EXERCISES -10 (SOLUTIONS)

1.

a. The market value of the firm's equity increases by $30 million, the amount of the decrease in the market value of the firm's existing debt. Therefore, the price of the stock increases to:

($150 million + $30 million)/15 million shares = $12

b. Since the market price of the shares is $12, the company can buy back:

$60 million/$12 = 5 million shares

c. After the change in capital structure, the market value of the firm is unchanged:

E + D= (10 million × $12) + $130 million = $250 million

d. The investors in the existing debt lose $30 million while the shareholders gain this $30 million. The value of each share increases by: $30 million/15 million shares = $2

2. We begin with r_E and the capital asset pricing model:

$$r_E = r_f + \beta_E (r_m - r_f) = 0.1 + 1.5 \times 0.08 = 22\%$$

Similarly for debt:

$$r_D = r_f + \beta_D (r_m - r_f) \Rightarrow 0.12 = 0.1 + \beta_D \times 0.08 \Rightarrow \beta_D = 0.25$$

Also, we know that:

$$WACC = \frac{D}{V} r_D + \frac{E}{V} r_E = 0.5 \times 0.12 + 0.5 \times 0.22 = 17\%$$

The beta of the WACC is equal to:

$$\beta_{WACC} = \frac{D}{V} \beta_D + \frac{E}{V} \beta_E = 0.5 \times 0.25 + 0.5 \times 1.5 = 0.875$$

Assume now that the firm changes its capital structure and the new debt ratio is 30%. We know from MM Proposition I that the value of the firm will not change. Also, because the expected operating income is unaffected by changes in leverage, the firm's overall cost of capital will not change. In other words, the WACC remains equal to 17% and its beta remains equal to 0.875. However, risk and, hence, the expected return for equity and for debt, will change. We know that r_D is 11%, so that, for debt:

$$r_D = r_f + \beta_D (r_m - r_f) \Rightarrow 0.11 = 0.1 + \beta_D \times 0.08 \Rightarrow \beta_D = 0.125$$

For equity:

$$r_E = WACC + (WACC - r_D) \frac{D}{E} = WACC + (WACC - r_D) \frac{D/V}{E/V} =$$

$$= 0.17 + (0.17 - 0.11) \frac{0.3}{0.7} = 19.6\%$$

Also, $r_E = r_f + \beta_E (r_m - r_f) \Rightarrow 0.196 = 0.1 + \beta_E \times 0.08 \Rightarrow \beta_E = 1.2$

3. The book value of the firm's assets is $97,652 million. With a 40 percent book debt ratio:

Long-term debt + Other long-term liabilities = 0.40 × $97,652 = $39,061 million

This is $39,061 – ($7,144 + $21,460) = $10,457 million more than shown in the table. The corporate tax rate is 35 percent, so firm's value increases by:

0.35 × $10,457 = $3,659 million

The market value of the firm is now: ($296,625 + $3,659) = $300,285 million
The market value balance sheet is:

Net working capital	$10,752	$17,601	Long-term debt
PV interest tax shield	6,160	21,460	Other long-term liabilities
Long-term assets	283,373	261,224	Equity
Total Assets	$300,285	$300,285	Total value

4. For $1 of debt income the corporate tax is $0 and the personal tax on interest is 0.35×$1 = $0.35. The total is $0.35.
For $1 of equity income, with all capital gains realized immediately the corporate tax is 0.35×$1 = $0.35 and the personal tax is:

$$0.35\times0.5\times(\$1-(0.35\times\$1))+0.15\times0.5\times(\$1-(0.35\times\$1))=\$0.163.$$

The total is 0.35 + 0.163 = $0.513.
For $1 of equity income, with all capital gains deferred forever the corporate tax rate is again $0.35 and the personal tax rate is

$$0.35\times0.5\times(\$1-(0.35\times\$1))=\$0.114$$

The total is 0.35 + 0.114 = $0.464.
In the first case the relative tax advantage of debt over equity is (1 – 0.35)/(1 – 0.513) = 1.33. For $1 increase in debt the firm's value would increase by 1 – 1/1.33 = 0.25 cents.
In the second case the relative tax advantage is (1 – 0.35)/(1 – 0.464) = 1.21. For $1 increase in debt the firm's value would increase by 1 – 1/1.21 = 0.17 cents.

5. The relative tax advantage of debt over equity is equal to:

$$\frac{1-\tau_{pB}}{(1-\tau_c)(1-\tau_{pS})}=\frac{1-0.4}{(1-0.3)(1-0.2)}=1.07$$

Since the relative tax advantage is larger than 1, debt has a tax advantage over equity.
The value of the firm with the new capital structure would be equal to:

$$V_L=V_U+\left(1-\frac{1}{1.07}\right)D=100+0.65\times50=103.25$$

6.

a. According to the CAPM the cost of equity is

$$r_E=r_f+\beta_E\left(r_m-r_f\right)=0.9+1\times0.06=15\%$$

Since it is an all-equity financed firm, the cost of capital is equal to the cost od equity. The after-tax operating income is 2(1 – 0.4) = 1.2. The value of the firm is

$$V_U=\frac{1.2}{0.15}=8 \text{ million}$$

b. The following table calculates the marginal tax benefits of debt and the marginal expected bankruptcy cost for the increase in debt reported in the table. When debt increases from 0 to 2.5 million, that is, by 2.5 million, then the marginal tax advantage of debt is 0.4×2.5 = 1 million and the marginal expected bankruptcy cost is 0 (as the probability of default is 0 when the

firm's debt is 2.5 million). When debt increases from 2.5 to 5 million, that is, by 2.5 million, the marginal tax advantage of debt is 0.4×2.5 = 1 million and the marginal expected bankruptcy cost is 0.08×8 = 640,000. When debt increases from 5 to 7.5 million, that is, by 2.5 million, the marginal tax advantage of debt is 0.4×2.5 = 1 million and the marginal expected bankruptcy cost is (0.205 - 0.08)×8 = 1 million. Working analogously we calculate the remaining rows of the table.

Value of debt	Increase in debt	Marginal tax benefits	Marginal bankruptcy cost
2,500,000	2,500,000	1,000,000	0
5,000,000	2,500,000	1,000,000	640,000
7,500,000	2,500,000	1,000,000	1,000,000
8,000,000	500,000	200,000	760,000
9,000,000	1,000,000	400,000	1,200,000
10,000,000	1,000,000	400,000	600,000
12,500,000	2,500,000	1,000,000	1,400,000

When the value of debt is equal to 7.5 million marginal benefits are equal to marginal costs. So, this is the optimal level of debt value for this firm.

c. The value of the firm at the optimal capital structure is equal to:

$$V_L = V_U + PV(\text{tax shields}) - PV(\text{bankruptcy costs}) =$$
$$= 8 + 0.4 \times 7.5 - 0.205 \times 8 = 8 + 1.36 = 9.36 \text{ million}$$

7.

a. Stockholders win. Bond value falls since the value of assets securing the bond has fallen.
b. Bondholder wins if we assume the cash is left invested in Treasury bills. The bondholder is sure to get $26 plus interest. Stock value is zero because there is no chance that the firm value can rise above $50 (the face value of bonds).
c. The bondholders lose. The firm adds assets worth $10 and debt worth $10. This would increase the firm's debt ratio, leaving the old bondholders more exposed. The old bondholders' loss is the stockholders' gain.
d. Both bondholders and stockholders win. They share the (net) increase in firm value. The bondholders' position is not eroded by the issue of a junior security.
e. Bondholders lose because they are at risk for a longer time. Stockholders win.

8.

a. The past policy of not using debt can be justified by noting that a pharmaceutical company with high returns and growth is subject to all three costs of debt. First, the growing opportunities of the firm mean that future earnings good be volatile. Second, the firm invests mostly on intangible assets. Thus, direct and indirect bankruptcy costs can be substantial for it. Second, the agency cost associated with monitoring actions is likely to be largest for firms whose projects are long-term, follow unpredictable paths and may take years to generate profits as in our case. Finally, the value of preserving flexibility could be high given the excess returns generated by the firm on its projects.

b. Given that returns on projects are declining, the value of preserving flexibility declines and future earnings could be less volatile. I would argue for a greater use for debt.