

**CHAPTER 17**  
**Does Debt Policy Matter?**

***Answers to Practice Questions***

1. a. The two firms have equal value; let  $V$  represent the total value of the firm. Rosencrantz could buy one percent of Company B's equity and borrow an amount equal to:

$$0.01 \times (D_A - D_B) = 0.002V$$

This investment requires a net cash outlay of  $(0.007V)$  and provides a net cash return of:

$$(0.01 \times \text{Profits}) - (0.003 \times r_f \times V)$$

where  $r_f$  is the risk-free rate of interest on debt. Thus, the two investments are identical.

- b. Guildenstern could buy two percent of Company A's equity and lend an amount equal to:

$$0.02 \times (D_A - D_B) = 0.004V$$

This investment requires a net cash outlay of  $(0.018V)$  and provides a net cash return of:

$$(0.02 \times \text{Profits}) - (0.002 \times r_f \times V)$$

Thus the two investments are identical.

- c. The expected dollar return to Rosencrantz' original investment in A is:

$$(0.01 \times C) - (0.003 \times r_f \times V_A)$$

where  $C$  is the expected profit (cash flow) generated by the firm's assets. Since the firms are the same except for capital structure,  $C$  must also be the expected cash flow for Firm B. The dollar return to Rosencrantz' alternative strategy is:

$$(0.01 \times C) - (0.003 \times r_f \times V_B)$$

Also, the cost of the original strategy is  $(0.007V_A)$  while the cost of the alternative strategy is  $(0.007V_B)$ .

If  $V_A$  is less than  $V_B$ , then the original strategy of investing in Company A would provide a larger dollar return at the same time that it would cost less than the alternative. Thus, no rational investor would invest in Company B if the value of Company A were less than that of Company B.

2. When a firm issues debt, it shifts its cash flow into two streams. MM's Proposition I states that this does not affect firm value if the investor can reconstitute a firm's cash flow stream by creating personal leverage or by undoing the effect of the firm's leverage by investing in both debt and equity.

It is similar with Carruther's cows. If the cream and skim milk go into the same pail, the cows have no special value. (If an investor holds both the debt and equity, the firm does not add value by splitting the cash flows into the two streams.) In the same vein, the cows have no special value if a dairy can costlessly split up whole milk into cream and skim milk. (Firm borrowing does not add value if investors can borrow on their own account.) Carruther's cows will have extra value if consumers want cream and skim milk and if the dairy cannot split up whole milk, or if it is costly to do so.

3. a. Yes, there is an arbitrage opportunity.

An investor who purchased 1% of the equity of Debt Zero would pay:

$$0.01 \times (3.6 \text{ million} \times \$86) = \$3.096 \text{ million}$$

This investor's dividend income would be:

$$0.01 \times \$35 \text{ million} = \$0.35 \text{ million per year}$$

On the other hand, the investor would acquire the same annual income by purchasing 1% of the debt of Debt Galore plus 1% of the equity of Debt Galore. The total value of the equity of Debt Galore is:

$$1.5 \text{ million} \times \$115 = \$172.5 \text{ million}$$

Therefore, this investment would require an outlay of:

$$(0.01 \times \$172.5 \text{ million}) + (0.01 \times \$150 \text{ million}) = \$3.225 \text{ million}$$

The investment in Debt Zero costs less than the investment in Debt Galore even though both investments produce the same income.

- b. Debt Galore is financed  $(\$150/\$322.5) = 46.5\%$  by debt and 53.5% by equity. The zero-risk, zero-investment portfolio is formed by borrowing:  $(0.465 \times \$1,000,000) = \$465,000$  and selling short \$535,000 of Debt Galore's common stock. The proceeds of these transactions would then be used to purchase \$1,000,000 of Debt Zero common stock. The net cost is zero. Interest on the debt is:

$$0.07 \times \$465,000 = \$32,550$$

The short seller pays to the lender of the stock an amount equal to the dividends on the borrowed stock. Total dividends for Debt Galore equal:

$$\$35 \text{ million} - (0.07 \times \$150 \text{ million}) = \$24.5 \text{ million}$$

Dividends for \$535,000 of Debt Galore stock equal:

$$[\$535,000 / (1.5 \text{ million} \times \$115)] \times \$24.5 \text{ million} = \$75,986$$

The total annual cost is:  $\$32,550 + \$75,986 = \$108,536$

Annual dividends for \$1,000,000 of Debt Zero stock equal:

$$[\$1,000,000 / (3.6 \text{ million} \times \$86)] \times \$35 \text{ million} = \$113,049$$

This is a zero-risk investment because the earnings of the two companies are perfectly correlated. Total income is positive:

$$\$113,049 - \$108,536 = \$4,513$$

4. a. Before refinancing:

$$r_A = \left( \frac{D}{D+E} \times r_D \right) + \left( \frac{E}{D+E} \times r_E \right) = \left( \frac{40}{40+300} \times 0.05 \right) + \left( \frac{300}{40+300} \times 0.10 \right)$$

$$r_A = 0.0941$$

After refinancing:

$$r_E = r_A + (r_A - r_D) \left( \frac{D}{E} \right) = 0.0941 + (0.0941 - 0.05) \left( \frac{80}{260} \right) = 0.1077 = 10.77\%$$

- b. Jacques owns a portfolio with €60,000 of his own money and €40,000 borrowed at the risk-free rate. The weights for this portfolio are 1.67 invested in Rastignac stock and -0.67 invested in the risk-free asset. The expected return for the portfolio is:

$$(1.67 \times 0.10) + (-0.67 \times 0.05) = 0.1335 = 13.35\%$$

Let  $\beta_{E-B}$  and  $\beta_{E-A}$  represent the equity beta for Rastignac before and after the refinancing, respectively. The beta for Jacques' portfolio before the refinancing is:  $(1.67 \times \beta_{E-B})$ . Use the following equation to determine the relationship between  $\beta_{E-B}$  and  $\beta_{E-A}$ :

$$\beta_A = \left( \frac{D}{D + E} \times \beta_D \right) + \left( \frac{E}{D + E} \times \beta_{E-B} \right)$$

$$\beta_A = \left( \frac{40}{340} \times 0 \right) + \left( \frac{300}{340} \times \beta_{E-B} \right)$$

$$\beta_{E-B} = \frac{340}{300} \times \beta_A$$

Also:

$$\beta_A = \left( \frac{D}{D + E} \times \beta_D \right) + \left( \frac{E}{D + E} \times \beta_{E-A} \right)$$

$$\beta_A = \left( \frac{80}{340} \times 0 \right) + \left( \frac{260}{340} \times \beta_{E-A} \right)$$

$$\beta_{E-A} = \frac{340}{260} \times \beta_A$$

Therefore:

$$\beta_{E-A} = \frac{300}{260} \times \beta_{E-B}$$

In order for Jacques to have a portfolio with  $\beta_P = 1.67$  after the refinancing, the weight for this portfolio in Rastignac stock must be:

$$1.67 \times \frac{260}{300} = 1.45$$

Therefore, Jacques must borrow:  $(0.45 \times \text{€}60,000) = \text{€}27,000$   
 Jacques will invest  $(\text{€}60,000 + \text{€}27,000) = \text{€}87,000$  in Rastignac stock.  
 The expected return and risk for this portfolio are the same as the expected return and risk for Jacques' portfolio before the refinancing.

c.

Assets		Liabilities and Equity	
Asset Value	341	Debt	82
		Equity	259
Total	341	Total	341

5. This is not a valid objection. MM's Proposition II explicitly allows for the rates of return for both debt and equity to increase as the proportion of debt in the capital structure increases. The rate for debt increases because the debt-holders are taking on more of the risk of the firm; the rate for common stock increases because of increasing financial leverage. See Figure 17.2 and the accompanying discussion.
6. a. Under Proposition I, the firm's cost of capital ( $r_A$ ) is not affected by the choice of capital structure. The reason the quoted statement seems to be true is that it does not account for the changing proportions of the firm financed by debt and equity. As the debt-equity ratio increases, it is true that both the cost of equity and the cost of debt increase, but a smaller proportion of the firm is financed by equity. The overall effect is to leave the firm's cost of capital unchanged.
- b. Moderate borrowing does not significantly affect the probability of financial distress, but it does increase the variability (and market risk) borne by stockholders. This additional risk must be offset by a higher average return to stockholders.
7. Before the refinancing, Schuldenfrei is all equity financed. The equity beta is 0.7 and the expected return on equity is 12%. Thus, the firm's asset beta is 0.7 and the firm's cost of capital is 12%. We know that these overall firm values will not change after the refinancing and that the debt is risk-free.
- a. 
$$\beta_A = \left( \frac{D}{D+E} \times \beta_D \right) + \left( \frac{E}{D+E} \times \beta_E \right)$$
  

$$0.7 = (0.5 \times 0) + (0.5 \times \beta_E) \Rightarrow \beta_E = 1.40$$
- b. After the refinancing:
- $$r_A = \left( \frac{D}{D+E} \times r_D \right) + \left( \frac{E}{D+E} \times r_E \right)$$
- $$0.12 = (0.5 \times 0.06) + (0.5 \times r_E)$$
- $$r_E = 0.18 = 18.0\%$$
- After the refinancing, the risk premium for the stock is 12%.
- c. The required return for the company remains at 12%.

- d. Let  $E$  be the operating profit of the company and  $N$  the number of shares outstanding before the refinancing. Also, we know that  $E$  is  $(0.10V)$ . Thus, the earnings per share before the refinancing is:

$$EPS_B = 0.10V/N$$

After the refinancing, the operating profit is still  $E$  and the number of shares is  $(0.5 \times N)$ . Interest on the debt is 6% of the value of the debt, which is  $(0.5 \times V)$ . Thus, the earnings per share after the refinancing is:

$$EPS_A = [0.10V - (0.06 \times 0.5 \times V)] / (0.5 \times N) = 0.14V/N$$

It follows that earnings per share has increased by 40%.

- e. Before the refinancing, the P/E ratio is 10. The price of the common stock is the same before and after the refinancing, but the earnings per share has increased from  $(0.10V/N)$  to  $(0.14V/N)$ . (See part (d) above.) Thus, the new P/E ratio is 7.14.
8. a. If the opportunity were the firm's only asset, this would be a good deal. Stockholders would put up no money and, therefore, would have nothing to lose. However, rational lenders will not advance 100 percent of the asset's value for an 8 percent promised return unless other assets are put up as collateral.
- Sometimes firms find it convenient to borrow all the cash required for a particular investment. Such investments do not support all of the additional debt; lenders are protected by the firm's other assets too.
- In any case, if firm value is independent of leverage, then any asset's contribution to firm value must be independent of how it is financed. Note also that the statement ignores the effect on the stockholders of an increase in financial leverage.
- b. This is not an important reason for conservative debt levels. So long as MM's Proposition I holds, the company's overall cost of capital is unchanged despite increasing interest rates paid as the firm borrows more. (However, the increasing interest rates may signal an increasing probability of financial distress—and that can be important.)
9. Examples of such securities are given in the text and include unbundled stock units, preferred equity redemption cumulative stock and floating-rate notes. Note that, in order to succeed, such securities must both meet regulatory requirements and appeal to an unsatisfied clientele.

10. [Note: In the following solution, we have assumed that €200 million of long-term bonds have been issued.]

a.  $E = €70 \times 10 \text{ million} = €700 \text{ million}$

$$V = D + E = €200 \text{ million} + €700 \text{ million} = €900 \text{ million}$$

$$\frac{D}{V} = \frac{200\text{million}}{900\text{million}} = 0.222$$

$$\frac{E}{V} = \frac{700\text{million}}{900\text{million}} = 0.778$$

$$\text{After-tax WACC} = r_D (1 - T_c) \frac{D}{V} + r_E \frac{E}{V}$$

$$= 0.08 \times (1 - 0.354) \times 0.222 + (0.15 \times 0.778) = 0.1282 = 12.82\%$$

b. As indicated in Table 17.4 in the text, the after-tax WACC would increase to the extent of the loss of the tax deductibility of the interest on debt. Therefore, the after-tax WACC would equal the opportunity cost of capital, computed from the WACC formula without the tax-deductibility of interest:

$$\text{WACC} = r_D \frac{D}{V} + r_E \frac{E}{V} = (0.08 \times 0.222) + (0.15 \times 0.778) = 0.1345 = 13.45\%$$

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

$$r_E = r_f + \beta_E (r_m - r_f) = 0.10 + 1.5 (0.18 - 0.10) = 0.22 = 22.0\%$$

Similarly for debt:

$$r_D = r_f + \beta_D (r_m - r_f)$$

$$0.12 = 0.10 + \beta_D (0.18 - 0.10)$$

$$\beta_D = 0.25$$

Also, we know that:

$$r_A = \left( \frac{D}{D + E} \times r_D \right) + \left( \frac{E}{D + E} \times r_E \right) = (0.5 \times 0.12) + (0.5 \times 0.22) = 0.17 = 17.0\%$$

To solve for  $\beta_A$ , use the following:

$$\beta_A = \left( \frac{D}{D + E} \times \beta_D \right) + \left( \frac{E}{D + E} \times \beta_E \right) = (0.5 \times 0.25) + (0.5 \times 1.5) = 0.875$$

12. We know from 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,  $r_A$  remains equal to 17% and  $\beta_A$  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:

$$r_D = r_f + \beta_D (r_m - r_f)$$

$$0.11 = 0.10 + \beta_D (0.18 - 0.10)$$

$$\beta_D = 0.125$$

For equity:

$$r_A = \left( \frac{D}{D + E} \times r_D \right) + \left( \frac{E}{D + E} \times r_E \right)$$

$$0.17 = (0.3 \times 0.11) + (0.7 \times r_E)$$

$$r_E = 0.196 = 19.6\%$$

Also:

$$r_E = r_f + \beta_E (r_m - r_f)$$

$$0.196 = 0.10 + \beta_E (0.18 - 0.10)$$

$$\beta_E = 1.20$$

13. We make use of the basic relationship:

$$r_A = \left( r_D (1 - T_C) \frac{D}{V} \right) + \left( r_E \times \frac{E}{V} \right)$$

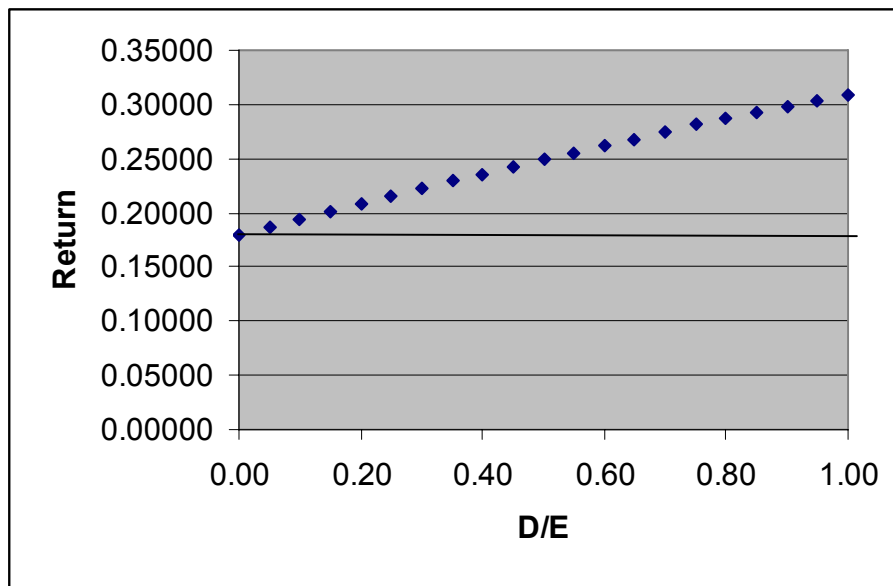
Since overall beta ( $\beta_A$ ) is not affected by capital structure or taxes, then:

$$r_A = r_f + \beta_A (r_m - r_f) = 0.06 + (1.5 \times 0.08) = 0.18$$



The following table shows the value of  $r_E$  for various values of  $D/E$  (and the corresponding values of  $D/V$ ), derived from the above formula. The graph is below the table.

D/E	D/V	$r_A$	$r_D$	$r_E$
0.00	0.00000	0.18	0.0600	0.1800
0.05	0.04762	0.18	0.0600	0.1871
0.10	0.09091	0.18	0.0600	0.1941
0.15	0.13043	0.18	0.0600	0.2012
0.20	0.16667	0.18	0.0600	0.2082
0.25	0.20000	0.18	0.0600	0.2153
0.30	0.23077	0.18	0.0610	0.2221
0.35	0.25926	0.18	0.0620	0.2289
0.40	0.28571	0.18	0.0630	0.2356
0.45	0.31034	0.18	0.0640	0.2423
0.50	0.33333	0.18	0.0650	0.2489
0.55	0.35484	0.18	0.0660	0.2554
0.60	0.37500	0.18	0.0670	0.2619
0.65	0.39394	0.18	0.0680	0.2683
0.70	0.41176	0.18	0.0690	0.2746
0.75	0.42857	0.18	0.0690	0.2814
0.80	0.44444	0.18	0.0700	0.2876
0.85	0.45946	0.18	0.0725	0.2929
0.90	0.47368	0.18	0.0750	0.2981
0.95	0.48718	0.18	0.0775	0.3031
1.00	0.50000	0.18	0.0800	0.3080



### Challenge Questions

1. Assume the election is near so that we can safely ignore the time value of money. Because one, and only one, of three events will occur, the guaranteed payoff from holding all three tickets is \$10. Thus, the three tickets, taken together, could never sell for less than \$10. This is true whether they are bundled into one composite security or unbundled into three separate securities.

However, unbundled they may sell for more than \$10. This will occur if the separate tickets fill a need for some currently unsatisfied clientele. If this is indeed the case, then Proposition I fails. The sum of the parts is worth more than the whole.

2. Some shoppers may want only the chicken drumstick. They could buy a whole chicken, cut it up, and sell off the other parts in the supermarket parking lot. This is costly. It is far more efficient for the store to cut up the chicken and sell the pieces separately. But this also has some cost, hence the observation that supermarkets charge more for chickens after they have been cut.

The same considerations affect financial products, but:

- a. The proportionate costs to companies of repackaging the cash flow stream are generally small.
  - b. Investors can also repackage cash flows cheaply for themselves. In fact, specialist financial institutions can often do so more cheaply than the companies can do it themselves.
3. Firms that are able to identify an 'unsatisfied' clientele and then design a financial service or instrument that satisfies the demands of this clientele can, in violation of MM's capital-structure irrelevance theory, enhance firm value. However, if this is done successfully by one financial innovator, others will follow, eventually restoring the validity of the MM irrelevance theory.

If the financial innovation can be patented, the creator of the innovation can restrict the use of the innovation by other financial managers and thereby continue to use the innovation to create value. Consequently, MM's capital-structure irrelevance theory would potentially be violated during the life of the patent.