Lecture 10 Capital Structure

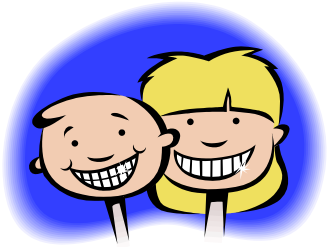
- We simplify the analysis by considering only common stock and common debt in this lecture.

- The capital structure decision is about how much to be financed by debt and how much to be financed by equity. The capital structure decision we consider is the decision to rely on debt.

1 The Pie Theory

“Better make it six, I am not that hungry for eight”

----*Yogi Berry, after being asked if he wanted his pizza in six or eight slices.*



The pie is the sum of the financial claims of the firm, debt and equity in this case.

We define the value of the firm to be this sum. Hence the value of the firm V, is

$$V \equiv B + S$$

Where B is the market value of the debt and S is the market value of the equity.

- If the goal of the management of the firm is to make the firm as valuable as possible, then the firm should pick the debt equity ratio that makes the pie—the total value—as big as possible.

- This lecture is trying to answer the following two questions:

  (1) Why should the stockholders in the firm care about maximizing the value of the entire firm 

  (2) What is the ratio of debt to equity that maximizes the shareholders' interests 

2 Maximizing Firm Value versus Maximizing Stockholder Interests

- The answer to the first question is that changes in capital structure benefit the stockholders if and only if the value of the firm increases. Conversely, these changes hurt the stockholders if and only if the value of the firm decreases.

- The following example illustrates that the capital structure that maximizes the value of the firm is the one that financial managers should choose for the shareholders.

Example 1:

Suppose the market value of the J.J.Sprint Company is $1,000. The company currently has no debt, and each of J.J. Sprint's 100 shares of stock sells for $10.

Further suppose that J.J. Sprint plans to borrow $500 and pay the $500 proceeds to shareholders as an extra cash dividend of $5 per share.

The investments of the firm will not change as a result of this transaction.

What will the value of the firm be after the proposed restructuring?

Management recognizes that, by definition, only one of three outcomes can occur from restructuring.

Firm value after restructuring can be either (1) greater than the original firm value of $1,000, (2) equal to $1,000 or (3) less than $1,000.

After consulting with investment bankers, management believes that restructuring will not change firm value more than $250 in either direction. Thus they view firm values of $1,250, $1,000 and $750 respectively.

	No Debt (original capital structure)	Value of Debt plus Equity after Payment of Dividend (three possibilities)		
		1	2	**3**
Debt	$0	$500	$500	$500
Equity	1,000	750	500	250
Firm Value	**$1,000**	**$1,250**	**$1,000**	**$750**

	Payoff to shareholders after restructuring		
	1	2	3
Capital gains	-$250	-$500	-$750
Dividends	500	500	500
Net gain or loss to stockholders	**$250**	**0**	**-$250**

3 Modigliani and Miller: Proposition I (No Taxes)

3.1 Leverage and Returns to Shareholders

Example 2:

Trans Am Corporation currently has no debt in its capital structure. The firm is considering issuing debt to buy back some of its equity. Both its current and proposed capital structures are presented in the following Table 1.

Table 1

	Current	Proposed
Assets	$8,000	$8,000
Debt	$0	$4,000
Equity	$8,000	$4,000
Interest rate	10%	10%
Market value/share	$20	$20
Shares outstanding	400	200

Table 2

	Recession	Expected	Expansion
Return on assets (ROA)	5%	15%	25%
Earnings	$400	$1,200	$2,000
Return on equity (ROE=Earnings/Equity)	5%	15%	25%
Earnings per share (EPS)	$1.00	$3.00	$5.00

Table 3

	Recession	Expected	Expansion
Return on assets (ROA)	5%	15%	25%
Earnings before interest (EBI)	$400	$1,200	$2,000
Interest	-400	-400	-400
Earnings after interest	$0	$800	$1,600
Return on equity (ROE=Earnings after interest/Equity)	0	20%	40%
Earnings per share (EPS)	0	$4.00	$8.00

Table 2 and 3 show that the effect of financial leverage depends on the company's earnings before interest.

If earnings before interest is equal to $1,200, the return on equity (ROE) is higher under the proposed structure. If earnings before interest is equal to $400, the ROE is higher under the current structure.

This idea is presented in the Figure.

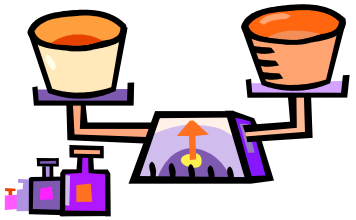
The solid line represents the case of no leverage.

The dotted line represents the case of $4,000 of debt.

- The slope of the line for the levered firm is greater than the slope of the line for the unlevered firm. This means that the levered stockholders have better returns in good times than do unlevered stockholders but have worse returns in bad times, implying _____ (greater/lower) risk with leverage.

In other words, the slope of the line measures the risk to stockholders, since the slope indicates the responsiveness of ROE (EPS) to changes in firm performance (EBI).

- Because the dotted line has a lower intercept but a higher slope, the two lines must intersect. The break even point （盈亏平衡点）occurs at $800 of EBI.



3.2 The Choice Between Debt and Equity

At this point, leverage may be beneficial, because EPS is expected to be $4 with leverage and only $3 without leverage.

However, leverage also creates risk.

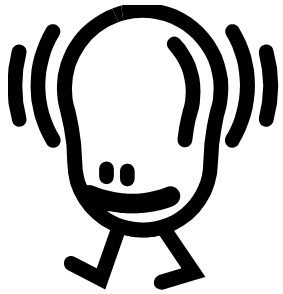
Thus a risk averse investor might prefer the all equity firm, while a risk neutral investor might prefer leverage.

Given this ambiguity, which capital structure is better?

Modigliani and Miller state that a firm cannot change the total value of its outstanding securities by changing the proportions of its capital structure. In other words, the value of the firm is always the same under different capital structures.

This result is famous MM proposition I.

$$V_U = V_L$$



We compare a simple strategy A with a two part strategy B. Both of these strategies for shareholders of Trans Am are illuminated in the Table 4.

Strategy A: Buy 100 shares of the levered equity.

Strategy B:

(1) Borrow $2,000 from a bank.

(2) Use the borrowed proceeds plus your own investment of $2,000 to buy 200 shares of the current unlevered equity at $20 per share.

Table 4

	Recession	Expected	Expansion
Strategy A: Buy 100 shares of Levered Equity			
EPS of levered equity	$0	$4	$8
Earnings per 100 shares	0	400	800
Initial Cost=100 shares@ $20/share=$2,000			

Strategy B: Homemade Leverage			
Earnings per 200 shares in current unlevered firm	$1*200=200	$3*200=600	$5*200=1,000
Interest at 10% on $2,000	-200	-200	-200
Net earnings	$0	$400	$800
Initial Cost=200 shares@ $20/share-$2,000=$2,000			

- The bottom of the Table 4 shows payoffs under B, which we call the **homemade leverage strategy**（自制财务杠杆）.

- Since both the cost and the payoff from the two strategies are the same. The firm is neither helping nor hurting its stockholders by restructuring.

In other words, an investor is not receiving anything from corporate leverage that he or she could not receive on their own.

Given the higher value of the levered firm, no rational investor would invest in the stock of the levered firm.

Anyone desiring shares in the levered firm would get the same dollar return more cheaply by borrowing to finance a purchase of the unlevered firm's shares. The equilibrium would be that the value of the levered firm would fall, and the value of the unlevered firm would rise until they became equal.

At this point, individuals would be indifferent between Strategy A and B.

- The value of the levered is the same as the value of the unlevered firm.

- **Homemade leverage**: Investors use leverage in their own portfolios to adjust the leverage choice made by the firm. As long as investors can borrow or lend at the same interest rate as the firm, homemade leverage is a prefect substitute for the use of leverage by the firm.

- Leverage does not affect the value of the firm. Since the stockholders' welfare is directly related to the firm's value, then changes in capital structure cannot affect the stockholders' welfare.

3.3 MM Proposition I （资本结构无关论）

Franco Modigliani and Merton Miller (1958)：*In a perfect capital market, the total value of a firm is equal to the market value of the total cash flows generated by its assets and is not affected by its choice of capital structure.*

In other words, financial managers cannot increase value by changing the mix securities used to finance the company.

MM proposition is based on the assumptions of perfect capital markets.

(1) Investors and firms can trade the same set of securities at competitive market prices equal to the present value of their future cash flows. Moreover, individuals and corporations borrow at the same rate.

(2) There are no taxes, transaction costs, or issuance costs associated with security trading.

(3) A firm's financing decisions do not change the cash flows generated by its investments, nor do they reveal new information about them.

4 Modigliani and Miller: Proposition II (No Taxes)

- Though the expected return rises with leverage, the risk rises as well.
- This greater range for the EPS of the levered firm implies greater risk for the levered firm's stockholders. In other words, levered stockholders have better returns in good times than do unlevered stockholders but have worse returns in bad times.
- The Tables also show greater range for the ROE of the levered firm's stockholders.

$$r_{WACC} = \frac{S}{S+B} \times r_S + \frac{B}{S+B} \times r_B$$

Where r_B is the interest rate, also called the cost of debt.

r_S is the expected return on equity or stock, also called the cost of equity or the required return on equity.

r_{WACC} is the firm's weighted average cost of capital.

B is the value of the firm's debt or bond.

S is the value of the firm's stock or equity.

Back to our example 2.

The expected earnings after interest for the unlevered firm are \$1,200. The equity for the unlevered firm is \$8,000. So r_S for the unlevered firm is

$$r_S = \frac{Expected\ earnings\ after\ interest}{Equity} = \frac{\$1{,}200}{\$8{,}000} = 15\%$$

The expected earnings after interest for the levered firm are \$800. The equity for the levered firm is \$4,000. So r_S for the levered firm is

$$r_S = \frac{Expected\ earnings\ after\ interest}{Equity} = \frac{\$800}{\$4{,}000} = 20\%$$

So the market requires only a 15% expected return for the unlevered equity, but it requires a 20% expected return for the levered equity.

Then we calculate r_{WACC} for both the levered and unlevered firm.

$$Unlevered\ firm: r_{WACC} = \frac{0}{\$8{,}000} \times 10\% + \frac{\$8{,}000}{\$8{,}000} \times 15\% = 15\%$$

$$Levered\ firm: r_{WACC} = \frac{\$4{,}000}{\$8{,}000} \times 10\% + \frac{\$4{,}000}{\$8{,}000} \times 20\% = 15\%$$

An implication is that r_{WACC} is a constant for a given firm, regardless of the capital structure. So for this firm, r_{WACC} is 15% with or without leverage.

Now we define r_0 be the cost of capital for an all equity firm. In this example,

$$r_0 = \frac{Expected\ earnings\ to\ unlevered\ firm}{Unlevered\ Equity} = \frac{\$1{,}200}{\$8{,}000} = 15\%$$

r_{WACC} is equal to r_0 in our example.

In fact, r_{WACC} must always equal r_0 in a world without corporate taxes.

MM proposition II states that the expected return on equity is positively related to leverage, because the risk to equityholders increases with leverage.

MM proposition II states the expected return of equity, r_S in terms of leverage.

$$r_S = r_0 + \frac{B}{S}(r_0 - r_B)$$

So the required return on equity is a linear function of the firm's debt to equity ratio.

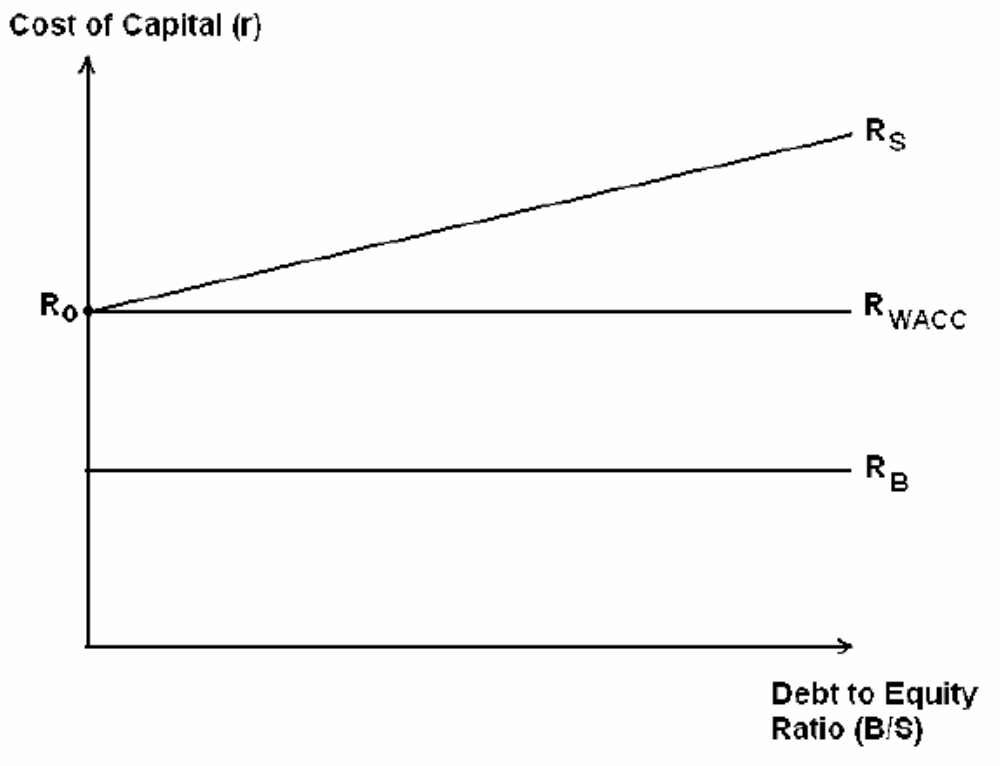
The cost of equity rises with increases in the debt equity ratio, B/S.

In our example:

$$r_S = r_0 + \frac{B}{S}(r_0 - r_B)$$
$$= 15\% + \frac{\$4{,}000}{\$4{,}000}(15\% - 10\%)$$
$$= 20\%$$

We can illustrate MM proposition II in the Figure.

We have plotted the relation between the cost of equity, r_S and the debt equity ratio B/S as a straight line.



- With perfect capital markets, r_{WACC} is independent of its capital structure and is equal to its equity cost of capital if it is unlevered, which matches the cost of capital of its assets, that is, for unlevered firm, we have $r_{wacc} = r_0 = r_{asset}$.

Therefore, if the risk of a project matches the risk of the assets of a firm, we can use the firm's r_{WACC} to estimate the appropriate cost of capital for the projects.

- Asset risk or the firm’s business risk is determined by the type of projects, not how these are financed. Financial leverage or changes in financial leverage do not affect the return to assets or the systematic risk of the firm.

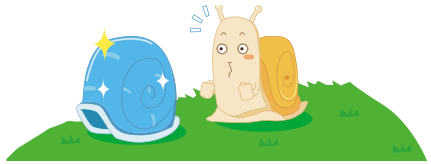
- Leverage impacts on the shareholders return and on their systematic risk.

Example 3:

Luteran Motors, an all equity firm, has expected earnings of $10 million per year in perpetuity. The firm pays all of its earnings out as dividends, so that the $10 million may also be viewed as the stockholder's expected cash flow.

There are 10 million shares outstanding, implying expected annual cash flow of $1 per share.

The cost of capital for this unlevered firm is 10%.



In addition, the firm will soon build a new plant of $4 million. The plant is expected to generate additional cash flow of $1 million per year.

Current Company		New Plant	
Cash flow:	$10 million	Initial outlay:	$4 million
Number of outstanding shares:	10 million	Additional annual cash flow:	$1 million

We assume the project is discounted at the same rate as the firm as a whole. The project's net present value is

$$NPV = -\$4million + \frac{\$1million}{0.1} = \$6million$$

The market value balance sheet of the firm is

Luteran Motors **Balance Sheet (all equity)**	
Old assets: $\frac{\$10million}{0.1} = \$100million$	**Equity:** $100 million (10 million shares of stock)

A Stock Financing.

Imagine that the firm announces that, in the near future, it will raise $4 million in equity in order to build a new plant. The stock price and therefore the value of the firm will rise to reflect the positive NPV of the plant.

According to the EMH, the increase occurs immediately. That is, the rise occurs on the day of the announcement.

The market value balance sheet becomes

Luteran Motors Balance Sheet (upon announcement of equity issue to construct plant)			
Old assets:	**$100 million**	**Equity:**	**$106million**
NPV of plant: $-\$4million+\frac{\$1million}{0.1}=\$6million$		(10 million shares of stock)	
Total assets:	**$106million**	**Total D+E:**	**$106million**

Imagine that funds are put in the bank temporarily before being used to build the plant. Then

Luteran Motors			
Balance Sheet (upon issuance of stock but before construction begins on plant)			
Old assets:	$100 million	**Equity:**	**$110million**
NPV of plant:	$6 million	(10,377,358 shares of stock)	
Proceeds from new issue of stock (currently placed in bank)	$4 million		
Total assets:	**$110million**	**Total D+E:**	**$110million**

Shortly after the new issue, the $4 million is given to a contractor who builds the plant. We assume that the plant is built immediately. Then

Luteran Motors **Balance Sheet (upon completion of the plant)**			
Old assets:	**$100 million**	**Equity:**	**$110million**
PV of plant: $\frac{\$1 million}{0.1} = \$10 million$		(10,377,358 shares of stock)	
Total assets:	**$110million**	**Total D+E:**	**$110million**

Expected annual cash flow from the firm is $11 million, $10 million of which comes from the old assets and $1 million from the new.

Since it is all equity firm, the expected return to equityholders is

$$r_S = \frac{\$11 million}{\$110 million} = 0.1$$

Because the firm is all equity, $r_S = r_0 = 0.1$

B Debt Financing

Alternatively, imagine that the firm announces that, in the near future, it will borrow $4 million at 6 percent to build a new plant. This implies yearly interest payments of $240,000 ($400,000*6%).

Again the stock price rises immediately to reflect the positive NPV of the plant.

Luteran Motors Balance Sheet (upon announcement of debt issue to construct plant)	
Old assets: $100 million	**Equity: $106million** (10 million shares of stock)
NPV of plant: $-\$4million+\frac{\$1million}{0.1}=\$6million$	
Total assets: $106million	**Total D+E: $106million**

The funds are placed in the bank temporarily. Then

Luteran Motors **Balance Sheet (upon debt issuance but before construction begins on plant)**			
Old assets:	$100 million	**Debt**	$4 million
NPV of plant:	$6 million		
Proceeds from debt issue (currently placed in bank)	$4 million	**Equity** (10 million shares of stock)	$106 million
Total assets:	**$110million**	**Total D+E:**	**$110 million**

Finally, the contractor receives $4 million and builds the plant. Then

Luteran Motors **Balance Sheet (upon completion of the plant)**			
Old assets:	$100 million	**Debt**	$4 million
PV of plant:	$10 million		
		Equity	$106 million
		(10 million shares of stock)	
Total assets:	**$110million**	**Total D+E:**	**$110million**

The equityholders expect annual cash flow after interest of

$$\$10{,}000{,}000 + \$1{,}000{,}000 - \$240{,}000 = \$10{,}760{,}000$$

The equityholders expect to earn a return of

$$r_S = \frac{\$10{,}760{,}000}{\$106{,}000{,}000} = 10.15\%$$

The return of 10.15% for levered equityholders is higher than the 10% return for the unlevered equityholders, since levered equity is riskier.

$$\begin{aligned} r_S &= r_0 + \frac{B}{S}(r_0 - r_B) \\ &= 10\% + \frac{\$4{,}000{,}000}{\$106{,}000{,}000}(10\% - 6\%) \\ &= 10.15\% \end{aligned}$$

So this example is consistent with MM proposition I because the value of the firm is $110 million after either equity or debt financing.

And the stock price is always at $10.60, regardless of whether debt or equity financing is used.

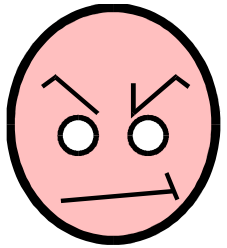
The example is also consistent with MM proposition II. The expected return to equityholders rises from 10 to 10.15% because the equityholders of a levered firm face more risk than do the equityholders of an unlevered firm.

5 An interpretation

- The propositions indicate that managers cannot change the value of a firm by repackaging the firm's securities. The firm's overall cost of capital cannot be reduced as debt is substituted for equity, even though debt appears to be cheaper than equity.
- MM say that a firm's capital structure is irrelevant.

- Do real world managers follow MM by treating capital structure decisions with indifference?

  However, this statement is at odds with the observation that firms invest significant resources, both in terms of managerial time and effect and investment banking fees, in managing their capital structures.



In many instances, the choice of leverage is of critical importance to a firm's value and future success. There are large and systematic variations in the typical capital structures for different industries.

Unfortunately for the theory, virtually all companies in certain industries, such as banking, choose high debt to equity ratios. Conversely, companies in other industries, such as pharmaceuticals, choose low debt to equity ratios.

For example, at year-end-2004, Amgen, a biotechnology and drug firm, has debt of $5 bil. And a market cap. of more than $81bil., giving the firm a debt-equity ratio of 0.06. In contrast, Navistar International, an auto and truck manufacturers, had a debt-equity ratio of 0.95. Truck manufacturers in general have higher debt ratios than biotechnology and drug companies.

In fact, almost any industry has a debt to equity ratio to which companies in that industry adhere.

Example 4:

Alpha Corporation and Beta Corporation are identical in every way except their capital structures. Alpha Corporation, an all equity firm, has 5,000 shares of stock outstanding, currently worth $20 per share.

Beta Corporation uses leverage in its capital structure. The market value of Beta's debt is $25,000. The cost of this debt is 12 percent per annum.

Each firm is expected to have earnings before interest of $350,000 in perpetuity. Neither firm pays taxes. Assume that every investor can borrow at 12 percent per annum.

A What is the value of Alpha Corporation?

B What is the value of Beta Corporation?

C What is the market value of Beta Corporation's equity?

D How much will it cost to purchase 20 percent of each firm's equity?

E Assuming each firm meets its earnings estimates, what will be the dollar return to each position in part D over the next year?

F Construct an investment strategy in which an investor purchases 20 percent of Alpha's equity and replicates both the cost and dollar return of purchasing 20 percent of Beta's equity.

G Is Alpha's equity more or less risky than Beta's equity? Explain.

Example 5：

The Veblen Company and the Knight Company are identical in every respect except that Veblen is not levered.

The market value of Knight Company's 6 percent bonds is $1 million. Financial information for the two firms appears below.

All earnings streams are perpetuities. Neither firm pays taxes. Both firms distribute all earnings available to common stockholders immediately.

	Veblen	Knight
Projected operating income	$300,000	$300,000
Year-end interest on debt		$60,000
Projected earnings available to common stock	$300,000	$240,000
Required return on equity	0.125	0.140
Market value of stock	$2,400,000	$1,714,000
Market value of debt		$1,000,000
Value of the firm	$2,400,000	$2,714,000
Weighted average cost of capital	0.125	0.110
Debt equity ratio	0	0.584

A An investor who is able to borrow at 6 percent per annum wishes to purchase 5 percent of Knight's equity. Can he increase his dollar return by purchasing 5 percent of Veblen's equity if he borrows so that the initial net cost of the two options are the same?

B Given the two investment strategies in A, which will investors choose? When will this process cease?

Example 6:

The Gulf Power Company, an all-equity firm, is planning to build a new power plant. Financial data pertaining to the company and the new power plant are listed below. Assume all earnings are paid out as dividends.

Company Data	
Annual expected earnings (in perpetuity)	$27 million
Number of shares outstanding	10 million
New Power Plant	
Initial outlay	$20 million
Added annual expected earnings (in perpetuity)	$3 million

The new power plant has the same risk as existing assets. The current required rate of return on the firm's equity is 10 percent. Assume there are no taxes and no costs of bankruptcy.

A Construct Gulf's market value balance sheet before the firm announces that it will build the new power plant. What is the price per share of Gulf's equity?

B Suppose Gulf decides to issue equity to fund the initial outlay for the power plant.

1 Construct Gulf's market value balance sheet immediately after the announcement. What is the new price per share of the firm's equity?

2 How many shares will Gulf need to issue in order to fund the outlay?

3 Construct Gulf's market value balance sheet after the equity issue but before the outlay is made.

4 Construct Gulf's market value balance sheet after the outlay has been made.

5 What will the value of Gulf's power be if common stock is issued to finance the construction of the new power plant?

C Suppose Gulf decides to issue $20 million of 8 percent bonds in order to fund the initial outlay for the power plant.

1 Construct Gulf's market value balance sheet immediately after the announcement. What is the new price per share of the firm's equity?

2 Construct Gulf's market value balance sheet after the debt issue but before the outlay is made.

3 Construct Gulf's market value balance sheet after the outlay has been made.

4 What will the value of Gulf Power be if debt is issued to finance the construction of the new power plant?

5 Calculate the rate of return required by equityholders after both the debt issue and the completion of the new plant.

6 Calculate the firm's weighted average cost of capital after both the debt issue and the completion of the new plant.