | FV |
| OUTPUT | 13.64% |

c. The price of a individual bond is \( \$66,000,000 / 600,000 = \$110 \) and the fee is 2% so the net proceeds are \( \$110 \times (1 - 0.02) = \$107.80 \) and the cost of debt is

\[
\$107.80 = \frac{\$100}{(1 + (YTM/2))^{60}} + \frac{\$6 \times (1 - 1/(1 + (YTM/2))^{60})}{(YTM/2)}
\]

And solving via a calculator we have: set \( P/Y = 2; \ C/Y = 2 \)

| INPUTS | 60 | ? | -107.80 | 6 | 100 |
| Variables | N | I/Y | PV | PMT | FV |
| OUTPUT | 11.10% |

d. The price of a individual bond is \( \$75,000,000 / 600,000 = \$125 \) and the fee is 2% so the net proceeds are \( \$125 \times (1 - 0.02) = \$122.50 \) and the cost of debt is

\[
\$122.50 = \frac{\$100}{(1 + (YTM/2))^{60}} + \frac{\$6 \times (1 - 1/(1 + (YTM/2))^{60})}{(YTM/2)}
\]

And solving via a calculator we have: set \( P/Y = 2; \ C/Y = 2 \)

| INPUTS | 60 | ? | -122.50 | 6 | 100 |
| Variables | N | I/Y | PV | PMT | FV |
| OUTPUT | 9.69% |

7. **Cost of preferred stock.** Kyle is raising funds for his company by selling preferred stock. The preferred stock has a par value of \( \$100 \) and a dividend rate of 6%. The stock is selling for \( \$80 \) in the market. What is the cost of preferred stock for Kyle?

**ANSWER**

The dividend is \( \$100 \times 0.06 = \$6.00 \)

And with a price of \( \$80 \) the cost of preferred stock is \( \$6 / \$80 = 0.075 \) or 7.5% 

8. **Cost of preferred stock.** Kyle hires Wilson Investment Bankers to sell the preferred stock from Problem 7. Wilson charges a fee of 3% on the sale of preferred stock. What is the cost of preferred stock for Kyle using the investment banker?
ANSWER

The dividend remains the same but the proceeds are \( \$80 \times (1 - 0.03) \) or \$77.60 so the cost of preferred stock is now, \( \frac{6}{77.60} = 0.0773 \) or 7.73%.

9. **Cost of equity: SML.** Stan is expanding his business and will sell common stock for the needed funds. If the current risk-free rate is 4% and the expected market return is 12%, what is the cost of equity for Stan if the beta of the stock is
   
   a. 0.75?
   
   b. 0.90?
   
   c. 1.05?
   
   d. 1.20?

ANSWER

a. Using the security market line we have,
   \[ E(r_i) = r_f + \beta_i (E(r_m) - r_f) \]
   Cost of Equity = \( E(r_i) = 0.04 + 0.75 (0.12 - 0.04) \)
   Cost of Equity = \( 0.04 + 0.75 (0.08) = 0.04 + 0.06 = 0.10 \) or 10%

b. Using the security market line we have,
   \[ E(r_i) = r_f + \beta_i (E(r_m) - r_f) \]
   Cost of Equity = \( E(r_i) = 0.04 + 0.90 (0.12 - 0.04) \)
   Cost of Equity = \( 0.04 + 0.90 (0.08) = 0.04 + 0.072 = 0.112 \) or 11.2%

c. Using the security market line we have,
   \[ E(r_i) = r_f + \beta_i (E(r_m) - r_f) \]
   Cost of Equity = \( E(r_i) = 0.04 + 1.05 (0.12 - 0.04) \)
   Cost of Equity = \( 0.04 + 1.05 (0.08) = 0.04 + 0.084 = 0.124 \) or 12.4%

d. Using the security market line we have,
   \[ E(r_i) = r_f + \beta_i (E(r_m) - r_f) \]
   Cost of Equity = \( E(r_i) = 0.04 + 1.20 (0.12 - 0.04) \)
   Cost of Equity = \( 0.04 + 1.20 (0.08) = 0.04 + 0.096 = 0.136 \) or 13.6%

10. **Cost of equity: SML.** Stan had to delay the sale of the common stock as outlined in Problem 9 for six months. When he finally did sell the stock, the risk-free rate had fallen to 3%, but the expected return on the market had risen to 13%. What was the effect on the cost of equity by waiting six months, using the four different betas from Problem 9? What do you notice about the increases in the cost of equity as beta increased?

ANSWER

a. The new rate is
   \[ E(r_i) = r_f + \beta_i (E(r_m) - r_f) \]
   Cost of Equity = \( E(r_i) = 0.03 + 0.75 (0.13 - 0.03) \)
   Cost of Equity = \( 0.03 + 0.75 (0.10) = 0.03 + 0.075 = 0.105 \) or 10.5%
And is an increase of 0.5% over the original cost of equity.

b. The new rate is

\[
\text{Cost of Equity } = E(r_e) = 0.03 + 0.90 (0.13 - 0.03)
\]
\[
\text{Cost of Equity } = 0.03 + 0.90 (0.10) = 0.03 + 0.09 = 0.12 \text{ or 12%}
\]

And is an increase of 0.8% over the original cost of equity.

c. The new rate is

\[
\text{Cost of Equity } = E(r_e) = 0.03 + 1.05 (0.13 - 0.03)
\]
\[
\text{Cost of Equity } = 0.03 + 1.05 (0.10) = 0.03 + 0.105 = 0.135 \text{ or 13.5%}
\]

And is an increase of 1.1% over the original cost of equity.

d. The new rate is

\[
\text{Cost of Equity } = E(r_e) = 0.03 + 1.20 (0.13 - 0.03)
\]
\[
\text{Cost of Equity } = 0.03 + 1.20 (0.10) = 0.03 + 0.12 = 0.15 \text{ or 15%}
\]

And is an increase of 1.4% over the original cost of equity.

The increases are growing but growing at a constant rate of 0.3% as you raise the beta by 0.15 units or a ratio of 2% over the change in the beta.

11. **Book value versus market value components.** Compare Trout Inc. with Salmon Enterprises using the balance sheet of Trout and the market data of Salmon for the weights in the weighted average cost of capital.

<table>
<thead>
<tr>
<th>Trout Inc.</th>
<th></th>
<th>Salmon Enterprises</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Assets:</td>
<td>$2,000,000</td>
<td>Bonds Outstanding 3,000 selling at $980</td>
</tr>
<tr>
<td>Long-term Assets:</td>
<td>$7,000,000</td>
<td>Common Stock Outstanding 260,000 selling at $23.40</td>
</tr>
<tr>
<td>Total Assets</td>
<td>$9,000,000</td>
<td>If the after-tax cost of debt is 8% for both companies and the cost of equity is 12% which company has the highest WACC?</td>
</tr>
<tr>
<td>Current Liabilities:</td>
<td>$1,000,000</td>
<td></td>
</tr>
<tr>
<td>Long-Term Liabilities:</td>
<td>$5,000,000</td>
<td></td>
</tr>
<tr>
<td>Owner’s Equity:</td>
<td>$3,000,000</td>
<td></td>
</tr>
</tbody>
</table>

**ANSWER**

Trout Inc. Component Weights,

\[
\text{Debt } = \frac{5,000,000}{8,000,000} = 0.625 \\
\text{Equity } = \frac{3,000,000}{8,000,000} = 0.375
\]

Salmon Enterprises Component Weights,

\[
\text{Market Value of Debt } = 980 \times 3,000 = 2,940,000 \\
\text{Market Value of Equity } = 23.40 \times 260,000 = 6,084,000 \\
\text{Debt Component } = \frac{2,940,000}{2,940,000 + 6,084,000} = 0.3258 \\
\text{Equity Component } = \frac{6,084,000}{2,940,000 + 6,084,000} = 0.6742
\]

WACC for Trout = 0.625 \times 8\% + 0.375 \times 12\% = 9.5\%

WACC for Salmont = 0.3258 \times 8\% + 0.6742 \times 12\% = 10.6968\%
12. **Book value versus market value components.** The CFO of DMI is trying to determine the company’s WACC. Brad, a promising MBA, says that the company should use book value to assign the components percentage for the WACC. Angela, a long-time employee and experienced financial analyst, says the company should use market value to assign the components. The after-tax cost of debt is at 7%, the cost of preferred stock is at 11%, and the cost of equity is at 14%. Calculate the WACC using both the book value and market value approaches with the following information. Which do you think is better? Why?

### DMI Company Balance Sheet (in thousands)

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount (in thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Assets:</strong></td>
<td>$32,000</td>
</tr>
<tr>
<td><strong>Long-Term Assets:</strong></td>
<td>$66,000</td>
</tr>
<tr>
<td><strong>Total Assets:</strong></td>
<td>$98,000</td>
</tr>
<tr>
<td><strong>Current Liabilities:</strong></td>
<td>$0</td>
</tr>
<tr>
<td><strong>Long-Term Liabilities:</strong></td>
<td>$54,000</td>
</tr>
<tr>
<td>Bonds Payable</td>
<td>$54,000</td>
</tr>
<tr>
<td>Owner’s Equity</td>
<td>$12,000</td>
</tr>
<tr>
<td>Preferred Stock</td>
<td>$32,000</td>
</tr>
<tr>
<td>Common Stock</td>
<td>$32,000</td>
</tr>
<tr>
<td><strong>Total L &amp; OE</strong></td>
<td>$98,000</td>
</tr>
</tbody>
</table>

### Market Information

<table>
<thead>
<tr>
<th>Component</th>
<th>Outstanding</th>
<th>Market Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt</td>
<td>54,000</td>
<td>$1085</td>
</tr>
<tr>
<td>Preferred Stock</td>
<td>120,000</td>
<td>$95.40</td>
</tr>
<tr>
<td>Common Stock</td>
<td>1,280,000</td>
<td>$32.16</td>
</tr>
</tbody>
</table>

### Answer

**Brad’s Book Value Component Weights**

- Debt Component = $54,000 / $98,000 = 0.5510
- Preferred Stock Component = $12,000 / $98,000 = 0.1224
- Common Stock Component = $32,000 / $98,000 = 0.3265

\[
WACC = 0.3265 \times 14\% + 0.1224 \times 11\% + 0.5510 \times 7\%
\]

\[
= 9.7755\%
\]

**Angela’s Market Values**

- Debt Market Value = 54,000 \times $1085 = $58,590,000
- Preferred Stock Market Value = 120,000 \times $95.40 = $11,448,000
- Common Stock Market Value = 1,280,000 \times $32.16 = $41,164,800
- Total Market Value = $58,590,000 + $11,448,000 + $41,164,800
- = $111,202,800

**Angela’s Market Value Component Weights**

- Debt Component = $58,590,000 / $111,202,800 = 0.5269
- Preferred Stock Component = $11,448,000 / $111,202,800 = 0.1029
- Common Stock Component = $41,164,800 / $111,202,800 = 0.3702

\[
WACC = 0.3702 \times 14\% + 0.1029 \times 11\% + 0.5269 \times 7\%
\]

\[
= 10.0030\%
\]
Using Angela’s approach is better because it reflects current market values of the debt, common stock, and preferred stock and thus is at the same point in time. The historical book values used by Brad are a collection of values over the history of the company and thus represent values at different points in time.

13. **Adjusted WACC.** Lewis runs an outdoor adventure company and wants to know what impact a tax change will have on his WACC. Currently Lewis has the following borrowing pattern:

- **Equity:** 35% and cost of 14%
- **Preferred Stock:** 15% and cost of 11%
- **Debt:** 50% and cost of 10% before taxes.

What is the adjusted WACC for Lewis if the tax rate is

a. 40%?

b. 30%?

c. 20%?

d. 10%?

e. 0%?

**ANSWER**

a. Adjusted WACC = \(0.35 \times 14% + 0.15 \times 11% + 0.50 \times 10% \times (1 - 0.40)\) = Adjusted WACC = 4.9% + 1.65% + 3.0% = 9.55%

b. Adjusted WACC = \(0.35 \times 14% + 0.15 \times 11% + 0.50 \times 10% \times (1 - 0.30)\) = Adjusted WACC = 4.9% + 1.65% + 3.5% = 10.05%

c. Adjusted WACC = \(0.35 \times 14% + 0.15 \times 11% + 0.50 \times 10% \times (1 - 0.20)\) = Adjusted WACC = 4.9% + 1.65% + 4.0% = 10.55%

d. Adjusted WACC = \(0.35 \times 14% + 0.15 \times 11% + 0.50 \times 10% \times (1 - 0.10)\) = Adjusted WACC = 4.9% + 1.65% + 4.5% = 11.05%

e. Adjusted WACC = \(0.35 \times 14% + 0.15 \times 11% + 0.50 \times 10% \times (1 - 0.00)\) = Adjusted WACC = 4.9% + 1.65% + 5.0% = 11.55%

14. **Adjusted WACC.** Clark Explorers Inc., an engineering firm has the following capital structure:

<table>
<thead>
<tr>
<th></th>
<th>Equity</th>
<th>Preferred Stock</th>
<th>Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market price</td>
<td>$30.00</td>
<td>$110.00</td>
<td>$955.00</td>
</tr>
<tr>
<td>Outstanding units</td>
<td>120,000</td>
<td>10,000</td>
<td>6,000</td>
</tr>
<tr>
<td>Book value</td>
<td>$3,000,000</td>
<td>$1,000,000</td>
<td>$6,000,000</td>
</tr>
<tr>
<td>Cost of capital</td>
<td>15%</td>
<td>12%</td>
<td>9%</td>
</tr>
</tbody>
</table>

Using market value and book value (separately, of course), find the adjusted WACC for Clark Explorers at the following tax rates:
Market Value Component weights are:

Equity Market Value = $30 \times 120,000 = $3,600,000

Preferred Stock Market Value = $110 \times 10,000 = $1,100,000

Debt Market Value = $955 \times 6,000 = $5,730,000

Total Market Value = $3,600,000 + $1,100,000 + $5,730,000 = $10,430,000

Equity Market Percent = $3,600,000 / $10,430,000 = 0.3452

Preferred Stock Market Percent = $1,100,000 / $10,430,000 = 0.1055

Debt Market Percent = $5,730,000 / $10,430,000 = 0.5494

Total Book Value = $3,000,000 + $1,000,000 + $6,000,000 = $10,000,000

Equity Book Percent = $3,000,000 / $10,000,000 = 0.30

Preferred Book Market Percent = $1,000,000 / $10,000,000 = 0.10

Debt Book Percent = $6,000,000 / $10,000,000 = 0.60

a. Adjusted WACC, market value
   = 0.3452 \times 15\% + 0.1055 \times 12\% + 0.5494 \times 9\% \times (1 - 0.35)
   = 5.1774\% + 1.2656\% + 3.2139\% = 9.6568\%

   Adjusted WACC, book value
   = 0.30 \times 15\% + 0.10 \times 12\% + 0.60 \times 9\% \times (1 - 0.35)
   = 4.5\% + 1.2\% + 3.51\% = 9.21\%

b. Adjusted WACC, market value
   = 0.3452 \times 15\% + 0.1055 \times 12\% + 0.5494 \times 9\% \times (1 - 0.25)
   = 5.1774\% + 1.2656\% + 3.7083\% = 10.1512\%

   Adjusted WACC, book value
   = 0.30 \times 15\% + 0.10 \times 12\% + 0.60 \times 9\% \times (1 - 0.25)
   = 4.5\% + 1.2\% + 4.05\% = 9.75\%

c. Adjusted WACC, market value
   = 0.3452 \times 15\% + 0.1055 \times 12\% + 0.5494 \times 9\% \times (1 - 0.15)
   = 5.1774\% + 1.2656\% + 4.2027\% = 10.6457\%

   Adjusted WACC, book value
   = 0.30 \times 15\% + 0.10 \times 12\% + 0.60 \times 9\% \times (1 - 0.15)
   = 4.5\% + 1.2\% + 4.59\% = 10.29\%

d. Adjusted WACC, market value
   = 0.3452 \times 15\% + 0.1055 \times 12\% + 0.5494 \times 9\% \times (1 - 0.05)
   = 5.1774\% + 1.2656\% + 4.6972\% = 11.1401\%

   Adjusted WACC, book value
   = 0.30 \times 15\% + 0.10 \times 12\% + 0.60 \times 9\% \times (1 - 0.05)
   = 4.5\% + 1.2\% + 5.13\% = 10.83\%
15. **Apply WACC in NPV.** Brawn Blenders has the following incremental cash flows for its new project:

<table>
<thead>
<tr>
<th>Category</th>
<th>Year 0</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>(-)</td>
<td>(-)</td>
<td>(-)</td>
<td>(-)</td>
</tr>
<tr>
<td>NWC Change</td>
<td>(-300,000)</td>
<td>(300,000)</td>
<td>(300,000)</td>
<td>(300,000)</td>
</tr>
<tr>
<td>OCFs</td>
<td>(1,500,000)</td>
<td>(1,500,000)</td>
<td>(1,500,000)</td>
<td>(1,500,000)</td>
</tr>
<tr>
<td>Salvage</td>
<td>(250,000)</td>
<td>(250,000)</td>
<td>(250,000)</td>
<td>(250,000)</td>
</tr>
</tbody>
</table>

Should Brawn Blenders accept or reject this project at an adjusted WACC of 6%, 8%, or 10%?

**ANSWER**

At 6% WACC we have,

\[ NPV = -4,300,000 + \frac{1,500,000}{1.06} + \frac{1,500,000}{1.06^2} + \frac{2,050,000}{1.06^3} \]

\[ NPV = -4,300,000 + 1,415,094 + 1,334,995 + 1,721,220 = 171,309 \]

Accept project if WACC is 6% or lower.

At 8% WACC we have,

\[ NPV = -4,300,000 + \frac{1,500,000}{1.08} + \frac{1,500,000}{1.08^2} + \frac{2,050,000}{1.08^3} \]

\[ NPV = -4,300,000 + 1,388,889 + 1,286,008 + 1,627,356 = 2,253 \]

Accept project if WACC is 8%.

At 10% WACC we have,

\[ NPV = -4,300,000 + \frac{1,500,000}{1.10} + \frac{1,500,000}{1.10^2} + \frac{2,050,000}{1.10^3} \]

\[ NPV = -4,300,000 + 1,363,636 + 1,239,669 + 1,540,195 = -156,499 \]

Reject project if WACC is 10% or higher.

16. **Apply WACC in IRR.** Leeward Sailboats is reviewing the following new boat line:

<table>
<thead>
<tr>
<th>Category</th>
<th>Year 0</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>(-9,000,000)</td>
<td>(-600,000)</td>
<td>(600,000)</td>
<td>(-600,000)</td>
</tr>
<tr>
<td>NWC Change</td>
<td>(-600,000)</td>
<td>(600,000)</td>
<td>(600,000)</td>
<td>(600,000)</td>
</tr>
<tr>
<td>OCFs</td>
<td>(3,200,000)</td>
<td>(3,800,000)</td>
<td>(4,500,000)</td>
<td>(4,500,000)</td>
</tr>
<tr>
<td>Salvage</td>
<td>(400,000)</td>
<td>(400,000)</td>
<td>(400,000)</td>
<td>(400,000)</td>
</tr>
</tbody>
</table>

At what adjusted WACCs will the company accept this project? *Hint: Find the IRR of the project and use it as the maximum adjusted WACC for accepting the project.*
ANSWER

Find the IRR.

Solve the following equation:

\[ 0 = -9,600,000 + \frac{3,200,000}{(1+IRR)} + \frac{3,800,000}{(1+IRR)^2} + \frac{5,500,000}{(1+IRR)^3} \]

You can iterate until you find IRR or use a spreadsheet or financial calculator. With a financial calculator

INPUTS

<table>
<thead>
<tr>
<th>CF0</th>
<th>C01</th>
<th>F01</th>
<th>C02</th>
<th>F02</th>
<th>C03</th>
<th>F03</th>
</tr>
</thead>
<tbody>
<tr>
<td>-9,600,000</td>
<td>3,200,000</td>
<td>1</td>
<td>3,800,000</td>
<td>1</td>
<td>5,500,000</td>
<td>1</td>
</tr>
</tbody>
</table>

COMPUTE IRR = 13.1097%

The company will accept this project if the adjusted WACC is below 13.11%.

17. Adjusted WACC. Ashman Motors is currently an all-equity firm. It has two million shares outstanding, selling for $43 per share. The company has a beta of 1.1, with the current risk-free rate at 3% and the market premium at 8%. The tax rate is 35% for the company. Ashman has decided to sell $43 million of bonds and retire half its stock. The bonds will have a yield to maturity of 9%. The beta of the company will rise to 1.3 with the new debt. What was the adjusted WACC of Ashman Motors before selling bonds? What is the new WACC of Ashman Motors after selling the bonds and retiring the stock with the proceeds from the sale of the bonds? Hint: The weight of equity before selling the bond is 100%.

ANSWER

Before the sale of bonds the weighted average cost of capital is the cost of equity.

\[ R_e = 3\% + 1.1 \times (8\%) = 11.8\% \] and this is the adjusted WACC.

After the sale of bonds the new cost of equity is:

\[ R_e = 3\% + 1.3 \times (8\%) = 13.4\% \]

If Bonds sell for $43 million can retire 1 million shares, $43,000,000 / $43 = 1,000,000

The market value of equity is now $43 \times 1,000,000 = $43,000,000

The market value of debt is $43,000,000

\[ E/V = \frac{43,000,000}{43,000,000 + 43,000,000} = 0.5 \]

\[ D/V = \frac{43,000,000}{43,000,000 + 43,000,000} = 0.5 \]

Adjusted WACC = 0.5 \times 13.4\% + 0.5 \times 9\% \times (1 – 0.35) = 6.7\% + 2.925\% = 9.625\%
18. **Adjusted WACC.** Thorpe and Company is currently an all equity firm. It has 3 million shares selling for $28 per share. Its beta is 0.85 and the current risk-free rate is 2.5%. The expected return on the market for the coming year is 13%. Thorpe will sell corporate bonds for $28,000,000 and retire common stock with the proceeds. The bonds are twenty-year semiannual bonds with a 10% coupon rate and $1,000 par value. The bonds are currently selling for $1,143.08 per bond. When the bonds are sold, the beta of the company will increase to 0.95. What was WACC of Thorpe and Company before the bond sale? What is the adjusted WACC of Thorpe and Company after the bond sale if the corporate tax rate is 40%? **Hint:** The weight of equity before selling the bond is 100%.

**ANSWER**

Before the sale of bonds the weighted average cost of capital is the cost of equity.  
\[ R_e = 2.5\% + 0.85 (13.0\% - 2.5\%) = 11.425\% \] and this is the adjusted WACC.

After the sale of bonds the new cost of equity is:

\[ R_e = 2.5\% + 0.95 (13.0\% - 2.5\%) = 12.475\% \]

Cost of debt is from the yield-to-maturity of the bond

- **Coupon** = 0.10 × $1,000 / 2 = $50 (every six months)
- **Price** = $1,143.08
- **Par Value** = $1,000
- **N** = 20 × 2 = 40
- **P/Y** = 2

\[
\begin{array}{cccc}
\text{Inputs} & 40 & ? & -1,143.08 & 50 & 1,000 \\
\text{Variables} & N & I/Y & PV & PMT & FV \\
\text{Compute} & & & 8.5\% \\
\end{array}
\]

If Bonds sell for $28 million can retire 1 million shares, $28,000,000 / $28 = 1,000,000

The market value of equity is now $28 × 2,000,000 = $56,000,000

The market value of debt is $28,000,000

\[
\begin{align*}
\text{E/V} &= \frac{56,000,000}{(56,000,000 + 28,000,000)} = 0.6667 \\
\text{D/V} &= \frac{28,000,000}{(56,000,000 + 28,000,000)} = 0.3333
\end{align*}
\]

Adjusted WACC = 0.667 × 12.475% + 0.3333 × 8.5% × (1 – 0.40) = 8.3167% + 1.7% = 10.0167%

19. **Adjusted WACC.** Hollydale’s is a clothing store in East Park. It paid an annual dividend of $2.50 last year to its shareholders and plans to increase the dividend annually at 2%. It has 500,000 shares outstanding. The shares currently sell for $21.25 per share. Hollydale’s has 10,000 semiannual bonds outstanding with a coupon rate of 7.5%, a maturity of 16 years, and a par value of $1,000. The bonds are currently selling for $874.08 per bond. What is the adjusted WACC for Hollydale’s if the corporate tax rate is 35%?
ANSWER

Find the cost of equity via the dividend growth model.

\[ R_e = \frac{\text{Dividend} \times (1 + \text{Growth rate})}{\text{Current stock price}} + \text{Growth rate} \]

\[ R_e = \frac{2.50 \times 1.02}{21.25} + 0.02 = 0.14 \text{ or } 14\% \]

Find the cost of the debt.

\[ \text{Coupon} = 0.075 \times \frac{1,000}{2} = 37.50 \text{ (every six months)} \]

\[ \text{Price} = 874.08 \]

\[ \text{Par Value} = 1,000 \]

\[ N = 16 \times 2 = 32 \]

\[ P/Y = 2 \]

\[
\begin{array}{cccccc}
\text{Inputs} & 32 & ? & -874.08 & 37.50 & 1,000 \\
\text{Variables} & N & I/Y & PV & PMT & FV \\
\text{Compute} & & & & & 9.0\% \\
\end{array}
\]

Find the weights of the two components:

\[ E = 500,000 \times 21.25 = 10,625,000 \]

\[ D = 10,000 \times 874.08 = 8,740,800 \]

\[ E/V = \frac{10,625,000}{10,625,000 + 8,740,800} = 0.5487 \]

\[ D/V = \frac{8,740,800}{10,625,000 + 8,740,800} = 0.4513 \]

\[ \text{Adjusted WACC} = 0.5487 \times 14\% + 0.4513 \times 9\% \times (1 - 0.35) = 7.6812\% + 2.6404\% = 10.3216\% \]

20. **Adjusted WACC**. Hollydale’s will issue an additional 5,000 bonds with the help of an investment banker. The bonds will be semiannual bonds with thirty years to maturity. The coupon rate will be 8% and the par value $1,000. These bonds will be sold at $851.86 in the market, but the investment banker will receive a 4% commission on the sold bonds. The original bonds have 16 years to maturity and are semiannual, with a coupon rate of 7.5% and a price of $874.08. There are 10,000 bonds outstanding with this senior issue. What is the new cost of capital for Hollydale’s if the company still has 500,000 shares outstanding selling at $21.25 with an annual dividend growth rate of 2% and the last annual dividend of $2.50? The tax rate remains at 35%.

ANSWER

Find the cost of equity via the dividend growth model.

\[ R_e = \frac{2.50 \times 1.02}{21.25} + 0.02 = 0.14 \text{ or } 14\% \]

Find the cost of the original debt.

\[ \text{Coupon} = 0.075 \times \frac{1,000}{2} = 37.50 \text{ (every six months)} \]

\[ \text{Price} = 874.08 \]

\[ \text{Par Value} = 1,000 \]

\[ N = 16 \times 2 = 32 \]

\[ P/Y = 2 \]

\[
\begin{array}{cccccc}
\text{Inputs} & 32 & ? & -874.08 & 37.50 & 1,000 \\
\text{Variables} & N & I/Y & PV & PMT & FV \\
\text{Compute} & & & & & 9.0\% \\
\end{array}
\]
Find the cost of the new debt:
Coupon = 0.08 × $1,000 / 2 = $40 (every six months)
Price = $851.86
Net Proceeds = $851.86 × (1 - 0.04) = $817.7856
Par Value = $1,000
N = 30 × 2 = 60
P/Y =2

Inputs

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>I/Y</th>
<th>PV</th>
<th>PMT</th>
<th>FV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compute</td>
<td>60</td>
<td>?</td>
<td>-817.7856</td>
<td>40.00</td>
<td>1,000</td>
</tr>
<tr>
<td>Compute</td>
<td>9.91%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Find the weights of the three components:
E = 500,000 × $21.25 = $10,625,000
D1 = 10,000 × $874.04 = $8,740,800
D2 = 5,000 × $817.7856 = $4,088,928

E/V = $10,625,000 / ($10,625,000 + $8,740,800 + $4,088,928) = 0.453
D1/V = $8,740,800 / ($10,625,000 + $8,740,800 + $4,088,928) = 0.373
D2/V = $4,088,928 / ($10,625,000 + $8,740,800 + $4,088,928) = 0.174

Adjusted WACC = 0.453 × 14% + 0.3713 × 9% × (0.65) + 0.1754 × 9.91% × (0.65) = 6.34% + 2.18% + 1.12 = 9.64%

21. **Beta of a project.** Magellan is adding a project to the company portfolio and has the following information: the expected market return is 14%, the risk-free rate is 3%, and the expected return on the new project is 18%. What is the project’s beta?

**ANSWER**

\[ E(r_{\text{project}}) = 18\% = 3\% + \beta_{\text{project}} \times (14\% - 3\%) \]
\[ \beta_{\text{project}} = \frac{(18\% - 3\%)}{(14\% - 3\%)} = \frac{15\%}{11\%} = 1.3636 \]

22. **Beta of a project.** Vespucci is adding a project to the company portfolio and has the following information, the expected market return is 12%, the risk-free rate is 5%, and the expected return on the new project is 10%. What is the beta of the project?

**ANSWER**

\[ E(r_{\text{project}}) = 10\% = 5\% + \beta_{\text{project}} \times (12\% - 5\%) \]
\[ \beta_{\text{project}} = \frac{(10\% - 5\%)}{(12\% - 5\%)} = \frac{5\%}{7\%} = 0.7143 \]

23. **Constraints on borrowing.** Country Farmlands, Incorporated is considering the following potential projects for this coming year, but has only $200,000 for these projects:

- **Project A:** Cost $60,000, NPV $4,000, and IRR 11%
- **Project B:** Cost $78,000, NPV $6,000, and IRR 12%
Project C: Cost $38,000, NPV $3,000, and IRR 10%
Project D: Cost $41,000, NPV $4,000, and IRR 9%
Project E: Cost $56,000, NPV $6,000, and IRR 13%
Project F: Cost $29,000, NPV $2,000, and IRR 7%

What projects should Farmlands pick?

**ANSWER**

Compare the total NPV of all projects that do not violate the spending constraint of $200,000

<table>
<thead>
<tr>
<th>Projects</th>
<th>Total Cost</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B, C</td>
<td>$176,000</td>
<td>$13,000</td>
</tr>
<tr>
<td>A, B, D</td>
<td>$179,000</td>
<td>$14,000</td>
</tr>
<tr>
<td>A, B, E</td>
<td>$194,000</td>
<td>$16,000</td>
</tr>
<tr>
<td>A, B, F</td>
<td>$167,000</td>
<td>$12,000</td>
</tr>
<tr>
<td>A, C, D, E</td>
<td>$195,000</td>
<td>$17,000</td>
</tr>
<tr>
<td>A, C, D, F</td>
<td>$168,000</td>
<td>$13,000</td>
</tr>
<tr>
<td>A, C, E, F</td>
<td>$183,000</td>
<td>$15,000</td>
</tr>
<tr>
<td>A, D, E, F</td>
<td>$186,000</td>
<td>$16,000</td>
</tr>
<tr>
<td>B, C, D, F</td>
<td>$186,000</td>
<td>$15,000</td>
</tr>
<tr>
<td>B, C, E</td>
<td>$172,000</td>
<td>$15,000</td>
</tr>
<tr>
<td>B, D, E</td>
<td>$175,000</td>
<td>$16,000</td>
</tr>
<tr>
<td>C, D, E, F</td>
<td>$164,000</td>
<td>$15,000</td>
</tr>
</tbody>
</table>

Pick Projects A, C, D, and E, highest NPV, while using almost all $200,000.

24. **Constraints on borrowing.** Runway Fashions Inc. is considering the following potential projects for the company but has only $1,000,000 in the capital budget. Which projects should it choose?

<table>
<thead>
<tr>
<th>Project</th>
<th>Cost</th>
<th>NPV</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter coats</td>
<td>$750,000</td>
<td>$95,000</td>
<td>13%</td>
</tr>
<tr>
<td>Spring dresses</td>
<td>$500,000</td>
<td>$45,000</td>
<td>9%</td>
</tr>
<tr>
<td>Fall suits</td>
<td>$500,000</td>
<td>$55,000</td>
<td>11%</td>
</tr>
<tr>
<td>Summer sandals</td>
<td>$400,000</td>
<td>$60,000</td>
<td>14%</td>
</tr>
</tbody>
</table>

**ANSWER**

Look at all combinations of the four projects that do not violate the capital budget and select the combination with the highest NPV.

- Winter Coats Only  
  NPV = $95,000
- Spring Dresses and Fall Suits  
  NPV = $45,000 + $55,000 = $100,000
- Spring Dresses and Summer Sandals  
  NPV = $45,000 + $60,000 = $105,000
- Fall Suits and Summer Sandals  
  NPV = $55,000 + $60,000 = $115,000

Select Fall Suits and Summer Sandals!
Solutions for Advanced Problems for Spreadsheet Application

1. *Changing WACC and optimal choice.* Lowest D/E ratio $\Rightarrow 1.27$; Lowest WACC $\Rightarrow 9.61\%$

<table>
<thead>
<tr>
<th>WACC</th>
<th>Company Value</th>
<th>$50,000,000.00</th>
<th>Tax Rate</th>
<th>40.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQUITY:</td>
<td>ALL EQUITY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Shares</td>
<td>2,000,000.00</td>
<td>1,840,000.00</td>
<td>1,680,000.00</td>
<td>1,040,000.00</td>
</tr>
<tr>
<td>Value of Shares</td>
<td>$50,000,000.00</td>
<td>$46,000,000.00</td>
<td>$42,000,000.00</td>
<td>$26,000,000.00</td>
</tr>
</tbody>
</table>

| Cost of Equity: | | | | | | | |
| Beta | | | | | | | |
| Market return | 12.00\% | 12.00\% | 12.00\% | 12.00\% | 12.00\% | 12.00\% | 12.00\% |
| Risk-free rate | 3.00\% | 3.00\% | 3.00\% | 3.00\% | 3.00\% | 3.00\% | 3.00\% |
| Cost of Equity | 10.65\% | 10.88\% | 11.10\% | 12.00\% | 12.23\% | 12.45\% | 12.68\% |

| DEBT: | | | | | | | |
| Value of Debt/Unit | $4,000,000.00 | | | | | | |
| Units of Debt | 0 | 1 | 2 | 6 | 7 | 8 | 9 |
| Value of Debt | $ - | $4,000,000.00 | $8,000,000.00 | $24,000,000.00 | $28,000,000.00 | $32,000,000.00 | $36,000,000.00 |
| Cost of Debt | 7.50\% | 7.50\% | 8.35\% | 11.75\% | 12.60\% | 13.45\% | 14.30\% |

| DEBT - EQUITY: | | | | | | | |
| Equity to Value | 100.00\% | 92.00\% | 84.00\% | 52.00\% | 44.00\% | 36.00\% | 28.00\% |
| Debt to Value | 0.00\% | 8.00\% | 16.00\% | 48.00\% | 56.00\% | 64.00\% | 72.00\% |

2. **Risk and cost of equity.** Final Set of accepted projects = 1, 3, 5, 7, 11 and 12.

<table>
<thead>
<tr>
<th>Company and Market Info</th>
<th>Project</th>
<th>IRR</th>
<th>Beta</th>
<th>Project</th>
<th>IRR</th>
<th>Beta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Company Beta</td>
<td>1.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expected Market Return</td>
<td>11.00%</td>
<td>1</td>
<td>6.25%</td>
<td>7</td>
<td>12.84%</td>
<td>1.15</td>
</tr>
<tr>
<td>Risk-free Rate</td>
<td>2.75%</td>
<td>2</td>
<td>6.89%</td>
<td>8</td>
<td>13.01%</td>
<td>1.25</td>
</tr>
<tr>
<td>Average Hurdle Rate</td>
<td>11.4125%</td>
<td>3</td>
<td>7.54%</td>
<td>9</td>
<td>13.66%</td>
<td>1.40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project Number</th>
<th>Accept or Reject vs. Average Hurdle</th>
<th>Risk Adj Hurdle</th>
<th>New Decision</th>
<th>Change</th>
<th>Go Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>reject</td>
<td>5.638% accept</td>
<td>YES</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>reject</td>
<td>8.113% reject</td>
<td>NO</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>reject</td>
<td>7.288% accept</td>
<td>YES</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>reject</td>
<td>8.525% reject</td>
<td>NO</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>reject</td>
<td>9.763% accept</td>
<td>YES</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>reject</td>
<td>10.588% reject</td>
<td>NO</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>accept</td>
<td>12.238% accept</td>
<td>NO</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>accept</td>
<td>13.063% reject</td>
<td>YES</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>accept</td>
<td>14.300% reject</td>
<td>YES</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>accept</td>
<td>15.125% reject</td>
<td>YES</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>accept</td>
<td>14.713% accept</td>
<td>NO</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>accept</td>
<td>15.538% accept</td>
<td>NO</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

**Solutions to Mini-Case**

**BioCom, Inc.: Part 3, A Fresh Look at the WACC**

This case provides a comprehensive and realistic review of WACC computations and some of the theoretical questions related to the WACC and its uses.

1. **Compute the yield to maturity and the after-tax cost of debt for the two bond issues.**

   **Bond 1**
   
   \[ \text{Bond 1} \]
   
   \[ \$1031 = 35 \times (1-(1/(1+YTM/2)^{12})/r) + 1000/(1+YTM/2)^{12} \]
   
   By trial and error, YTM/2 = 3.185%. YTM = Rd = 6.37%

   Using a calculator, N=12, PV = -1031, PMT = 35, FV = 1000, solve for i/y = 3.185%

   **Bond 2**
   
   \[ \text{Bond 2} \]
   
   \[ \$1035 = 40 \times (1-(1/(1+YTM/2)^{32})/r) + 1000/(1+YTM/2)^{32} \]
   
   By trial and error, YTM/2 = 3.81%. YTM = Rd = 7.62%

   Using a calculator, N=32, PV = -1035, PMT = 40, FV = 1000, solve for i/y = 3.81%

2. **Compute BioCom’s cost of preferred stock.**

   \[ R_{ps} = \frac{1.50}{919} = 7.89\% \]

3. **Compute BioCom’s cost of common equity.** Use the average of results from the dividend growth model and the security market line.
Dividend Growth model
\[ R_e = \frac{2.50}{35} \times (1.06) + .06 = 13.57\% \]
CAPM approach:
\[ R_e = 3\% + 1.2(12\%-3\%) = 13.8\% \]
Average:
\[ \frac{(13.57\% + 13.8\%)}{2} = 13.69\% \]

4. **Compute BioCom’s weighted average cost of capital. Should you use book values or market values for this computation?**

It is always best to use market weights when computing the Weighted Average Cost of Capital. Also keep in mind that we need to adjust \( R_d \) for taxes.
\[ WACC = .15(6.37\%)(1-.34) + .20(7.62\%)(1-.34) + .10(7.89\%) + .55(13.69\%) = .631\% + 1.006\% + 7.530\% = 9.96\% \]

5. **BioCom could sell new bonds with maturities of fifteen to twenty years at approximately the same yield as Bond 2. It would, however, incur flotation costs of $20.00 per $1,000 of par value. Estimate the effective interest rate BioCom would have to pay on a new issue of long-term debt.**

BioCom would most likely issue bonds with coupon rates to reflect investors current expected yield to maturity, or about 7.62\%. This would result in semi-annual coupon payments of $1,000 \times .0762/2 = $38.10. BioCom would also realize only $980 ($1,000 - $20 flotation cost) per bond unit issued. Assuming the bonds were issued with a 20 year maturity, the effective \( R_d \) would be
\[ 980 = 38.10 \times (1-(1/(1+YTM/2)^40)/r)+1000/(1+YTM/2)^40 \]

By trial and error, \( YTM/2 = 3.91\% \), \( YTM = 7.82\% \)

Using a calculator, \( N=40, PV = -980, PMT = 38.10, FV = 1000, \) solve for \( i/y = 3.91\% \)

6. **Some of BioCom’s projects are of low risk, some average risk, and some high risk. Should BioCom use the cost of capital to evaluate all of its projects, or adjust the discount rate to reflect different levels of risk?**

It is common practice to adjust the discount rate used in capital budgeting upward to reflect the higher rate of return required as compensation for higher levels of risk. The adjustment is usually subjective. It is theoretically preferable to find project betas and use them to recalculate the WACC for the specific project. One way to do this is to find companies whose business is similar to the project and use their beta. In practice, such “pure play” comparisons are quite difficult to find.

### Additional Problems with Solutions

1. **Cost of debt for a firm.** You have been assigned the task of estimating the after-tax cost of debt for a firm as part of the process in determining the firm’s cost of capital. After doing some checking, you find out that the firm’s original 20-year 9.5% coupon bonds (paid semi-annually), currently have 14 years until they mature and are selling at a price of $1,100 each. You are also told that the investment bankers charge a commission of $25 per bond when new bonds are sold. If these bonds are the only
The Cost of Capital

1. Cost of Capital for a Firm. The firm’s capital structure consists of debt outstanding for the firm, what is the after-tax cost of debt for this firm if the marginal tax rate for the firm is 34 percent?

**ANSWER**

Calculate the YTM on the currently outstanding bonds, after adjusting the price for the $25 commission.

i.e. Net Proceeds = $1100-$25 $\Rightarrow$ $1075

Set $P/Y=2$ and $C/Y = 2$

<table>
<thead>
<tr>
<th>Input</th>
<th>28</th>
<th>?</th>
<th>-1075</th>
<th>47.5</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key</td>
<td>N</td>
<td>I/Y</td>
<td>PV</td>
<td>PMT</td>
<td>FV</td>
</tr>
<tr>
<td>Output</td>
<td>8.57%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

After-tax cost of debt = 8.57%×(1-.34) $\Rightarrow$ 5.66%

2. Cost of Equity for a Firm. R.K. Boats Inc. is in the process of making some major investments for growth and is interested in calculating their cost of equity so as to be able to correctly estimate their adjusted WACC. The firm’s common stock is currently trading for $43.25 and their annual dividend, which was paid last year, was $2.25, and should continue to grow at 6% per year. Moreover, the company’s beta is 1.35, the risk-free rate is at 3%, and the market risk premium is 9%. Calculate a realistic estimate of RKBI’s cost of equity. (Ignore floatation costs)

**ANSWER**

Using the SML Approach:

$R_f=3%$; $R_m-R_f = 9%$; $\beta = 1.35$; $R_e=3%+(9\%)*1.35$ $\Rightarrow$ 15.15%

Using the Dividend Growth Model (constant growth)

$P_0 = $43.25; $D_0=$2.25; $g=6%$; $\Rightarrow (2.25*(1.06)/43.25)+.06 \Rightarrow 11.51%$

A realistic estimate of RKBI’s cost of equity = Average of the 2 estimates $\Rightarrow (15.15%+11.51%)/2 \Rightarrow 13.33%$

3. Calculating capital component weights. T.J. Enterprises is trying to determine the weights to be used in estimating their cost of capital. The firm’s current balance sheet and market information regarding the price and number of securities outstanding are listed below.

<table>
<thead>
<tr>
<th>TJ Enterprises Balance Sheet (in thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Assets: $50,000</td>
</tr>
<tr>
<td>Long-Term Assets: $60,000</td>
</tr>
<tr>
<td>Bonds Payable $48,000</td>
</tr>
<tr>
<td>Preferred Stock $15,000</td>
</tr>
<tr>
<td>Common Stock $47,000</td>
</tr>
</tbody>
</table>
Calculate the firm’s capital component weights using book values as well as market values.

**ANSWER**

Based on book values:
- Weight of Debt = $48,000/$110,000 $\rightarrow 43.64\%$
- Weight of P/S = $15,000/$110,000 $\rightarrow 13.64\%$
- Weight of C/S = $47,000/$110,000 $\rightarrow 42.72\%$

Based on market value:
- Market value of Debt = $40,800,000
- Market Value of P/S = $9,730,800
- Market Value of C/S = $52,000,000
- Total Market Value = $102,530,000
- Weight of Debt = $40,800/$102,530 $\rightarrow 39.79\%$
- Weight of P/S = $9,730.8/$102,530 $\rightarrow 9.49\%$
- Weight of C/S = $52,000/$102,530 $\rightarrow 50.72\%$

4. **Computing WACC.** New Ideas Inc. currently has 30,000 of its 9% semi-annual coupon bonds outstanding (Par value = 1000). The bonds will mature in 15 years and are currently priced at $1,340 per bond. The firm also has an issue of 1 million preferred shares outstanding with a market price of $11.00. The preferred shares offer an annual dividend of $1.20. New Ideas Inc. also has 2 million shares of common stock outstanding with a price of $30.00 per share. The firm is expected to pay a $3.20 common dividend one year from today, and that dividend is expected to increase by 7 percent per year forever. The firm typically pays flotation costs of 2% of the price on all newly issued securities. If the firm is subject to a 35 percent marginal tax rate, then what is the firm’s weighted average cost of capital?

**ANSWER**

1) Determine the component costs

Cost of Debt:
P = 1340; F = 2%; Net proceeds = P(1 - F)
Net proceeds = $1340*(1 - .02) = $1273

Set P/Y = 2 and C/Y = 2

<table>
<thead>
<tr>
<th>Input</th>
<th>?</th>
<th>-1273</th>
<th>45</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key</td>
<td>N</td>
<td>I/Y</td>
<td>PV</td>
<td>PMT</td>
</tr>
<tr>
<td>Output</td>
<td>6.18%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Before-tax Rd → 6.18%

Cost of preferred stock:

\[ D_p = $1.20; \ P_p = $11; \ F = 2\% \]

\[ R_p = \frac{D_p}{P_p(1-F)} \rightarrow \frac{1.20}{(11)(.98)} \rightarrow \frac{1.20}{10.78} \rightarrow 11.13\% \]

Cost of common stock:

\[ P_c = $30; \ D_1 = $3.2; \ g = 7\%; \ F = 2\% \]

Using the constant dividend growth model:

\[ R_c = \frac{D_1}{P_0(1-F)} + g \rightarrow \frac{3.2}{30(.98)} + .07 \rightarrow 17.88\% \]

2) Determine the market value weights of the components:

Market value of bonds = $1340*30,000 → $40,200,000
Market value of P/S = $11*1,000,000 → $11,000,000
Market value of C/S = $30*2,000,000 → $60,000,000
Total Market value → $111,200,000

Weight of debt = 40.2m/111.2m → 36.15%
Weight of P/S = 11m/111.2m → 9.89%
Weight of C/S = 60m/111.2m → 53.96%

3) Calculate the adjusted WACC

\[ WACC_{adj} = E \times R_e + \frac{P_S}{V} \times R_p + \frac{D}{V} \times R_d \times (1-T_c) \]

\[ WACC = .5396 \times 17.88\% + .0989 \times 11.13\% + .3615 \times 6.18\% \times (1-.35) = 9.65 + 1.10\% + 1.45\% \rightarrow 12.2\% \]

5. **Capital Rationing.** Quick Start Ventures, Incorporated is has received 6 excellent funding proposals, but is only able to fund up to $2,500,000

   - Project A: Cost $700,000, NPV $50,000
   - Project B: Cost $800,000, NPV $60,000
   - Project C: Cost $500,000, NPV $40,000
   - Project D: Cost $600,000, NPV $50,000
   - Project E: Cost $700,000, NPV $60,000
   - Project F: Cost $300,000, NPV $30,000

Which projects should Quick Start select?

**ANSWER**

1) Compute the Profitability Index of the projects and rank order from highest to lowest PI:

\[ PI = \frac{NPV + \text{Cost}}{\text{Cost}} \]

<table>
<thead>
<tr>
<th>Project</th>
<th>Cost</th>
<th>NPV</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>300,000</td>
<td>30,000</td>
<td>1.10</td>
</tr>
<tr>
<td>E</td>
<td>700,000</td>
<td>60,000</td>
<td>1.09</td>
</tr>
</tbody>
</table>
2) Form combinations of projects going from highest to lowest PI until $2,500,000 is used up:

<table>
<thead>
<tr>
<th>Combinations</th>
<th>Cost</th>
<th>NPV</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>F,E,D,B</td>
<td>2,400,000</td>
<td>200,000</td>
<td>1.0833</td>
</tr>
<tr>
<td>F, E, C,B</td>
<td>2,300,000</td>
<td>200,000</td>
<td>1.0870</td>
</tr>
<tr>
<td>E,D,C,A</td>
<td>2,500,000</td>
<td>150,000</td>
<td>1.0600</td>
</tr>
<tr>
<td>F,E,B,A</td>
<td>2,500,000</td>
<td>200,000</td>
<td>1.0800</td>
</tr>
</tbody>
</table>

Pick the combination which has the highest PI → Projects F, E, C, and B. Together they cost $2,300,000 and will have an NPV of $200,000 with a PI of 1.087.