Chapter 12: The Optimal Financing Mix

In the previous chapter we have examined the qualitative trade-off between debt and equity and we have discussed the reasons why some firms use debt whereas others use equity capital to finance their operations. In this chapter we are going to develop the necessary tools to determine the optimal financing mix for a corporation. In a sense we need to quantify the discussion made in the previous chapter.
In general, there are five ways to find the optimal mix. The first approach is to find the optimal capital structure that minimizes the cost of capital. Other things being equal, when the cost of capital is minimized, the firm value is maximized. The second approach also attempts to maximize firm value, but it does so by adding the value of the unlevered firm to the PV of the interest tax shields and subtracting the PV of bankruptcy costs. The third approach starts with the probability distribution of future operating income. We can then decide how much debt to carry by defining the maximum probability of default we are willing to bear. The fourth approach is to view leverage as a way of maximizing the return differential between the returns made by equity investors on the investments and the cost of equity. The fifth approach is to base the financing mix on the way comparable firms finance their operations.
In this chapter we are going to examine the first approach as it is widely used in practice and it is tightly related to the trade-off theory of capital structure developed in the previous chapter. We will also show how this approach can be appropriately used in the valuation of the firm's individual projects.

12.1. Cost of capital approach

As we have noted throughout all preceding chapters the (company) cost of capital is the weighted average of the costs of debt and equity (assuming that the firm issues these two kinds of securities).
Consider that the firm pays corporate taxes. The cash flow to the firm (as defined in Chapter 6) is equal to:

$$\text{CF to firm} = \text{EBIT}(1-\tau_c) + \text{Dep} - \text{I}$$

where EBIT is the earnings of the firm before interest and taxes, Dep is the depreciation of capital expenditures, and I is the investment required for the continuation of the firm's projects (including investment in working capital). The only difference with Chapter 6 is that now this cash flow is not for an individual project, but for the entire firm. Similarly, we can define the cash flow to equity investors as:

$$\text{CF to equity} = (\text{EBIT} - \text{Interest})(1-\tau_c) + \text{Dep} - \text{I}$$

The last formula implies that:

$$\text{CF to equity} = \text{CF to firm} - \text{Interest}(1-\tau_c)$$

which is equivalent to:

$$\text{CF to equity} + \text{CF to bondholders} = \text{CF to firm} + \tau_c \times \text{Interest}$$

where the cash flow to bondholders is equal to the interest. The last formula indicates that the CF to the firm is not equal to the CF to stockholders and bondholders as one might expect. In fact, you need to add the interest tax shields to the CF to the firm to get the CF to stockholders and bondholders. This means that the CF to the firm that

we have defined (and it is also used in investment analysis) does not account for the financing decisions (i.e., the mix of debt and equity that the firm uses), and it is equal to the CF received by investors *assuming that the firm is all-equity financed*.
The value of the firm is equal to the value of equity and debt. Assuming that the firm generates a constant perpetual cash flow to stockholders and bondholders we can write that:[1]

$$V = E + D = \frac{\text{CF to equity}}{r_E} + \frac{\text{CF to bondholders}}{r_D} = \frac{\text{CF to firm}}{\text{after-tax WACC}}$$

where the **after-tax weighted average cost of capital (WACC)** is defined as:

$$\boxed{WACC = r_D(1-\tau_c)\frac{D}{V} + r_E\frac{E}{V}} \quad (1)$$

In the after-tax WACC formula term $r_D(1 - \tau_c)$ is the after-tax cost of debt. It reflects the default risk of the firm and the tax advantage associated with debt, since interest is tax deductible. In a world without taxes, this after-tax WACC would be equal to the WACC as defined in Chapter 11.
We observe that the firm's value is a function of the firm's cash flows (if the firm were all-equity financed) and the cost of capital (now defined by the after-tax WACC). If we assume that the cash flows to the firm are unaffected by the choice of capital structure, and the cost of capital is reduced as a consequence of changing the financing mix, the value of the firm will increase. If the objective in choosing the financing mix for the firm is the maximization of the firm value, we can accomplish it, by *minimizing the cost of capital*.
In this approach, the effect of firm value of changing the capital structure is isolated by keeping the operating income fixed and varying only the cost of capital. In practical terms this requires to make two assumptions. First, the debt ratio is decreased by raising new equity and retiring debt; conversely the debt ratio is increased by issuing debt and buying back stock. This process is called **recapitalization**. Second, the pre-tax operating income is assumed to be unaffected by firm's capital structure and, by extension, its bond rating. If the operating income is also affected when the debt ratio increases (through, for example, the indirect financial distress costs) then minimizing the cost of capital would not be equivalent to maximizing firm value. In that case, the value of the firm will have to be computed at each debt level, and the optimal debt ratio will be that which maximizes firm value.

12.1.1. Steps in cost of capital approach

In order to apply the cost of capital approach we need to calculate the after-tax cost of debt and the cost of equity for each level of debt and equity ratios.
Let us begin with the cost of equity. From MM proposition 2 we already know that (even in a world without taxes) the cost of equity will change as the debt ratio also changes. This is due to the exposure of the equity investors in financial risk which will also cause a change in the beta of the stock. In fact, we can write that the levered beta is equal to:

$$\beta_L = \beta_U\left(1 + (1-\tau_c)\frac{D}{E}\right) \quad (2)$$

[1] The proof of the second equality can be found in the appendix.

where β_U is the unlevered beta of the stock (i.e., the beta under the assumption that the firm is all-equity financed).[2] This formula indicates that if we can estimate the unlevered beta for a firm, we can use it to estimate the levered beta of the stock at every debt ratio. This levered beta can then be used to compute the cost of equity at each debt ratio using the CAPM.

The cost of debt for a firm is primarily a function of the firm's default risk. As firms borrow more, their default risk will increase and so will the cost of debt. If we use the bond ratings as a measure of default risk, we can estimate the cost of debt in three steps. First, we estimate a firm's cash debt and interest expenses at each debt ratio; as firms increase their debt ratio, both cash debt and interest expenses will rise. Second, at each debt level, we compute a financial ratio (or ratios) that measure default risk, and we use the ratio(s) to estimate a rating for the firm; again as the firm borrows more, this rating will decline. Third, a default spread, based on the estimated rating, is added to the risk-free rate to calculate the pre-tax cost of debt. Applying the corporate tax rate on the pre-tax cost of debt yields the after-tax cost of debt.

Once we estimate the cost of equity and debt at each debt level, we weight them based on the proportions used in each to estimate the cost of capital.

12.1.2. Analyzing the capital structure for Ford

We will use the cost of capital approach to find the optimal capital structure for Ford at the end of 2015. We will do that in the following steps:[3]

1. *Estimate the cost of debt and equity with the observed capital structure*: Ford has a BBB/Baa2 rating from S&P/Moody's on its long-term debt. The default spread, i.e., the difference between the cost of debt and the risk-free rate, with this credit rating is estimated to be equal to 2.25% at the end of 2015.[4] We will use this as an estimate of the pre-tax cost of debt for Ford. The beta of the Ford's stock is estimated to be equal to 1.13. Using the CAPM with a market risk premium of 8% and a risk-free rate of 1.8% we have that the cost of equity is equal to:
$$r_E = r_f + \beta(r_m - r_f) = 0.018 + 1.13 \times 0.08 = 11.24\%$$
2. *Estimate the market value of debt and* equity: The market value of equity can be easily calculated for publically traded firms. It is the product of the number of shares outstanding and the current stock price. At the end of 2015 this is close to $47.5 billion. The market value of debt is more difficult to obtain directly, first, because firms issues a variety of bonds (with different maturities and coupon payments), and, second, many firms have nontraded debt, such as bank debt, which is specified in book values terms but not in market values. A simple way to convert book value debt into market value is to treat the entire debt on the books as one coupon bond, with a coupon payment set equal to the interest expenses on all the debt and the maturity set equal to the face value weighted average maturity of the debt. At the end of 2015 the book value of long-term and short-debt debt is $132.965 billion and the interest expenses are $3.247 billion for Ford. Assuming for simplicity that all bonds will mature in 10 years we can calculate the market value of debt for Ford using the 2.25% + 1.8% = 4.05% cost of debt as:

[2] The proof of this formula can be found in Copeland, Weston and Shastri, 4th edition, Chapter 15.
[3] All data and information used in this example are taken from Thomson One database.
[4] See http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/ratings.htm

$$\text{Market value of debt} = 3.247 \times \text{annuity factor}\left(10, 4.05\%\right) + \frac{132.965}{(1+0.0405)^{10}} = \$115.6$$

So the market value of debt is \$115.6 billion. The market debt and equity ratio are equal to 115.6/(115.6 +47.5) = 71% and 47.5/(115.6 + 47.5) = 29%.
The after-tax WACC is equal to:[5]

$$\text{After-tax WACC} = 0.0405(1-0.34)\times 0.71 + 0.1124 \times 0.29 = 5.15\%$$

3. *Cost of equity and debt ratio*: We would estimate now the cost of equity at different debt ratios. In so doing we start from computing the unlevered beta using equation (2). This is given as:

$$\beta_U = \frac{\beta_L}{1+(1-\tau_c)\dfrac{D}{E}} = \frac{1.13}{1+(1-0.34)\dfrac{115.6}{47.5}} = 0.43$$

Now we can use this unlevered beta to estimate the levered beta for different debt ratios and then the cost of equity using the CAPM. This is shown Table 1.

Table 1: Cost of equity and debt ratio

Debt ratio	Beta	Cost of equity
0	0.43	5.24%
0.1	0.46	5.49%
0.2	0.50	5.81%
0.3	0.55	6.21%
0.4	0.62	6.75%
0.5	0.71	7.51%
0.6	0.86	8.65%
0.7	1.09	10.54%
0.8	1.57	14.32%
0.9	2.98	25.67%

4. *Cost of debt and debt ratio*: The cost of debt depends on the default risk of the firm. We will assume that the exposure to default risk can be measured by the times-interest-earned ratio (see Chapter 8). This is given as:

$$\text{Times-interest-earned ratio} = \frac{\text{EBIT}}{\text{interests}}$$

The relation between this ratio and default risk can be considered as a simplified credit scoring system (for a more elaborated model see Chapter 5). Note also here, that both Standard and Poor's and Moody's use this ratio to determine a firm's rating. The times-interest-earned ratio changes as a firm changes its financial mix. In fact, it decreases as the debt ratio increases. At the end of 2015 the times-interest-earned ratio for Ford is equal to 3.11. Table 2, which can be found in the web page of A. Damodaran (see the link in footnote 4), reports the results of a cross-sectional analysis that aims to relate the times-interest-earned ratio, the credit ratings and the default yields of large manufacturing firms. This table indicates that a firm with a times-interest-earned ratio of 3.11 (as Ford) should have an A3/A- credit rating. The actual rating of Ford which is Baa2/BBB is just one notch lower.

[5] I calculate the effective tax rate as the ratio of income taxes to pre-tax income. For Ford this is equal to 34%.

Table 2: Times-interest-earned ratio and cost of debt

If times-interest-earned ratio is			
>	≤	Rating	Spread
-100000	0.199999	D2/D	20.00%
0.2	0.649999	C2/C	16.00%
0.65	0.799999	Ca2/CC	12.00%
0.8	1.249999	Caa/CCC	9.00%
1.25	1.499999	B3/B-	7.50%
1.5	1.749999	B2/B	6.50%
1.75	1.999999	B1/B+	5.50%
2	2.2499999	Ba2/BB	4.25%
2.25	2.49999	Ba1/BB+	3.25%
2.5	2.999999	Baa2/BBB	2.25%
3	4.249999	A3/A-	1.75%
4.25	5.499999	A2/A	1.25%
5.5	6.499999	A1/A+	1.10%
6.5	8.499999	Aa2/AA	1.00%
8.50	100000	Aaa/AAA	0.75%

We will use this table as a guideline to compute the cost of debt in different debt ratios. This is done in Table 3. To do so, we calculate the interest payments at each level of debt ratio, compute the times-interest-earned ratio at that level of debt, and find the rating that corresponds to that level of debt ratio. Finally, we match this rating with the appropriate default spread using the previous table. For example, when the debt ratio is 0.1 the level of debt is equal to $0.1\times(115.6+47.5)=16.31$. The interest payment is $0.0255\times16.31=0.42$. The times-interest-earned ratio is 10.101/0.42 = 24.3 (where 10.101 is the EBIT of Ford at the end of 2015). This corresponds to an AAA credit rating with a default spread of 0.75% and a cost of debt of 0.75% + 1.8% = 2.55%.[6]

Table 3: Cost of debt and debt ratio

Debt ratio	Debt	Interests	T-I-E ratio	Rating	Default spread	Cost of Debt
0	0	0	∞	AAA	0.75%	2.55%
0.1	16.31	0.42	24.3	AAA	0.75%	2.55%
0.2	32.62	0.83	12.1	AAA	0.75%	2.55%
0.3	48.93	1.25	8.1	AA	1.00%	2.80%
0.4	65.24	1.83	5.5	A+	1.10%	2.90%
0.5	81.55	2.36	4.3	A	1.25%	3.05%
0.6	97.86	2.98	3.4	A-	1.75%	3.55%
0.7	114.17	4.05	2.5	BBB	2.25%	4.05%
0.8	130.48	5.28	1.9	B+	5.50%	7.30%
0.9	146.79	10.72	0.9	CCC	9.00%	10.80%

T-I-E ratio denotes the times-interest-earned ratio.

[6] Note here that the interest payment is calculated using the cost of debt of the previous reported debt ratio. It would be impossible to calculate the interests using the cost of debt at the actual debt ratio, as the latter is estimated by the times-interest-earned ratio, which, in turn, is computed by the interest payment.

5. *Cost of capital and debt ratio*: Now that we have estimated the cost of equity and the cost of debt at each debt ratio level, we can compute Ford's cost of capital. This is done for each debt ratio level in Table 4. The cost of capital, which is 5.24%, when the firm is unlevered, decreases as the firm initially borrows taking into advantage the interest tax shields, reaches the minimum of 4.76% at 50% debt, and then starts to increase again, as the increase in the cost of debt offsets the tax advantages of debt.

Table 4: Cost of capital and debt ratio

Debt ratio	Cost of equity	Cost of Debt	After-tax WACC
0	5.24%	2.55%	5.24%
0.1	5.49%	2.55%	5.11%
0.2	5.81%	2.55%	4.98%
0.3	6.21%	2.80%	4.90%
0.4	6.75%	2.90%	4.82%
0.5	7.51%	3.05%	4.76%
0.6	8.65%	3.55%	4.86%
0.7	10.54%	4.05%	5.03%
0.8	14.32%	7.30%	6.72%
0.9	25.67%	10.80%	8.98%

Figure 1 shows the cost of debt, cost of equity and the cost of capital for different debt ratio values. Observe that when the debt ratio is 50%, the cost of capital is minimized.

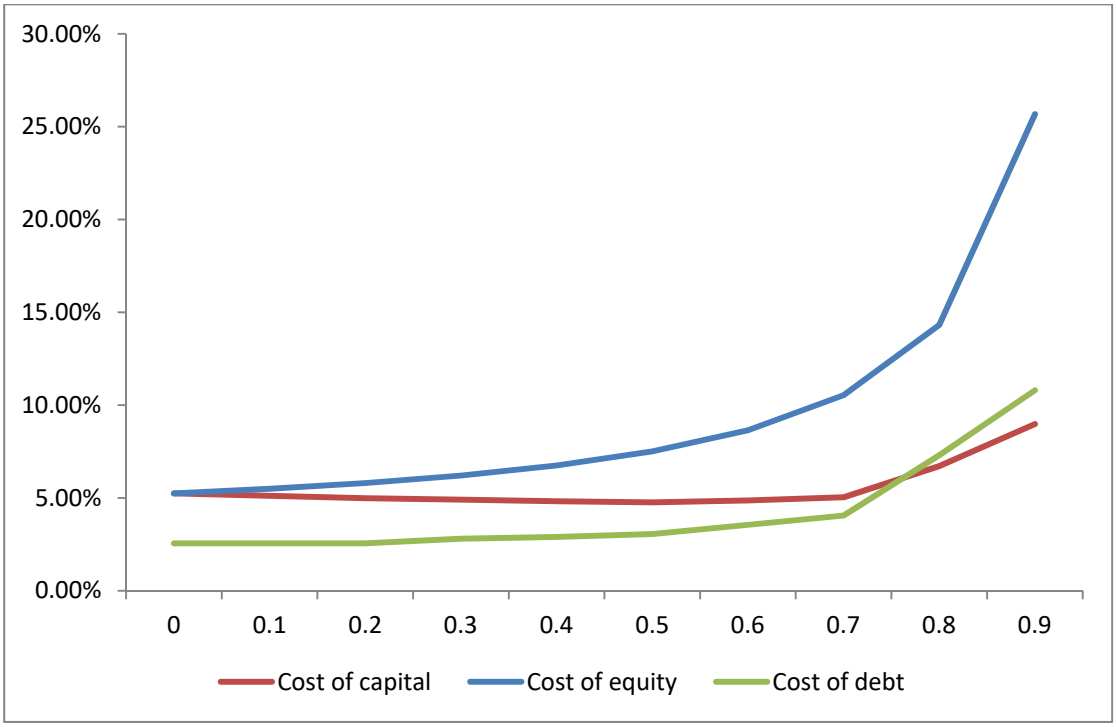

Figure 1: Cost of capital, cost of equity and cost of debt for different levels of debt ratio.

12.1.3. The value of the firm at the optimal capital structure

To illustrate the effects of moving to the optimal financing mix for Ford's firm value we start with a simple valuation model described in Chapter 6, designed to value a firm with a constant growth rate. If FCFF is the current free cash flow to the firm and we expect this to increase with a constant growth rate g to infinity then the current value of the firm is given as:

$$V = \frac{FCFF(1+g)}{\text{after-tax WACC} - g}$$

We can use the FCFF reported at the end of 2015, which is equal to $3.554 billion, the current value of the firm 115.6 +47.5 = 163.1 billion and the cost of capital of 5.15% estimated at the current debt ratio to solve the previous equation for g. This gives us a g = 2.9%. Now assume that the firm shifts to the optimal debt ratio of 50% and the cost of capital is equal to 4.76%. The value of the firm would be equal to:

$$V = \frac{3.554(1+0.029)}{0.0476 - 0.029} = 196.4$$

The value of the firm will increase from 163.1 billion to 196.4 billion if the firm moves the optimal capital structure. Figure 2 shows the firm value at different debt ratios. As expected the value is maximized at the optimal debt ratio. This figure resembles very much the theoretical predictions of the trade-off theory concerning the value of firm as presented in the previous chapter.

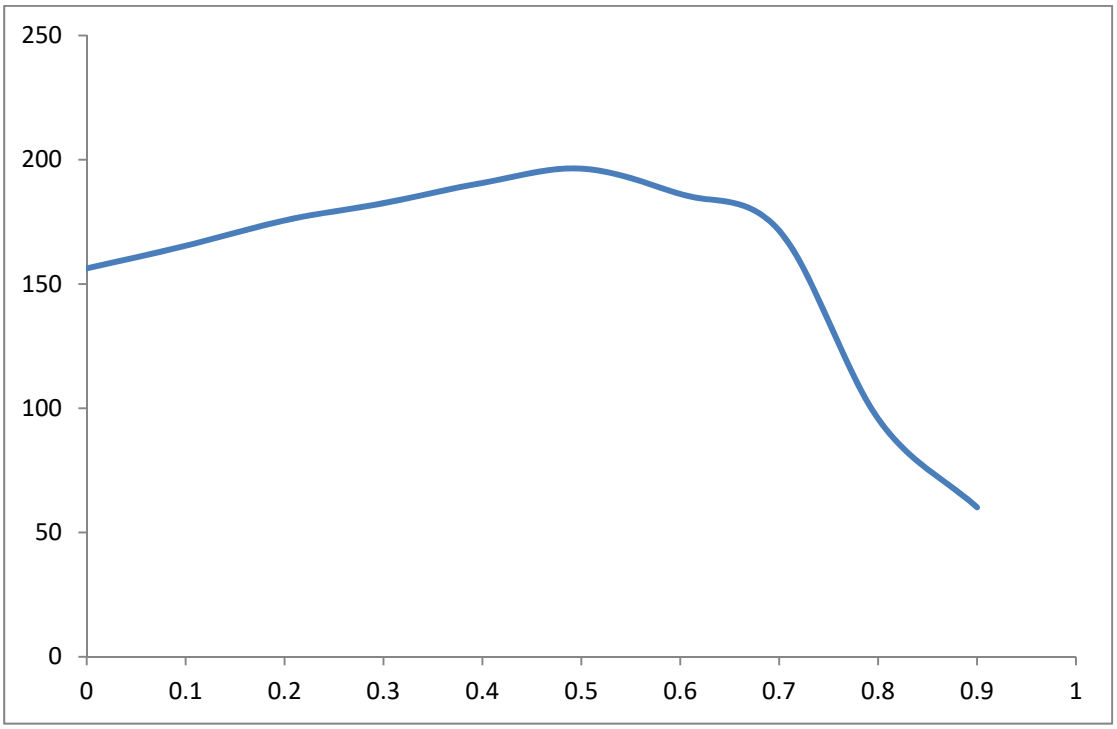

Figure 2: The value of the firm for different levels of debt ratio.

12.1.4. Extensions of the cost of capital approach

The cost of capital approach that we have described is based on several assumptions. First, the optimal debt ratio may indicate a bond rating (below, for example,

investment-grade) which may put the firm's survival in question. Second, the assumption that the operating income is unaffected by the bond rating may not be close to reality. If the operating income declines as default risk increases, the value of the firm may not be maximized where the cost of capital is minimized. Third, the optimal debt ratio was computed using the operating income from the most recent financial year. To the extent that the operating income is volatile and can decline, firms may want to reduce their borrowing. In the remainder of this paragraph we will present how we can bring each of these considerations into the cost of capital approach.

One way to using the cost of capital approach without putting firms into financial distress is to impose a **bond rating constraint** on the cost of capital analysis. Once this constraint has been imposed, the optimal debt ratio is the one that has the lower cost of capital, subject to the constraint that the bond rating meets or exceeds a certain level. For example, in the capital structure analysis of Ford, the optimal debt ratio of 50% implies a bond rating of A. If the firm wants to have, for example, an A+ bond rating the constrained optimal debt ratio would be now equal to 40%.

The second assumption that the cost of capital approach uses is that the operating income remains constant as the debt ratio increases. Although this assumption simplifies the analysis, it is not realistic. For many firms, operating income will drop as the default risk increases, due to the indirect bankruptcy costs that we have discussed in the previous chapter. The drop may become more pronounced as the default risk falls below an acceptable label. Thus, a general model for capital structure would allow both operating income and cost of capital to change as the debt ratio changes. In this more general setting the optimal debt ratio may no longer be the point at which the cost of capital is minimized. Instead, the optimal has to be defined as that debt ratio at which the firm value is maximized.

A key input that drives the optimal capital structure is the current operating income. If this income is depressed, either because the firm is a cyclical firm and you do the analysis during a recession year, or because there are firm-specific factors that are expected to be temporary, the optimal debt ratio that will emerge from the analysis will be much lower than the true optimal one. When evaluating a firm with depressed current operating income, we must first decide whether the drop in income is temporary or permanent. If the drop is temporary, we must estimate the **normalized operating income** for the firm. This is an estimate of how much the firm would earn in a normal year, that is, a year without the specific events that are depressing earnings during this year. The way to normalize income will vary across firms:

1. For cyclical firms whose current income may be overstated (if the economy is in the expansion) or understated (if the economy is in a recession), we can estimate the normalized operating income using the average operating margin for these firms over a business cycle (normally 5 to 10 years) as follows:

   $$\text{Normalized operating income} = \text{average operating margin} \times \text{current sales}$$

2. For firms that have had a bad year in terms of operating income due to firm-specific factors we can use the operating margin for the industry in which the firm operates to calculate the normalized operating income as:

   $$\text{Normalized operating income} = \text{average operating margin for industry} \times \text{current sales}$$

12.2. The after-tax WACC in investment analysis

The analysis in the beginning of this chapter indicates that if we discount the cash flows to the firm with the after-tax WACC we can estimate the value of the firm. The same reasoning holds for an individual project. If we discount the cash flows to the firm of the individual project (that we have defined in Chapter 6) with the after-tax WACC *of the project* then we can estimate the NPV of it. In some cases we can also use the after-tax WACC *of the firm* as the discount rate for the calculation of the NPV of an individual project. This is true when the two following assumptions hold:

1. The project's business risks are the same as those of the firm's other assets and remain so for the life of the project.
2. The project supports the same fraction of debt ratio as in the firm's overall capital structure, which remains constant for the life of the project.

Example: Assume that Ford examines a new project which requires an initial investment of $1 billion. This project has an equivalent risk exposure to the existing assets of the firm. It supports the same fraction of debt ratio as the firm's overall capital structure. Thus, we can use the after-tax WACC of the firm which is estimated to be equal to 5.15%. The following table reports the expected cash flows (in billions) to the firm of this project.

C_1	C_2	C_3	C_4	C_5	C_6
0.3	0.3	0.3	0.4	0.5	0.6

The NPV of this project is equal to:

$$NPV = -1 + \frac{0.3}{1+0.0515} + \frac{0.3}{(1+0.0515)^2} + \frac{0.3}{(1+0.0515)^3} + \frac{0.4}{(1+0.0515)^4} + \frac{0.5}{(1+0.0515)^5} + \frac{0.6}{(1+0.0515)^6} = 0.97$$

This NPV is not the optimal one. If the firm moves to the optimal debt ratio of 50% the after-tax WACC would decrease to 4.76%. If the expected cash flows of the project are unaffected by a change in the capital structure then the NPV of the project would now increase.

Appendix: The value of the firm using the after-tax WACC

The value of equity is given as:

$$E = \frac{\text{CF to firm} - \text{Interest}(1-\tau_c)}{r_E} \Rightarrow \text{CF to firm} = E \times r_E + \text{Interest}(1-\tau_c) \Rightarrow$$

$$\Rightarrow \frac{\text{CF to firm}}{E \times r_E + \text{Interest}(1-\tau_c)} = 1$$

If the firm has issued a perpetual bond with cost of debt r_D, then $\text{Interest} = D \times r_D$, and we can write the previous formula as:

$$\frac{\text{CF to firm}}{E \times r_E + D \times r_D(1-\tau_c)} = 1$$

If we multiply both sides of the last formula with V (the value of the firm) we obtain:

$$V = \frac{\text{CF to firm}}{\frac{E}{V} r_E + \frac{D}{V} r_D (1 - \tau_c)}$$

The denominator defines the after-tax WACC.

EXERCISES-11

1. The balance sheet of XYZ Corporation (in millions) is given in the next table.

Assets		Liabilities	
Current assets	1,000	Debt	2,500
Fixed assets	4,000	Equity	2,500

In addition we have the following information:

- The debt is in a form of long-term bonds, with a coupon rate of 10%. The bonds are currently rated AA at a yield of 12%. The market value of the bonds is 80% of the face value.
- The firm currently has 50 million of shares outstanding, and the current market price is $80 per share. The price/earnings ratio is 10.
- The beta of the stock is 1.2. The risk-free rate is 8% and the market risk premium is 5.5%.
- The tax rate of the firm is 40%.

Based on this information, answer to the following questions.

a. Calculate the debt-to-equity ratio in book and market value terms.
b. Calculate the debt ratio in book and market value terms.
c. Calculate the cost of equity.
d. Calculate the after-tax WACC of the firm.

2. Now assume that XYZ Corporation is considering a project that requires an initial investment of $100 million and has following expected income statement (in millions):

EBIT	20
-Interest	4
Taxable income	16
-Taxes	6.4
Net income	9.6

Depreciation of the project is expected to be $5 million a year forever. The project has equivalent risk to the existing assets of the firm and is going to be financed at the same debt ratio as the overall firm. The project would last forever. Assume that the debt issued to finance this project is also perpetual (there are no principal repayments).

a. Calculate the NPV of the project from the equity investors' standpoint.
b. Calculate the NPV of the project from the firm's standpoint.

3. XYZ Corporation is considering a change in its capital structure. It has three options.
Option 1: Issue $1 billion in new stock and repurchase half of the outstanding debt. This will make it an AAA rated firm. The yield of the AAA rated firms is 11%.
Option 2: Issue $1 billion in new debt and buy back stock. This will drop its rating to A-. The yield of the A- rated firms is 13%.
Option 3: Issue $3 billion in new debt and buy back stock. This will drop its rating to CCC. The yield of the CCC rated firms is 18%.

a. Calculate the cost of equity, cost of debt and cost of capital under each option.
b. Calculate the value of the firm, the value of equity and debt and the stock price under each option.
c. Using the cost of capital approach, which of the three options would you pick, or would you stay at your current capital structure?
d. How would your analysis change (if at all) if the money under the three options listed above were used to take new investments (instead of repurchasing debt or equity)?

4. The financial manager of ABC Corporation must decide how much it can afford to borrow. You currently have 10 million shares outstanding, and the market price per share is $50. You currently have $200 million market value in debt outstanding. You are rated as a BBB corporation. Your stock has a beta of 1.5, the risk-free rate is 8% and the market risk premium is 5.5%. The tax rate is 46%. You estimate that your rating will change to a B if you borrow $100 million. The BBB rate is 11%. The B rate is 12.5%.

a. Using the cost of capital approach, should you go ahead with the $100 million borrowing? This borrowing amount will not be used to repurchase stock.
b. If you borrow the $100 million, what will the price per share be after the borrowing?
c. Assume that you have a project that requires an investment of $100 million. It has expected cash flows of $10.8 million a year in perpetuity. Calculate the NPV of the project if (a) the risk of the project is the same to the overall risk of the firm's assets and it would be financed with the same debt ratio as the firm overall, (b) the cash flows of the project are certain.

5. As the financial manager of SmartCom Corporation you evaluate whether it has an appropriate amount of debt. You have collected the following information about the firm's current position:

- There are 100 shares outstanding, at $20 each. The stock beta is 1.15. The market risk premium is 5.5% and the risk-free rate is 6%.
- The company has $500,000 (market value) in long-term debt outstanding and is currently rated BBB. The current yield is 10% on BBB bonds.
- The company's tax rate is 40%.
- You also collect the following data on how increasing debt will affect the company's ratings:

Additional Debt	New rating	Yield (in %)
$500,000	BB	10.5
$1,000,000	B	11.5
$1,500,000	B-	13.5
$2,000,000	C	15

a. Using the cost of capital approach find the optimal capital structure of the firm. Assume that the additional debt would not be used to repurchase stock.
b. Calculate the price per share after the company takes on new debt.
c. Assume that you are considering a perpetual project that has the following income statement. The project has the same risk to the existing projects and it would be financed with the new capital structure. The initial investment is $3 million. Calculate the NPV of the project.

Revenues	1,000,000
Cost of goods sold	300,000
Depreciation	100,000
EBIT	600,000
Debt repayments	100,000
Taxable income	500,000
Tax	200,000
Net income	300,000

6. JJ Corporation currently has 70 million shares outstanding trading at $10 per share. In addition it has 500,000 bonds trading at $1,000 per bond. JJ Corporation is rated BBB with a yield of 10%. The beta of the stock is 1.2, the risk-free rate is 6%, the market risk premium is 5.5% and the tax rate is 40%. JJ Corporation is proposing to borrow $250 million and use it for the following purposes:

- Buy back $100 million worth of stock
- Pay $100 million in dividends
- Invest $50 million in a project with a NPV of $25 million.

The effect of this additional borrowing will be a drop in the bond rating to B, which currently carries a yield of 11%.

a. Calculate the after-tax WACC of the firm after the additional borrowing.
b. Calculate the value of the firm after this additional borrowing.