

Solved Problems

- 10.1 Cost of Debt.** Calculate the after-tax cost of debt under each of the following cases: (a) the interest rate is 10 percent, and the tax rate is 40 percent; (b) the interest rate is 11 percent, and the tax rate is 50 percent.

SOLUTION

$$k_d = k_i(1 - t)$$

- (a) $k_d = 10\% (1 - 0.4) = 6\%$
(b) $k_d = 11\% (1 - 0.5) = 5.5\%$

- 10.2 Cost of Bonds.** XYZ Company has bonds outstanding with 7 years left before maturity. The bonds are currently selling for \$800 per \$1,000 face value. The interest is paid annually at a rate of 12 percent. The firm's tax rate is 40 percent. Calculate the after-tax cost of debt using (a) the regular method, and (b) the shortcut method.

SOLUTION

- (a) Using the regular method, the yield to maturity is:

$$\begin{aligned} V &= \sum_{t=1}^n \frac{I}{(1+r)^t} + \frac{M}{(1+r)^n} \\ &= I(\text{PVIFA}_{r,n}) + M(\text{PVIF}_{r,n}) \\ \$800 &= \$120(\text{PVIFA}_{r,7}) + \$1,000(\text{PVIF}_{r,7}) \end{aligned}$$

At 17%,

$$V = \$120(3.9215) + \$1,000(0.3338) = \$470.58 + \$333.80 = \$804.38$$

which is close enough to \$800; therefore, the yield to maturity or before-tax cost of debt is 17 percent.

The after-tax cost of debt is computed as:

$$\begin{aligned} k_d &= k_i(1 - t) \\ &= 17\% (1 - 0.4) = 10.2\% \end{aligned}$$

(b) Using the shortcut method:

$$k_i = \frac{I + [(M - V)/n]}{(M + V)/2} = \frac{\$120 + [(\$1,000 - \$800)/7]}{(\$1,000 + \$800)/2} = \frac{\$120 + \$28.57}{\$900} = 16.51\%$$

Therefore, the after-tax cost of debt is computed as:

$$k_d = 16.51\%(1 - 0.4) = 9.91\%$$

10.3 Cost of Bonds. Assume the same data as in Problem 10.2, but now assume the interest is paid semiannually. Calculate the after-tax cost of debt, using (a) the regular method, and (b) the shortcut method.

SOLUTION

(a) Since the interest is paid semiannually, the interest payment is $\$120 \div 2 = \60 and the number of periods is 14. Using the regular method gives:

$$\begin{aligned} V &= I(PVIFA_{r,n}) + M(PVIF_{r,n}) \\ \$800 &= \$60(PVIFA_{i,14}) + \$1,000(PVIF_{i,14}) \end{aligned}$$

To arrive at a value of \$800, first try 8 percent:

$$V = \$60(8.2442) + \$1,000(0.3405) = \$494.65 + \$340.50 = \$835.15$$

Since this is too high, try 9 percent:

$$V = \$60(7.7862) + \$1,000(0.2992) = \$467.17 + \$299.20 = \$766.37$$

Since this value is too low, the cost of debt is somewhere between 8 percent and 9 percent. Using the interpolation:

	8%	9%
PV	\$835.15	\$835.15
True rate	800.00	
PV		766.37
Difference	\$ 35.15	\$ 68.78

$$\text{True rate} = 8\% + \frac{\$35.15}{\$68.78}(1\%) = 8\% + 0.51 = 8.51\%$$

$$\text{Annual rate} = 8.51\% \times 2 = 17.02\%$$

Therefore, the after-tax cost of debt is computed as:

$$k_d = k_i(1 - t) = 17.02\%(1 - 0.4) = 10.21\%$$

(b) Using the shortcut method:

$$k_i = \frac{\$60 + [(\$1,000 - \$800)/14]}{(\$1,000 + \$800)/2} = \frac{\$60 + \$14.29}{\$900} = 8.25\%$$

$$\text{Annual rate} = 8.25\% \times 2 = 16.5\%$$

Therefore, the after-tax cost of debt is computed as:

$$k_d = 16.5\%(1 - 0.4) = 9.9\%$$

10.4 Cost of Preferred Stock. In its capital structure, ABC Corporation has preferred stock paying a dividend of \$5 per share and selling for \$23. The company's tax rate is 40 percent. Calculate (a) the before-tax cost of preferred stock, and (b) the after-tax cost of preferred stock.

SOLUTION

(a) The before-tax cost of preferred stock is:

$$k_p = \frac{d_p}{p} = \frac{\$5}{\$23} = 21.7\%$$

(b) The same as the above, since preferred stock dividends are not a tax-deductible expense and are therefore paid out after taxes.

10.5 Cost of Retained Earnings. Plato Company's common stock is selling for \$50. Last year's dividend was \$4.8 per share. Compute the cost of retained earnings (or internal equity) if both earnings and dividends are expected to grow at (a) zero percent and (b) a constant rate of 9 percent.

SOLUTION

$$(a) \quad D_1 = D_0(1 + g) = \$4.8(1 + 0) = \$4.8$$

$$k_s = \frac{D_1}{P_0} = \frac{\$4.8}{\$50} = 9.6\%$$

$$(b) \quad D_1 = D_0(1 + g) = \$4.8(1 + 0.09) = \$5.232$$

$$k_s = \frac{D_1}{P_0} + g = \frac{\$5.232}{\$50} + 9\% = 10.5 + 9\% = 19.5\%$$

10.6 Cost of Retained Earnings (or Internal Equity). Epsilon Company's last annual dividend was \$4 per share, and both earnings and dividends are expected to grow at a constant rate of 8 percent. The stock now sells for \$50 per share. The company's beta coefficient is 1.5. The return of a market portfolio is 12 percent, and the risk-free rate is 8 percent. The company's A-rated bonds are yielding 12 percent. Calculate the cost of retained earnings (or internal equity) using: (a) the Gordon's growth model; (b) the bond plus method; and (c) the capital asset pricing model.

SOLUTION

(a) For the Gordon's growth model:

$$D_1 = D_0(1 + g) = \$4.00(1 + 0.08) = \$4.32$$

$$k_s = \frac{D_1}{P_0} + g = \frac{\$4.32}{\$50} + 8\% = 8.64\% + 8\% = 16.64\%$$

$$(b) \quad k_s = \text{bond yield} + \text{risk premium} = 12\% + 4\% = 16\%$$

For the bond plus method, a risk premium of about 4 percent is commonly used:

(c) For the CAPM:

$$k_s = r_f + b(r_m - r_f) = 8\% + 1.5(12\% - 8\%) = 8\% + 6\% = 14\%$$

10.7 Cost of New Common Stock. Assume the data given in Problem 10.5 are for new stock. Compute the cost of new common stock (or external equity). Assume there is a 10 percent flotation cost associated with issuing new common stock.

SOLUTION

$$(a) \quad D_1 = D_0(1 + g) = \$4.80(1 + 0) = \$4.80$$

$$k_e = \frac{D_1}{P_0(1 - f)} + g = \frac{\$4.80}{\$50(1 - 0.1)} + 0 = \frac{\$4.80}{\$45} = 10.67\%$$

$$(b) \quad D_1 = D_0(1 + g) = \$4.80(1 + 0.09) = \$5.232$$

$$k_e = \frac{D_1}{P_0(1 - f)} + g = \frac{\$5.232}{\$50(1 - 0.1)} + 9\%$$

$$= \frac{\$5.232}{\$45} + 9\% = 11.63\% + 9\% = 20.63\%$$

10.8 Costs of Retained Earnings and New Common Stock. Armon Brothers, Inc., is attempting to evaluate the costs of internal and external common equity. The company's stock is currently selling for \$62.50 per share. The company expects to pay \$5.42 per share at the end of the year. The dividends for the past 5 years are given below:

Year	Dividend
19X5	\$5.17
19X4	\$4.92
19X3	\$4.68
19X2	\$4.46
19X1	\$4.25

The company expects to net \$57.50 per share on a new share after flotation costs. Calculate: (a) the growth rate of dividends; (b) the flotation cost (in percent); (c) the cost of retained earnings (or internal equity); and (d) the cost of new common stock (or external equity).

SOLUTION

$$(a) \quad \$5.17 = \$4.25(\text{FVIF}_{i, 5 \text{ yrs}})$$

$$\text{FVIF}_{i, 5 \text{ yrs}} = \frac{\$5.17}{\$4.25} = 1.216$$

From Appendix A, we obtain 5 percent from the 4-year line.
Alternatively,

$$\$5.42 = \$4.25(\text{FVIF}_{i, 5 \text{ yrs}})$$

$$\text{FVIF}_{i, 5 \text{ yrs}} = \frac{\$5.42}{\$4.25} = 1.276$$

From Appendix A, obtain 5 percent in the 5-year line.

- (b) The flotation cost percentage is calculated as follows:

$$\frac{\$62.50 - \$57.50}{\$62.50} = \frac{\$5}{\$62.50} = 8\%$$

- (c) The cost of retained earnings, k_s , is:

$$k_s = \frac{D_1}{P_0} + g = \frac{\$5.42}{\$62.50} + 5\% = 8.67\% + 5\% = 13.67\%$$

- (d) The cost of new common stock, k_e , is:

$$\begin{aligned} k_e &= \frac{D_1}{P_0(1-f)} + g = \frac{\$5.42}{\$62.5(1-0.08)} + 5\% = \frac{\$5.42}{\$57.50} + 5\% \\ &= 9.43\% + 5\% = 14.43\% \end{aligned}$$

10.9 Weighted Average Cost of Capital. The Gamma Products Corporation has the following capital structure, which it considers optimal:

Bonds, 7% (now selling at par)	\$ 300,000
Preferred stock, \$5.00	240,000
Common stock	360,000
Retained earnings	300,000
	<u>\$1,200,000</u>

Dividends on common stock are currently \$3 per share and are expected to grow at a constant rate of 6 percent. Market price per share of common stock is \$40, and the preferred stock is selling at \$50. Flotation cost on new issues of common stock is 10 percent. The interest on bonds is paid annually. The company's tax rate is 40 percent.

Calculate: (a) the cost of bonds; (b) the cost of preferred stock; (c) the cost of retained earnings (or internal equity); (d) the cost of new common stock (or external equity); and (e) the weighted average cost of capital.

SOLUTION

- (a) Since the bonds are selling at par, the before-tax cost of bonds (k_i) is the same as the coupon rate, that is, 7 percent. Therefore, the after-tax cost of bonds is

$$\begin{aligned} k_d &= k_i(1-t) \\ &= 7\%(1-0.4) = 4.20\% \end{aligned}$$

- (b) The cost of preferred stock is:

$$k_p = \frac{d_p}{p} = \frac{\$5}{\$50} = 10\%$$

- (c) The cost of retained earnings is:

$$\begin{aligned} D_1 &= D_0(1+g) = \$3(1+0.06) = \$3.18 \\ k_s &= \frac{D_1}{P_0} + g = \frac{\$3.18}{\$40} + 6\% = 7.95\% + 6\% = 13.95\% \end{aligned}$$

- (d) The cost of new common stock is:

$$k_e = \frac{D_1}{P_0(1-f)} + g = \frac{\$3.18}{\$40(1-0.1)} + 6\% = 8.83\% + 6\% = 14.83\%$$

(e) The weighted average cost of capital is computed as follows:

Source of Capital	Capital Structure	Percentage	Cost	Weighted Cost
Bonds	\$ 300	25%	4.20%	1.05 %
Preferred stock	240	20	10.00%	2.00
Common stock	360	30	13.95%	4.185
Retained earnings	300	25	14.83%	3.708
Totals	<u>\$1,200</u>	<u>100%</u>		<u>10.943%</u>

Weighted average cost of capital = 10.943%

10.10 Weighted Average Cost of Capital. Valie Enterprises, Inc., has compiled the following investments:

Type of Capital	Book Value	Market Value	After-Tax Cost
Long-term debt	\$3,000,000	\$2,800,000	4.8%
Preferred stock	102,000	150,000	9.0%
Common stock	<u>1,108,000</u>	<u>2,500,000</u>	13.0%
	\$4,210,000	\$5,450,000	

(a) Calculate the weighted average cost of capital, using (1) book value weights and (2) market value weights. (b) Explain the difference in the results obtained in (a).

SOLUTION

(a) (1) Book value weights are computed as follows:

Type of Capital	Book Value	Weight	Cost	Weighted Cost
Long-term debt	\$3,000,000	0.713	4.8%	3.422%
Preferred stock	102,000	0.024	9.0%	0.216
Common stock	<u>1,108,000</u>	<u>0.263</u>	13.0%	<u>3.419</u>
	\$4,210,000	1.000		<u>7.057%</u>

(2) Market value weights are computed as follows:

Type of Capital	Market Value	Weight	Cost	Weighted Cost
Long-term debt	\$2,800,000	0.514	4.8%	2.467%
Preferred stock	150,000	0.028	9.0%	0.252
Common stock	<u>2,500,000</u>	<u>0.458</u>	13.0%	<u>5.954</u>
	\$5,450,000	1.000		<u>8.673%</u>

(b) The book value weights give the firm a much greater leverage (or debt position) than the market value weights. The cost of capital based on market value weights is more realistic, since it is based on the prevailing market values. Since common stock usually sells at a higher value than its book value, the cost of capital is higher when using market value weights.

10.11 Cost of Capital. The Conner Company has the following capital structure:

Mortgage bonds, 6%	\$ 20,000,000
Common stock (1 million shares)	25,000,000
Retained earnings	55,000,000
	<u>\$100,000,000</u>

Mortgage bonds of similar quality could be sold at a net of 95 to yield 6½ percent. Their common stock has been selling for \$100 per share. The company has paid 50 percent of earnings in dividends for several years and intends to continue the policy. The current dividend is \$4 per share. Earnings are growing at 5 percent per year. If the company sold a new equity issue, it would expect to net \$94 per share after all costs. Their marginal tax rate is 50 percent.

Conner wants to determine a cost of capital to use in capital budgeting. Additional projects would be financed to maintain the same relationship between debt and equity. Additional debt would consist of mortgage bonds, and additional equity would consist of retained earnings. (a) Calculate the firm's weighted average cost of capital, and (b) explain why you used the particular weighting system. (CMA, adapted.)

SOLUTION

(a)

	Amount	Proportion	After-Tax Cost	Weighted Average
Bonds	20	20%	3.25% ^a	0.65%
Common stock	25	25	9.0 ^b	2.25
Retained earnings	55	55	9.0	4.95
	<u>100</u>	<u>100%</u>		<u>7.85%</u>

^a3.25% = 6.5%(1 - 0.5)

^bThe cost of equity capital is:

$$k_e = \frac{D_1}{P_0} + g = \frac{4.00}{100.00} + 0.05 = 9.0\%$$

Market value weighting (in millions) produces the following cost of capital:

Bonds	19	16%	3.25%	0.52%
Common and retained earnings	100	84	9.00%	7.56
	<u>119</u>	<u>100%</u>		<u>8.08%</u>

- (b) The weighting to be used should reflect the mix of capital the company intends to use (presumably based upon its understanding of the optimal mix). The problem states that the company intends to maintain the same relationship between debt and equity. If that relationship is defined as the book value relationship, then that should be used to calculate the weighted average cost of capital. If the relationship referred to means the market value weighted average cost of capital, then that relationship should be used.

10.12 Cost of Capital Comparison. The treasurer of a new venture, Start-Up Scientific, Inc., is trying to determine how to raise \$6 million of long-term capital. Her investment adviser has devised the alternative capital structures shown below:

Alternative A		Alternative B	
\$2,000,000	9% debt	\$4,000,000	12% debt
\$4,000,000	Equity	\$2,000,000	Equity

If alternative A is chosen, the firm would sell 200,000 shares of common stock to net \$20 per share. Stockholders would expect an initial dividend of \$1 per share and a dividend growth rate of 7 percent.

Under alternative B, the firm would sell 100,000 shares of common stock to net \$20 per share. The expected initial dividend would be \$0.90 per share, and the anticipated dividend growth rate 12 percent.

Assume that the firm earns a profit under either capital structure and that the effective tax rate is 50 percent. (a) What is the cost of capital to the firm under each of the suggested capital structures? Explain your result. (b) Explain the logic of the anticipated higher interest rate on debt associated with alternative B. (c) Is it logical for shareholders to expect a higher dividend growth rate under alternative B? Explain your answer. (CMA, adapted.)

SOLUTION

- (a) The cost of capital for a firm is computed as a weighted average of the component costs of the sources used to raise capital where the weights relate to the percentage of total capital raised. In this case the two components are debt and equity.

$$\text{Cost of debt } (k_d) = (\text{interest rate})(1 - \text{tax rate})$$

$$\text{Cost of equity } (k_e) = \frac{\text{dividend}}{\text{price}} + \text{growth}$$

$$\text{Overall cost of capital } (k_o) = (\text{weight of debt})(k_d) + (\text{weight of equity})(k_e)$$

For alternative A:

$$k_d = 0.09(1 - 0.5) = 4.5\%$$

$$k_e = \frac{\$1}{\$20} + 0.07 = 12\%$$

$$k_o = \frac{2}{6} \times 0.045 + \frac{4}{6} \times 0.12 = 9.5\%$$

For alternative B:

$$k_d = 0.12(1 - 0.5) = 6\%$$

$$k_e = \frac{\$0.90}{\$20} + 0.12 = 16.5\%$$

$$k_o = \frac{4}{6} \times 0.06 + \frac{2}{6} \times 0.165 = 9.5\%$$

The weighted average cost of capital is the same for alternatives A and B because the risk = return trade-offs for A and B balance each other.

- (b) The interest rate on debt is higher for alternative B because the financial risk is greater due to the increased use of leverage. As a result, the probability of not being able to meet the high fixed payment increases, causing the bond market to have a higher required rate of return to offset this greater risk.
- (c) It is logical for shareholders to expect a higher dividend growth rate under alternative B because of the additional financial risk and increased fixed interest requirement. Equity holders will demand a higher return to compensate them for the additional financial risk. Dividends per share should grow at a faster rate than alternative A because earnings per share grow faster due to the greater amount of leverage (smaller base). In addition, assuming a given payout rate, it follows that dividends per share would also grow faster than alternative A.

- 10.13 Cost of Capital.** Timel Company is in the process of determining its capital budget for the coming fiscal year. Timel Company's balance sheet reflects five sources of long-term funds. The current outstanding amounts from these five sources are shown below and represent the company's historical sources of funds fairly accurately.

Source of Funds	\$ Amount (in Millions)	%
Mortgage bonds (\$1,000 par, $7\frac{1}{2}\%$)	135	15.0
Debentures (\$1,000 par, 8%, due 19X5)	225	25.0
Preferred stock (\$100 par, $7\frac{1}{2}\%$)	90	10.0
Common stock (\$10 par)	150	16.7
Retained earnings	<u>300</u>	<u>33.3</u>
	<u>900</u>	<u>100.0</u>

Timel will raise the funds necessary to support the selected capital investment projects so as to maintain its historical distribution among the various sources of long-term funds. Thus, 15 percent will be obtained from additional mortgage bonds on new plant, 25 percent from debentures, 10 percent from preferred stock, and 50 percent from some common equity source. Timel's policy is to reinvest the funds derived from each year's earnings in new projects. Timel issues new common stock only after all funds provided from retained earnings have been exhausted.

Management estimates that its net income after taxes for the coming year will be \$4.50 per common share. The dividend payout ratio will be 40 percent of earnings to common shareholders (\$1.8 per share), the same ratio as the prior 4 years. The preferred stockholders will receive \$6.75 million. The earnings retained will be used as needed to support the capital investment program.

The capital budgeting staff, in conjunction with Timel's investment broker, has developed the following data regarding Timel's sources of funds if it were to raise funds in the current market.

Source of Funds	Par Value (\$)	Interest or Dividend Rate (%)	Issue Price (\$)
Mortgage bonds	1,000	14	1,000.00
Debentures	1,000	$14\frac{1}{2}$	1,000.00
Preferred stock	100	$13\frac{1}{2}$	99.25
Common stock	10		67.50

The estimated interest rates on the debt instruments and the dividend rate on the preferred stock are based upon the rates being experienced in the market by firms which are of the same size and quality as Timel. The investment banker believes that the price of \$67.50 for the common stock is justified, since Timel's price/earnings ratio of 15 is consistent with the 10 percent earnings growth rate that the market is capitalizing.

Timel is subject to a 40 percent income tax rate.

Calculate (a) the after-tax marginal cost of capital for each of the five sources of capital for Timel Company, and (b) Timel Company's after-tax weighted average cost of capital. (c) Timel Company follows a practice that 50 percent of any funds raised will be derived from common equity sources. Determine the point of expansion at which Timel's source of common equity funds would switch from retained earnings to new common stock in the coming year. (d) If the basic business risks are similar for all firms in the industry in which Timel Company participates,

would all firms in the industry have approximately the same weighted average cost of capital? Explain your answer. (CMA, adapted.)

SOLUTION

(a) For a mortgage bond:

$$k_d = \text{current yield} (1 - \text{tax rate}) = 14\%(1 - 0.4) = 8.4\%$$

For a debenture:

$$k_d = \text{current yield} (1 - \text{tax rate}) = 14.5\%(1 - 0.4) = 8.7\%$$

For preferred stock:

$$k_p = \frac{\text{dividend}}{\text{issue price}} = \frac{\$13.5}{\$99.25} = 13.6\%$$

For common stock:

$$k_e = \frac{\text{current dividend}}{\text{current price}} + \text{expected growth rate} = \frac{\$1.80}{\$67.50} + 10\% = 12.67\%$$

For retained earnings:

$$k_s = \text{opportunity rate of return on common stock} = k_e = 12.67\%$$

(b) The weighted average cost of capital is calculated as follows:

Source	Current Component Cost (%)	Weights	Weighted Average Cost
Mortgage bond	8.4	0.15	0.0126
Debenture	8.7	0.25	0.0217
Preferred stock	13.6	0.10	0.0136
Common stock	12.67	0.167	0.0212
Retained earnings	12.67	0.333	0.0422
Total			<u>0.1113</u>

The weighted average cost of capital is 11.13 percent.

(c) The maximum expansion from retained earnings before a new common stock is required is calculated as follows (in millions of dollars):

Net income (\$4.50/common share × 15 million shares)	\$67.5
Less: Dividend payout (\$1.80/common share × 15 million shares)	27.0
Preferred stock dividend	<u>6.75</u>
Retained earnings available for expansion	<u>\$33.75</u>

If common equity is to be 50 percent of total capital, then the \$33.75 million increase in retained earnings would be matched by raising an additional \$33.75 million from debt and preferred stock for a total of \$67.5 million expansion before common shares would be issued.

(d) The weighted average cost of capital may vary among firms in the industry even if the basic business risk is similar for all firms in the industry. This is true because each firm selects the degree of financial leverage it desires. A firm with a high degree of financial leverage would be assigned a high-risk premium by investors.

10.14 Cost of Capital and Weighting System. Electro Tool Co., a manufacturer of diamond drilling, cutting, and grinding tools, has \$1 million of its 8 percent debenture issue maturing on September 1, 19X1. The \$1 million that has been accumulated to retire this debt is now going to be used to acquire additional manufacturing machinery. To meet the debt and purchase of machinery, an additional \$1 million must be raised. One proposal that has been particularly appealing is the sale and lease-back of the company's general office building. This proposal has a lower interest cost than the financing program proposed by the equipment vendor.

The building would be sold to FHR, Inc., for \$1 million and leased back on a 25-year lease. The lease calls for Electro Tool to pay \$110,168 annually, which permits FHR, Inc., to recover its investment and earn 10 percent on the investment. Electro Tool will pay for all maintenance costs, property taxes, and insurance during the lease period. At the end of the 25 years Electro Tool will reacquire the building for a very small payment. The sale and lease-back will be treated the same for both financial reporting and income tax purposes.

The current capital structure and cost of the individual components for Electro Tool Co. are shown below.

Capital Component	Amount per Recent Balance Sheet	Before-Tax Component Cost
8% debentures (including the \$1,000,000 to be retired)	\$ 5,000,000 1,000,000	8% 9%
9% preferred stock	2,000,000	13%
Common stock	2,000,000	12%
Retained earnings	<u>\$10,000,000</u>	

Electro Tool is subject to a 40 percent income tax rate.

(a) Using the data provided, calculate the historical weighted average cost of capital of Electro Tool Co. (1) before the retirement of the debentures and the sale and lease-back action, and (2) after the retirement of the debentures and the sale and lease-back transaction. (b) If the component costs and weightings used to calculate the weighted average cost of capital in (a) (1) are different from those used in (a) (2), explain why. If the amounts used to calculate (a) (1) are the same as those used in (a) (2), explain why. (c) Market values for the capital components were not presented. What arguments are given to support the use of market values in calculating the weighted average cost of capital? (CMA, adapted.)

SOLUTION

(a) (1) The historical weighted average cost of capital before the retirement of the debentures and the sale and lease-back transaction is 8.3 percent, as calculated below.

	(1) Amount per Recent Balance Sheet	(2) % of Total	(3) Before-Tax Cost	(4) After-Tax Cost	(5) Weighted Cost (2) × (4)
8% debentures	\$ 5,000,000	50%	0.08	0.048	0.024
9% preferred stock	1,000,000	10	0.09	0.09	0.009
Common stock	2,000,000	20	0.13	0.13	0.026
Retained earnings	2,000,000	20	0.12	0.12	0.024
	<u>\$10,000,000</u>	<u>100%</u>			<u>0.083</u>

(2) The historical weighted average cost of capital after the retirement of the debentures and the sale and lease-back transaction is 8.42 percent as calculated below.

	(1) Amount per Recent Balance Sheet	(2) % of Total	(3) Before-Tax Cost	(4) After-Tax Cost	(5) Weighted Cost (2) × (4)
Lease	\$ 1,000,000	10%	0.10	0.06	0.006
Debentures	4,000,000	40	0.08	0.048	0.0192
Preferred stock	1,000,000	10	0.09	0.09	0.009
Common stock	2,000,000	20	0.13	0.13	0.026
Retained earnings	2,000,000	20	0.12	0.12	0.024
	<u>\$10,000,000</u>	<u>100%</u>			<u>0.0842</u>

- (b) The component costs and weightings used to calculate the historical weighted average cost of capital are different in (a) (1) and (a) (2) because lease financing is substituted for a portion of the debentures. Therefore, the debentures now represent only 40 percent of the total capital and the lease 10 percent. The after-tax cost of the lease is $0.10 \times 0.60 = 0.06$, whereas the after-tax cost of the debentures is $0.08 \times 0.60 = 0.048$. The overall cost of capital is increased because a higher cost component replaced a lower cost component.
- (c) Market values should be used in calculating the weighted average cost of capital because the cost of capital calculation is used to estimate the current marginal cost of capital for the company. The use of market values: (1) recognizes the current investor attitudes regarding the company's risk position and thus will reflect current rates for capital; (2) recognizes better the capital proportions the company must consider in the capital sources decision; and (3) ignores the influence of past values which are not relevant to future decisions.

10.15 Bond Rating and Cost of Capital. Two bond rating agencies, Moody's and Standard and Poor's, lowered the ratings on Appleton Industries' bonds from triple-A to double-A in response to operating trends revealed by the financial reports of recent years. The change in the ratings is of considerable concern to the Appleton management because the company plans to seek a significant amount of external financing within the next 2 years.

(a) Identify several events or circumstances which could have occurred in the operations of Appleton Industries that might have influenced the factors the bond rating agencies use to evaluate the firm and, as a result, caused the bond rating agencies to lower Appleton's bond rating. (b) If Appleton Industries maintains its present capital structure, what effect will the lower bond ratings have on the company's weighted average cost of capital? Explain your answer. (c) If Appleton Industries' capital structure was at an optimal level before the rating of its bonds was changed, explain what effect the lower bond ratings will have on the company's optimal capital structure. (CMA, adapted.)

SOLUTION

- (a) Factors or circumstances which may have caused the rating agencies to lower the bond rating of Appleton Industries include:
1. Lowered long-term solvency reflected by a reduction in the times-interest-earned ratio or a reduction in the fixed-charge-coverage ratio
 2. Lowered short-term liquidity reflected by a decrease in the current ratio or quick ratio
 3. Lowered profitability reflected by a reduced market share, lower return on sales, or decreased profits
 4. An increased risk of financial stability due to major pending litigation which would be damaging to the firm or a large increase in earnings variability
 5. A major change in management which is perceived negatively by the financial community

- (b) The weighted average cost of capital can be expected to rise. The lower bond rating is usually relied upon as an indication of greater risk being assumed by the bond investors. This change will be noted by the investors of other Appleton securities. Thus the investors in each capital component of Appleton Industries can be expected to require a higher return.
- (c) Appleton Industries capital structure will shift toward greater equity with less debt. The fact that the bond rating was lowered would indicate to investors that the risk has increased. To reduce the risk and minimize the increase in the cost of capital, the optimal capital structure will have to shift toward one with an increased percentage of equity.

10.16 Earnings Multiple and Cost of Capital. The Jefferson Corporation is contemplating a \$50 million expansion project. Over the years, the firm's board of directors has adhered to a policy of rejecting any investment proposal that would jeopardize the market value of the firm's common stock.

A preliminary analysis projected a rate of return on the new project of around 14 percent before taxes. Jefferson has reached tentative agreement with an insurance company to finance the project through a private placement of the \$50 million in the form of 10 percent notes.

The firm's common stock has been historically selling at 10 times after-tax earnings. Current earnings per share are \$2.70 and the firm faces a 50 percent corporate income tax rate.

Long-term debt (8%)	\$ 10,000,000
Common stock (\$2 par, 10,000,000 shares outstanding)	20,000,000
Paid-in capital, in excess of par	70,000,000
Retained earnings	<u>100,000,000</u>
Total capitalization	<u>\$200,000,000</u>

- (a) One of the members of Jefferson Corporation's board of directors argued that the firm should immediately place the notes, since the before-tax marginal cost of capital for the project is only 10 percent (the interest on the notes), and indications are that the project's before-tax rate of return would be greater than 10 percent. Discuss.
- (b) Assuming Jefferson's earnings multiple declines to 9, what level of annual earnings must the new project generate in order to meet the director's objective? (CMA, adapted.)

SOLUTION

- (a) The board members' conclusion is not valid because the facts seem to indicate the Jefferson Corporation's capitalization is not in equilibrium. The issuance of the notes will move debt from 5 percent of total capitalization (10/200) to 24 percent (60/250). This increases the financial risk that common equity must bear through increased fixed interest payments, and the increased risk can be expected to be manifested by a decline in the earnings multiple. While the marginal cost of capital appears to be 10 percent (the cost of the private placement), the marginal cost of capital is a combination of explicit interest cost on the notes and the additional costs of earnings that must occur to compensate the common stockholders for the decline in the earnings multiple.

Jefferson Corporation should have calculated the weighted average cost of capital according to the following formula:

$$\left(\frac{\text{Percent of new funds raised from debt}}{\text{raised from debt}} \right) \times (\text{cost of debt}) + \left(\frac{\text{percent of funds raised from equity}}{\text{raised from equity}} \right) \times (\text{additional cost of equity})$$

The 14 percent rate of return on this project should be compared to the firm's average cost of capital. If the project's return is at least as great as the weighted average cost of capital, then the value of the firm's stock will not decrease.

- (b) The stock is now selling at 10 times earnings:

$$P_0 = 10(\$2.70) = \$27.00$$

This is the price that must be maintained upon taking on the new project. If the new project causes

the P/E ratio to fall to 9 and offers no additional earnings, the price of stock would fall by \$2.70 to \$24.30.

In order to get the price of stock back up to \$27, the earnings provided by the new asset must equal X :

$$\begin{aligned}(\text{New P/E})(\text{new EPS}) &= \$27 \\ 9(\$2.70 + X) &= \$27 \\ \$2.70 + X &= \$3 \\ X &= \$0.30\end{aligned}$$

This assumes that currently held assets are capable of continuing to provide \$2.70 in earnings per share.

The annual earnings the new project must generate to meet Jefferson Corporation's objective are determined as follows:

- (1) Required EPS to maintain \$27 price with a multiple of 9:

$$\frac{\$27.00}{9} = \$3.00$$

- (2) Required earnings after taxes:

$$\$3.00 \times 10,000,000 \text{ shares} = \$30,000,000$$

- (3) Required earnings before taxes:

$$\frac{\$30,000,000}{0.5} = \$60,000,000$$

- (4) Interest expense:

$$(\$10,000,000)(0.08) + (\$50,000,000)(0.10) = \$800,000 + \$5,000,000 = \$5,800,000$$

- (5) Required earnings before interest and taxes:

$$\$60,000,000 + \$5,800,000 = \$65,800,000$$

- (6) Old earnings before interest and taxes:

$$\frac{(\$2.70 \times 10,000,000 \text{ shares})}{0.5} + \$800,000 = \$54,800,000$$

- (7) Additional before interest and taxes earnings required:

Projected earnings	\$65,800,000
Old earnings	<u>54,800,000</u>
	<u>\$11,000,000</u>

10.17 The MCC and IOS Schedules. Rhonda Pollak Company is considering three investments whose initial costs and internal rates of return are given below:

Project	Initial Cost (\$)	Internal Rate of Return (%)
A	100,000	19
B	125,000	15
C	225,000	12

The company finances all expansion with 40 percent debt and 60 percent equity capital. The after-tax cost is 8 percent for the first \$100,000, after which the cost will be 10 percent. Retained earnings in the amount of \$150,000 is available, and the common stockholders' required rate of return is 18 percent. If the new stock is issued, the cost will be 22 percent.

Calculate (a) the dollar amounts at which breaks occur, and (b) calculate the weighted cost of capital in each of the intervals between the breaks. (c) Graph the firm's weighted marginal cost of capital (MCC) schedule and investment opportunities schedule (IOS). (d) Decide which projects should be selected and calculate the total amount of the optimal capital budget.

SOLUTION

- (a) Breaks (increases) in the weighted marginal cost of capital will occur as follows:

For debt:

$$\frac{\text{Debt}}{\text{Debt/assets}} = \frac{\$100,000}{0.4} = \$250,000$$

For common stock:

$$\frac{\text{Retained earnings}}{\text{Equity/assets}} = \frac{\$150,000}{0.6} = \$250,000$$

The debt break is caused by exhausting the lower cost of debt, while the common stock break is caused by using up retained earnings.

- (b) The weighted cost of capital in each of the intervals between the breaks is computed as follows:
With \$0–\$250,000 total financing:

Source of Capital	Weight	Cost	Weighted Cost
Debt	0.4	8%	3.2%
Common stock	0.6	18%	10.8
			$k_o = \underline{\underline{14.0\%}}$

With over \$250,000 total financing:

Source of Capital	Weight	Cost	Weighted Cost
Debt	0.4	10%	4.0%
Common stock	0.6	22%	13.2
			$k = \underline{\underline{17.2\%}}$

- (c) See Fig. 10-2.

- (d) Accept projects A and B for a total of \$225,000, which is the optimal budget.

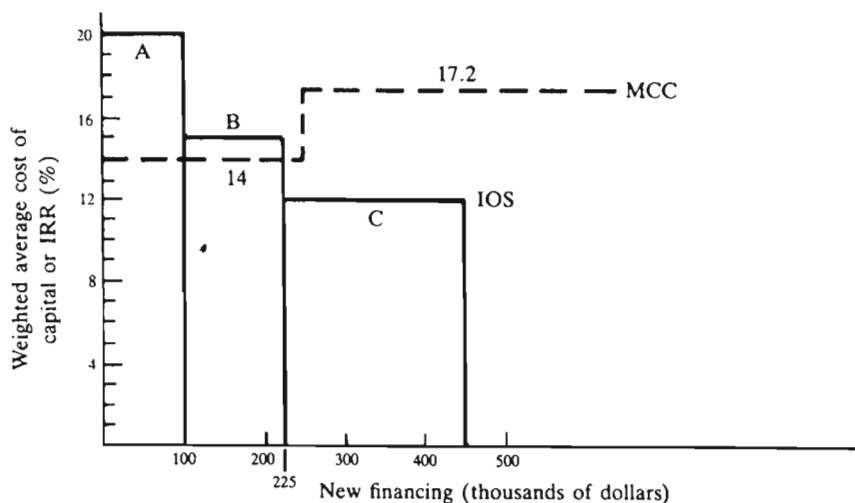


Fig. 10-2

10.18 The MCC and IOS Schedules. John Conostas & Company has to decide which of the following four projects should be selected:

Project	Initial Investment (\$)	Internal Rate of Return (%)
A	250,000	16
B	300,000	10
C	100,000	12
D	150,000	13

The company has the following capital structure:

Debt (long-term only)	30%
Equity	70%

The company's last earnings per share was \$400.

It pays out 50 percent of its earnings as dividends. The company has \$210,000 of retained earnings available for investment purposes. The cost of debt (before taxes) is 10 percent for the first \$180,000. The cost of any additional debt (before taxes) is 14 percent. The company's tax rate is 40 percent; the current market price of its stock is \$43; the flotation cost is 15 percent of the selling price; the expected growth rate in earnings and dividends is 8 percent.

(a) How many breaks are there in the MCC schedule, and at what dollar amounts do the breaks occur? (b) What is the weighted cost of capital in each of the intervals between the breaks? (c) Graph the MCC and IOS schedules. (d) Which projects should the company accept and what is the total amount of the optimal capital budget?

SOLUTION

(a) There are two breaks in the MCC schedule:

$$\text{For common stock: } \frac{\text{Retained earnings}}{\text{Equity/assets}} = \frac{\$210,000}{0.7} = \$300,000$$

$$\text{For debt: } \frac{\text{Debt}}{\text{Debt/assets}} = \frac{\$180,000}{0.3} = \$600,000$$

(b) The weighted cost of capital in each of the intervals between the breaks is calculated as follows:
With \$0 – \$300,000:

Source of Capital	Weight	After-Tax Cost	Weighted Cost
Debt	0.3	6% ^a	1.8%
Retained earnings	0.7	13% ^b	9.1
			$k_o = \underline{\underline{10.9\%}}$

$$^a k_d = k_t(1 - t) = 10\%(1 - 0.4) = 6\%$$

$$^b k_s = \frac{D_1}{P_0} + g = \frac{(\$2.00)(1 + 0.08)}{\$43} + 8\% = \frac{\$2.16}{\$43} + 8\% = 13.0\%$$

With \$300,000–\$600,000:

Source of Capital	Weight	After-Tax Cost	Weighted Cost
Debt	0.3	6%	1.80%
External equity	0.7	13.9% ^a	9.73
			$k_o = \underline{\underline{11.53\%}}$

$$^a k_e = \frac{D_1}{P_0(1 - f)} + g = \frac{(\$2.00)(1 + 0.08)}{\$43(1 - 0.15)} + 8\% = \frac{\$2.16}{\$36.55} + 8\% = 13.9\%$$

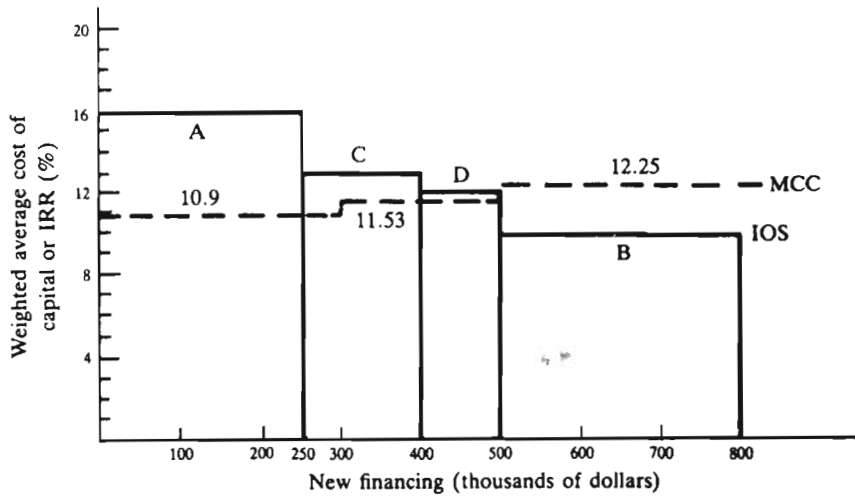


Fig. 10-3

Above \$600,000:

Source of Capital	Weight	After-Tax Cost	Weighted Cost
Debt	0.3	8.4% ^a	2.52%
External equity	0.7	13.9%	9.73
			<u><u>$k_o = 12.25\%$</u></u>

^a $k_d = k_t(1 - t) = 14\%(1 - 0.4) = 8.4\%$

- (c) The MCC and IOS schedules are shown in Fig. 10-3.
- (d) The company should select projects A, D, and C for a total optimal capital budget of \$500,000.