EXERCISES -11 (SOLUTIONS)

1.

a. In book values the debt-to-equity ratio is 2,500/2,500 = 100%. The market value of equity is 50×80 million = 4,000 million. The market value of debt is 0.8×2,500 = 2,000 million. The debt-to-equity ratio in market value terms is 2,000/4,000 = 50%.

b. The debt ratio in book value terms is 2,500/5,000 = 50%. The market value of the firm is 2,000 + 4,000 = 6,000 million. So the debt ratio in market value terms is 2,000/4,000 = 33.33%.

c. According to the CAPM the cost of equity is $r_E = 0.08 + 1.2\times0.055 = 14.6\%$.

d. The after-tax WACC is equal to $0.146\times(1 - 0.33) + 0.12\times(1 - 0.4)\times0.33 = 12.13\%$.

2.

a. To calculate the NPV from equity investors' standpoint we need first to calculate the cash flows to equity. This is equal to Net Income + Depreciation = 9.6 + 5 = 14.6 million. The initial equity investment in the project is 100×0.66 = $66.6 million. As the risk of the project is equivalent to the risk of the existing projects of the firm we can estimate the NPV to equity investors by discounting the cash flows to equity with the cost of equity. This yields NPV to equity = -66.6 + 14.6/0.146 = 33.3 million.

b. To calculate the NPV from the firm's standpoint we need first to calculate the cash flows to the firm. This is equal to $EBIT(1 - \tau_c)$ + Depreciation = 20(1 – 0.4) + 5 = 17 million. Using the after-tax as a discount rate we have that the NPV is equal to -100 + 17/0.1213 = 40.1 million.

3.

a. To calculate the cost of equity, cost of debt and cost of capital under the three options we need first to compute the unlevered beta, using the levered beta at the actual capital structure. This yields:

$$\beta_U = \frac{1.2}{1+(1-0.4)0.5} = 0.92$$

In the first option if the firm issues $1 billion in new stock and repurchase half of its outstanding debt, then the value of debt would be equal to 1,000 and the debt-to-equity ratio would be 1,000/5,000 = 20%.[1] In the second option the debt-to-equity ratio would be 100%, while in the third one it would be equal to 500%. The following table summarizes the calculations.

	D/E ratio	Beta	Cost of equity	Cost of debt	After-tax WACC
Option 1	20%	1.03	13.69%	11%	12.51%

[1] Note here that this is an approximation as an increase or decrease in the debt level would change the value of the firm and the value of equity. So in reality the value of equity will no more be equal to 5,000. We will use however this approach (as it simplifies considerably our calculations) in all the exercises of this chapter.

Option 2	100%	1.48	16.12%	13%	11.96%
Option 3	500%	3.69	28.31%	18%	13.72%

b. To calculate the value of the firm under the three options we first estimate the expected cash flows to the firm under the current capital structure under the assumptions that these cash flows are perpetual. This is equal to 6,000×0.1213 = 727.8 million. Now we can use the expected cash flows to estimate the value of the firm under each option. These calculations are summarized in the following table.

	Firm Value	Debt	Equity	Stock price
Option 1	5,818	1,000	4,818	76.36
Option 2	6,085	3,000	3,085	81.7
Option 3	5,305	5,000	305	66.1

The stock price under the new capital structure is estimated as the initial stock price of \$80 plus the change in the value of the firm divided by the number of stock outstanding. In case of option 1 this is equal to 80 + (5,818 – 6,000)/50 = \$76.36.

c. From the cost of capital standpoint, option 2 is the optimal one.
d. If the new debt or equity is used to undertake a new projects, the analysis would change for three reasons:
   i. The projects may have different risk profile than the firm's risk profile.
   ii. The NPV of the projects has to be added to the value of the firm calculated.
   iii. The firm value itself will increase (or decrease) as the new debt and equity is issued.

4.

a. The current debt-to-equity ratio is 200/500 = 40%. The debt ratio is 200/700 = 28.5%. The cost of equity is $r_E = 0.08 + 1.5\times0.055 = 16.25\%$ and the after-tax WACC is $(1 – 0.285)\times0.1625 + 0.11\times(1 – 0.46)\times0.285 = 13.3\%$.
The unlevered beta is equal to 1.5/(1 + (1 – 0.46)0.4) = 1.234. If the firm borrows \$100 million the debt-to-equity ratio becomes 300/500 = 60% and the debt ratio 300/800 = 37.5%. The new beta is equal to 1.234(1 + (1 – 0.46)0.6) = 1.634. The new cost of equity becomes $r_E = 0.08 + 1.634\times0.055 = 16.98\%$ and the new after-tax WACC is equal to $(1 – 0.375)\times0.1698 + 0.125\times(1 – 0.46)\times0.375 = 13.15\%$. Since the cost of capital drops, you should go ahead with the borrowing, assuming that the new funds are invested in similar (in terms of risk) projects as the existing firm.
b. To calculate the value of the firm with the new capital structure we will estimate the expected cash flows of the firm assuming they are perpetual using the initial capital structure. These are equal to 700×0.133 = 93.1. The value of the firm with the new capital structure is equal to 93.1/0.1315 = 708. So the increase in the firm's value is 8 million. The stock price after the borrowing would be 50 + 8/10 = \$50.8.

c. In the first case we will discount the expected cash flows of the project with the after-tax WACC of the firm. The NPV is equal to -100 + 10.8/0.1315 = -$17.7 million, so the project should be rejected. In the second case we will discount the certain cash flows of the project with the risk-free rate. The NPV is equal to -100 + 10.8/0.08 = $35 million, so the project should be undertaken.

5.

a. The current cost of equity is $r_E = 0.06 + 1.15\times0.055 = 12.33\%$. The debt ratio is 500/2,500 = 0.2 and the equity ratio is 0.8. The after-tax WACC is equal to $0.8\times0.1233 + (1 - 0.4)\times0.10\times0.2 = 11.06\%$. To examine how the cost of capital change with the additional debt, we start by calculating the unlevered beta. This is equal to $\beta_U = 1.15/(1 + (1 - 0.4)(500/2{,}000)) = 1.00$. If the firm adds $500,000 in long-term debt the debt-to-equity ratio is equal to 1,000/2,000 = 50%. Note here that this additional debt is not used to repurchase stock. The levered beta under this new capital structure would be $\beta_L = 1(1 + (1 - 0.4)0.5) = 1.3$. The cost of equity is now equal to $r_E = 0.06 + 1.3\times0.055 = 13.15\%$. With an extra $500,000 in debt the credit rating drops to BB, which implies a cost of debt of 10.5%. The after-tax WACC is equal to $0.667\times0.1315 + (1 - 0.4)\times0.105\times0.333 = 10.87\%$. These calculations are summarized in the next table.

Additional debt	Beta	Cost of equity	Cost of debt	Cost of capital
Current	1.15	12.33%	10%	11.06%
$500,000	1.30	13.15%	10.5%	10.87%
$1,000,000	1.45	13.98%	11.5%	10.94%
$1,500,000	1.60	14.80%	13.5%	11.45%
$2,000,000	1.75	15.63%	15%	11.94%

From this table we observe that the minimum cost of capital (10.87%) is achieved when the firm borrows an additional amount of $1,000,000.

b. To calculate the value of the firm with the new capital structure we will estimate the expected cash flows of the firm assuming they are perpetual using the initial capital structure. These are equal to $2{,}500\times0.1106 = 276.5$. The value of the firm with the new capital structure is equal to 276.5/0.1087 = 2,543.7. So the increase in the firm's value is $43.7 thousands. The increase in the stock price after the new borrowing would be 43.7/100 = $0.44.

c. The expected cash flow to the firm = $EBIT(1 - \tau_c) + Dep = 600{,}000(1 - 0.4) + 100{,}000 = 460{,}000$. The NPV of the project is equal to -3,000 + 460/0.1087 = 1,231 million.

6.

a. The initial value of equity is equal to $E = 70\times10 = 700$ million. The initial value of debt is $D = 0.5\times1{,}000 = 500$ million. The value of the firm is V = 1,200 million. The debt-to-equity ratio is 500/700 = 71.4%. Following similar calculations as in the previous exercises we find that the after-tax WACC is equal to 9.85%. The unlevered beta is $\beta_U = 1.2/(1 + (1 - 0.4)0.714) = 0.84$.

The firm borrows \$250 million to buy back stock, pay dividends and take a project. The value of equity is equal to E = 700 – 100 – 100 + 25 = 525 million. Note that the value of equity decreases by the amount of stock repurchase and the amount of dividends that is paid out to stockholders. It also increases by the NPV of the new project. The value of debt is equal to D = 500 + 250 = 750 million. The debt-to-equity ratio is 750/525 = 143%. The levered beta is equal to $\beta_L = 0.84(1 + (1 – 0.4)1.43) = 1.56$. The cost of equity is $r_E = 0.06 + 1.56 \times 0.055 = 14.58\%$. The after-tax WACC is now equal to $0.412 \times 0.1458 + (1 – 0.4) \times 0.11 \times 0.588 = 9.88\%$.

b. The value of the firm would change for two reasons now. The first is the change in the capital structure and the second is the new project that the firm has acquired. To measure the first effect we first calculate the expected cash flows to the firm assuming that they are perpetual using the initial capital structure. These are equal to $1{,}200 \times 0.0985 = 118.2$. The value of the firm with the new capital structure is equal to 118.2/0.0988 = 1,196.4. So the decrease in the firm's value due to the change in the capital structure is equal to \$3.6. The second effect is measured by the NPV of the new project which is equal to \$25 million. So, the new firm value after borrowing is 1,200 + 50 + 25 – 3.6 = \$1,271.4 million.