CHAPTER 8

CAPITAL STRUCTURE: THE OPTIMAL FINANCIAL MIX

What is the optimal mix of debt and equity for a firm? While in the last chapter we looked at the qualitative trade off between debt and equity, we did not develop the tools we need to analyze whether debt should be 0%, 20%, 40% or 60% of capital. Debt is always cheaper than equity, but using debt increases risk in terms of default risk to lenders, and higher earnings volatility for equity investors. Thus, using more debt can increase value for some firms and decrease value for others, and for the same firm, debt can be beneficial up to a point and destroy value beyond that point. We have to consider ways of going beyond the generalities in the last chapter to specific ways of identifying the right mix of debt and equity.

In this chapter, we explore three ways to find an optimal mix. The first approach begins with a distribution of future operating income; we can then decide how much debt to carry by defining the maximum possibility of default we are willing to bear. The second approach is to choose the debt ratio that minimizes the cost of capital. Here, we review the role of cost of capital in valuation and discuss its relationship to the optimal debt ratio. The third approach, like the second, also attempts to maximize firm value, but it does so by adding the value of the unlevered firm to the present value of tax benefits and then netting out the expected bankruptcy costs. The final approach is to base the financing mix on the way comparable firms finance their operations.

Operating Income Approach

The *operating income approach* is the simplest and one of the most intuitive ways of determining how much a firm can afford to borrow. We determine the firm's maximum acceptable probability of default. Based upon the distribution of operating income, we then determine how much debt the firm can carry.

Steps in Applying Operating Income Approach

We begin with an analysis of a firm's operating income and cash flows, and we consider how much debt it can afford to carry based upon its cash flows. The steps in the operating income approach are as follows:

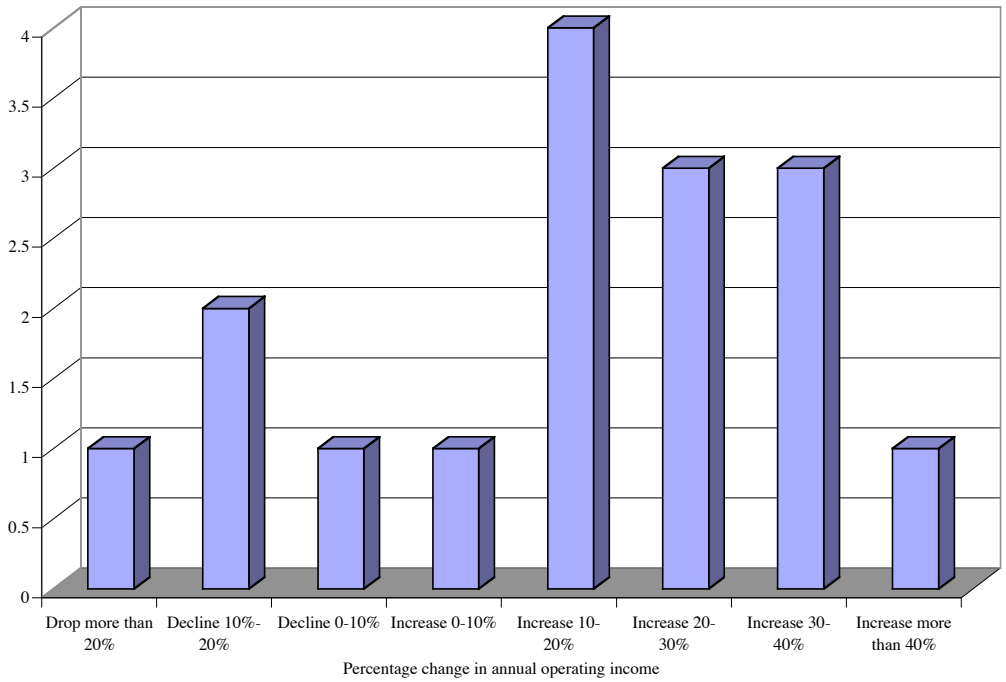
1. We assess the firm's capacity to generate operating income based upon both current conditions and past history. The result is a distribution for expected operating income, with probabilities attached to different levels of income.
2. For any given level of debt, we estimate the interest and principal payments that have to be made over time.
3. Given the probability distribution of operating cash flows and the debt payments, we can estimate the probability that the firm will be unable to make those payments.
4. We set a limit on the probability of its being unable to meet debt payments. Clearly, the more conservative the management of the firm, the lower this probability constraint will be.
5. We compare the estimated probability of default at a given level of debt to the probability constraint. If the probability of default is higher than the constraint, the firm chooses a lower level of debt; if it is lower than the constraint, the firm chooses a higher level of debt.

Illustration 8.1: Estimating Debt Capacity Based Upon Operating Income Distribution

In the following analysis, we apply the operating income approach to analyzing whether Disney should issue an additional $ 5 billion in new debt.

Step 1: We derive a probability distribution for expected operating income from Disney's historical earnings and estimate operating income changes from 1988 to 2003 and present it in figure 8.1.

Figure 8.1: Disney: Operating Income Changes - 1988-2003



The average change in operating income on an annual basis over the period was 10.09%, and the standard deviation in the annual changes is 19.54%. If we assume that the changes are normally distributed, these statistics are sufficient for us to compute the approximate probability of being unable to meet the specified debt payments.

Step 2: We estimate the interest and principal payments on a proposed bond issue of $ 5 billion by assuming that the debt will be rated BBB, lower than Disney's current bond rating of BBB+[1]. Based upon this rating, we estimated an interest rate of 5.5% on the debt. In addition, we assume that the sinking fund payment set aside to repay the bonds is 5% of the bond issue. This results in an annual debt payment of $ 550 million–

Additional Debt Payment = Interest Expense + Sinking Fund Payment
= 0.055 * 5,000 + .05 * 5,000 = $ 525 million

The total debt payment then can be computed by adding the interest payment on existing debt in 2003— $ 666 million — as well as the operating lease expenses from 2003 - $

[1] This is Disney's current bond rating.

556 million - to the additional debt payment that will be created by taking on $ 5 billion in additional debt.

Total Debt Payment = Interest on Existing Debt + Operating lease expense + Additional Debt Payment = $ 666 million + $ 556 million + $ 525 million = $ 1,747 million

Step 3: We can now estimate the probability[2] of default from the distribution of operating income by assuming that the percentage changes in operating income are normally distributed and by considering the operating income of $ 2,713 million that Disney earned in 2003 as the base year income.

T statistic = (Current EBIT- Debt Payment) / σ_{OI} (Current Operating Income)

= ($ 2,713- $ 1747 million) / (.1954 * $2713) = 1.82

Based upon the t statistic, the probability that Disney will be unable to meet its debt payments in the next year is 3.42%.

Step 4: Assume that the management at Disney set a constraint that the probability of default be no greater than 5%.

Step 5: Since the estimated probability of default is indeed less than 5%, Disney can afford to borrow more than $ 5 billion. If the distribution of operating income changes is normal, we can estimate the level of debt payments Disney can afford to make for a probability of default of 5%.

T statistic for 5% probability level = 1.645

Consequently, the debt payment can be estimated as

($2,713 - X)/ (.1954* $2,713) = 1.645

Solving for X, we estimate a breakeven debt payment of -

Break Even Debt Payment = $ 1,841 million

Subtracting out the existing interest and lease payments from this amount yields a break-even additional debt payment of $619 million

Break-Even Additional Debt Payment = 1841- 666 – 556 = $619 million

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[2] This is the probability of defaulting on interest payments in one period. The cumulative probability of default over time will be much higher.

If we assume that the interest rate remains unchanged at 5.5% and the sinking fund will remain at 5% of the outstanding debt, this yields an optimal debt level of $ 5,895 million.

Optimal Debt Level = Break Even Debt Payment / (Interest Rate + Sinking Fund Rate)

= $ 619 / (.055 + .05) = $ 5,895 million

The optimal debt level will be lower if the interest rate increases as Disney borrows more money.

Limitations of the Operating Income Approach

Although this approach may be intuitive and simple, it has some drawbacks. First, estimating a distribution for operating income is not as easy as it sounds, especially for firms in businesses that are changing and volatile. For instance, the operating income of firms can vary widely from year to year, depending upon the success or failure of individual products. Second, even when we can estimate a distribution, the distribution may not fit the parameters of a normal distribution, and the annual changes in operating income may not reflect the risk of consecutive bad years. This can be remedied by calculating the statistics based upon multiple years of data. For Disney, in the above example, if operating income is computed over rolling two-year periods[3], the standard deviation will increase and the optimal debt ratio will decrease..

This approach is an extremely conservative way of setting debt policy because it assumes that debt payments have to be made out of a firm's cash balances and operating income and that the firm has no access to financial markets. Finally, the probability constraint set by management is subjective and may reflect management concerns more than stockholder interests. For instance, management may decide that it wants no chance of default and refuse to borrow money as a consequence.

Refinements on the Operating Income Approach

The operating income approach described in this section is simplistic because it is based upon historical data and the assumption that operating income changes are

[3] By rolling two-year periods, we mean 1980 & 1981, 1981 & 1982, 1982 & 1983 .... The resulting standard deviation is corrected for the multiple counting of the same observations.

normally distributed. We can make it more sophisticated and robust by making relatively small changes:

- You can look at simulations of different possible outcomes for operating income, rather than looking at historical data; the distributions of the outcomes are based both upon past data and upon expectations for the future.
- Instead of evaluating just the risk of defaulting on debt, you can consider the indirect bankruptcy costs that can accrue to a firm, if operating income drops below a specified level.
- You can compute the present value of the tax benefits from the interest payments on the debt, across simulations, and thus compare the expected cost of bankruptcy to the expected tax benefits from borrowing.

With thee changes, you can look at different financing mixes for a firm, and estimate the optimal debt ratio as that mix that maximizes the firm's value.[4]

Cost of Capital Approach

In chapters 3 and 4, we estimated the minimum acceptable hurdle rates for equity investors (the cost of equity), and for all investors in the firm - (the cost of capital). We defined the cost of capital to be the weighted average of the costs of the different components of financing — including debt, equity and hybrid securities — used by a firm to fund its financial requirements. By altering the weights of the different components, firms might be able to change their cost of capital[5]. In the cost of capital approach, we estimate the costs of debt and equity at different debt ratios, use these costs to compute the costs of capital, and look for the mix of debt and equity that yields the lowest cost of capital for the firm. At this cost of capital, we will argue that firm value is maximized.[6].

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[4] Opler, Grinblatt and Titman have an extended discussion of this approach.
[5] If capital structure is irrelevant, the cost of capital will be unchanged as the capital structure is altered.
[6] If capital structure is irrelevant, the cost of capital will be unchanged as the capital structure is altered.

Definition of the Weighted Average Cost of Capital (WACC)

The weighted average cost of capital (WACC) is defined as the weighted average of the costs of the different components of financing used by a firm.

$$WACC = k_e (E/ (D+E+PS)) + k_d (D/ (D+E+PS)) + k_{ps} (PS/ (D+E+PS))$$

where WACC is the weighted average cost of capital, k_e, k_d and k_{ps} are the costs of equity, debt and preferred stock, and E, D and PS are their respective market values.

The estimation of the costs of the individual components - equity, debt, and preferred stock, and of the weights in the cost of capital formulation are explored in detail in Chapter 4. To summarize:

- The cost of equity should reflect the riskiness of an equity investment in the company. The standard models for risk and return — the capital asset pricing model and the arbitrage pricing model — measure risk in terms of market risk, and convert the risk measure into an expected return.
- The cost of debt should reflect the default risk of the firm - the higher the default risk, the greater the cost of debt - and the tax advantage associated with debt - interest is tax deductible.

  Cost of Debt = Pre-tax Interest Rate on Borrowing (1 - tax rate)
- The cost of preferred stock should reflect the preferred dividend and the absence of tax deductibility.

  Cost of Preferred Stock = Preferred Dividend / Preferred Stock Price
- The weights used for the individual components should be market value weights rather than book value weights.

The Role of Cost of Capital in Investment Analysis and Valuation

In order to understand the relationship between the cost of capital and optimal capital structure, we first have to establish the relationship between firm value and the cost of capital. In chapter 5, we noted that the value of a project to a firm could be computed by discounting the expected cash flows on it at a rate that reflected the riskiness of the cash flows, and that the analysis could be done either from the viewpoint of equity investors alone or from the viewpoint of the entire firm. In the latter approach, we discounted the cash flows to the firm on the project, i.e., the project cash flows prior

to debt payments but after taxes, at the project's cost of capital. Extending this principle, the value of the entire firm can be estimated by discounting the aggregate expected cash flows over time at the firm's cost of capital. The firm's aggregate cash flows can be estimated as cash flows after operating expenses, taxes and any capital investments needed to create future growth in both fixed assets and working capital.

Cash Flow to Firm = EBIT (1-t) - (Capital Expenditures - Depreciation) - Change in Working Capital

The value of the firm can then be written as –

$$\text{Value of Firm} = \sum_{t=1}^{t=n} \frac{\text{CF to Firm}_t}{(1+\text{WACC})^t}$$

The value of a firm is therefore a function of its cash flows and its cost of capital. In the specific case where the cash flows to the firm are unaffected as the debt/equity mix is changed, and the cost of capital is reduced, the value of the firm will increase. If the objective in choosing the financing mix for the firm is the maximization of firm value, this can be accomplished, in this case, by minimizing the cost of capital. In the more general case where the cash flows to the firm are a function of the debt-equity mix, the optimal financing mix is the one that maximizes firm value.[7]

The optimal financing mix for a firm is simple to compute if one is provided with a schedule that relates the costs of equity and debt to the leverage of the firm.

Illustration 8.2: WACC, Firm Value, and Leverage

Assume that you are given the costs of equity and debt at different debt levels for Belfan's, a leading manufacturer of chocolates and other candies, and that the cash flows to this firm are currently $200 million. Belfan's is in a relatively stable market, and these cash flows are expected to grow at 6% forever, and are unaffected by the debt ratio of the firm. The WACC schedule is provided in Table 8.1, along with the value of the firm at each level of debt.

Table 8.1: WACC, Firm Value and Debt Ratios

D/(D+E)	*Cost of Equity*	*Cost of Debt*	*WACC*	*Firm Value*

[7] In other words, the value of the firm might not be maximized at the point that cost of capital is minimized, if firm cash flows are much lower at that level.

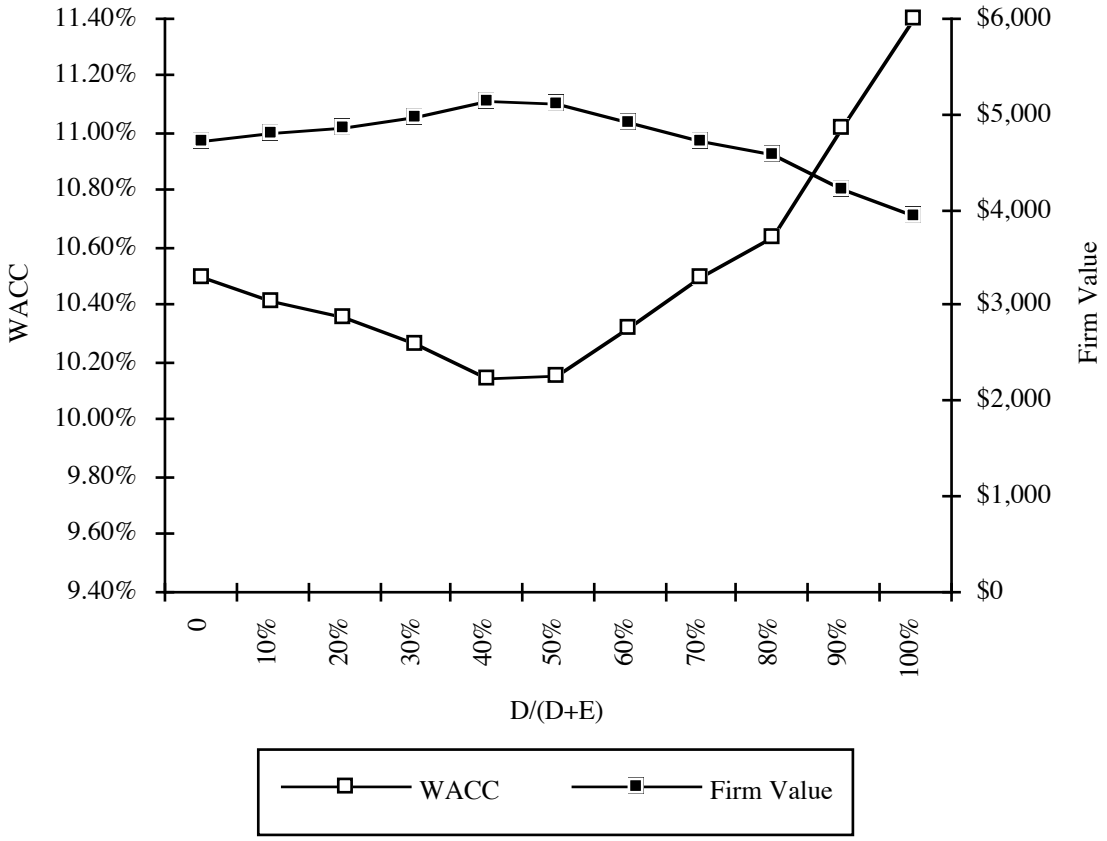
0	10.50%	4.80%	10.50%	$4,711
10%	11.00%	5.10%	10.41%	$4,807
20%	11.60%	5.40%	10.36%	$4,862
30%	12.30%	5.52%	10.27%	$4,970
40%	13.10%	5.70%	10.14%	$5,121
50%	14.00%	6.30%	10.15%	$5,108
60%	15.00%	7.20%	10.32%	$4,907
70%	16.10%	8.10%	10.50%	$4,711
80%	17.20%	9.00%	10.64%	$4,569
90%	18.40%	10.20%	11.02%	$4,223
100%	19.70%	11.40%	11.40%	$3,926

Note that the value of the firm = Cash flows to firm*(1+g)/ (WACC - g)

= $200 * 1.06 / (WACC - .06)

The value of the firm increases (decreases) as the WACC decreases (increases), as illustrated in Figure 8.2.

WACC AND FIRM VALUE AS A FUNCTION OF LEVERAGE



While this illustration makes the choice of an optimal financing mix seem trivial, it obscures some real problems that may arise in its applications. First, an analyst typically does not have the benefit of having the entire schedule of costs of financing prior to an analysis. In most cases, the only level of debt about which there is any certainty about the cost of financing is the current level. Second, the analysis assumes implicitly that the level of cash flows to the firm is unaffected by the financing mix of the firm and, consequently, by the default risk (or bond rating) for the firm. While this may be reasonable in some cases, it might not in others. For instance, a firm that manufactures consumer durables (cars, televisions etc.) might find that its sales drop if its default risk increases because investors are reluctant to buy its products.

8.1. ☞: **Minimizing Cost of Capital and Maximizing Firm Value**

A lower cost of capital will lead to a higher firm value only if

a. the operating income does not change as the cost of capital declines
b. the operating income goes up as the cost of capital goes down
c. any decline in operating income is offset by the lower cost of capital

Steps in the Cost of Capital Approach

We need three basic inputs to compute the cost of capital – the cost of equity, the after-tax cost of debt and the weights on debt and equity. The costs of equity and debt change as the debt ratio changes, and the primary challenge of this approach is in estimating each of these inputs.

Let us begin with the cost of equity. In chapter 4, we argued that the beta of equity will change as the debt ratio changes. In fact, we estimated the levered beta as a function of the debt to equity ratio of a firm, the unlevered beta and the firm's marginal tax rate:

$$\beta_{levered} = \beta_{unlevered} [1+(1-t)Debt/Equity]$$

Thus, if we can estimate the unlevered beta for a firm, we can use it to estimate the levered beta of the firm at every debt ratio. This levered beta can then be used to compute the cost of equity at each debt ratio.

Cost of Equity = Riskfree rate + $\beta_{levered}$ (Risk Premium)

The cost of debt for a firm is a function of the firm's default risk. As firms borrow more, their default risk will increase and so will the cost of debt. If we use bond ratings as our measure of default risk, we can estimate the cost of debt in three steps. First, we estimate a firm's dollar debt and interest expenses at each debt ratio; as firms increase their debt ratio, both dollar debt and interest expenses will rise. Second, at each debt level, we compute a financial ratio or ratios that measures default risk and use the ratio(s) to estimate a rating for the firm; again, as firms borrow more, this rating will decline. Third, a default spread, based upon the estimated rating, is added on to the riskfree rate to arrive at the pre-tax cost of debt. Applying the marginal tax rate to this pre-tax cost yields an after-tax cost of debt.

Once we estimate the costs of equity and debt at each debt level, we weight them based upon the proportions used of each to estimate the cost of capital. While we have not explicitly allowed for a preferred stock component in this process, we can have

preferred stock as a part of capital. However, we have to keep the preferred stock portion fixed, while changing the weights on debt and equity. The debt ratio at which the cost of capital is minimized is the optimal debt ratio.

In this approach, the effect on firm value of changing the capital structure is isolated by keeping the operating income fixed and varying only the cost of capital. In practical terms, this requires us to make two assumptions. First, the debt ratio is decreased by raising new equity and retiring debt; conversely, the debt ratio is increased by borrowing money and buying back stock. This process is called **recapitalization**. Second, the pre-tax operating income is assumed to be unaffected by the firm's financing mix and, by extension, its bond rating. If the operating income changes with a firm's default risk, the basic analysis will not change, but minimizing the cost of capital may not be the optimal course of action, since the value of the firm is determined by both the cashflows and the cost of capital. The value of the firm will have to be computed at each debt level and the optimal debt ratio will be that which maximizes firm value.

Illustration 8.3: Analyzing the Capital Structure for Disney: March 2004

The cost of capital approach can be used to find the optimal capital structure for a firm, as we will for Disney in March 2004. Disney had $13,100 million in debt on its books. The estimated market value of this debt was $12,915 million was added the present value of operating leases, of $1,753 million to arrive at a total market value for the debt of $14,668 million. [8] The market value of equity at the same time was $55,101 million; the market price per share was $ 22.26, and there were 2475.093 million shares outstanding. Proportionally, 21.02% of the overall financing mix was debt, and the remaining 78.98% was equity.

The beta for Disney's stock in March 2004, as estimated in chapter 7, was 1.2456. The treasury bond rate at that time was 4%. Using an estimated market risk premium of 4.82%, we estimated the cost of equity for disney to be 10.00%:

Cost of Equity = Riskfree rate + Beta * (Market Premium)

=4.00% + 1.2456 (4.82%) = 10.00%

[8] The details of this calculation are in illustration 4.15 in chapter 4.

Disney's senior debt was rated BBB+. Based upon this rating, the estimated pre-tax cost of debt for Disney is 5.25%. The tax rate used for the analysis is 37.30%.

Value of Firm = 14,668+ 55,101 = $ 69,769 million

After-tax Cost of debt = Pre-tax interest rate (1- tax rate)

= 5.25% (1- 0.373) = 3.29%

The cost of capital was calculated using these costs and the weights based upon market value:

WACC = Cost of Equity (Equity/(Equity + Debt)) + After-tax Cost of Debt (Debt/(Debt +Equity))

= 10.00%* [55,101/69.769] + 3.58% *[14,668/69,769] = 8.59%

8.2. ☞**: Market Value, Book Value and Cost of Capital**

Disney had a book value of equity of approximately $ 16.5 billion. Using the book value of debt of $ 13.1 billion, estimate the cost of capital for Disney using book value weights.

I. Disney's Cost of Equity and Leverage

The cost of equity for Disney at different debt ratios can be computed using the unlevered beta of the firm, and the debt equity ratio at each level of debt. We use the levered betas that emerge to estimate the cost of equity. The first step in this process is to compute the firm's current unlevered beta, using the current market debt to equity ratio and a tax rate of 37.30%.

Unlevered Beta = Current Beta / (1 + (1-t) Debt/Equity)

= 1.2456/ (1 + (1-0.373) (14,668/55,101))

= 1.0674

Note that this is the bottom-up unlevered beta that we estimated for Disney in chapter 4, based upon its business mix. We continued to use the treasury bond rate of 4% and the market premium of 4.82% to compute the cost of equity at each level of debt. If we keep the tax rate constant at 37.30%, we obtain the levered betas for Disney in table 8.2.

Table 8.2: Leverage, Betas And The Cost Of Equity

Debt Ratio	*D/E Ratio*	*Levered Beta*	*Cost of Equity*
0.00%	0.00%	1.0674	9.15%
10.00%	11.11%	1.1418	9.50%
20.00%	25.00%	1.2348	9.95%
30.00%	42.86%	1.3543	10.53%
40.00%	66.67%	1.5136	11.30%

50.00%	100.00%	1.7367	12.37%
60.00%	150.00%	2.0714	13.98%
70.00%	233.33%	2.6291	16.67%
80.00%	400.00%	3.7446	22.05%
90.00%	900.00%	7.0911	38.18%

In calculating the levered beta in this table, we assumed that all market risk is borne by the equity investors; this may be unrealistic especially at higher levels of debt. We will also consider an alternative estimate of levered betas that apportions some of the market risk to the debt:

$$\beta_{levered} = \beta_u [1+(1-t)D/E] - \beta_{debt} (1-t) D/E$$

The beta of debt is based upon the rating of the bond and is estimated by regressing past returns on bonds in each rating class against returns on a market index. The levered betas estimated using this approach will generally be lower than those estimated with the conventional model.[9]

II. Disney's Cost of Debt and Leverage

Several financial ratios are correlated with bond ratings and, ideally, we could build a sophisticated model to predict ratings. For purposes of this illustration, however, we use a much simpler version: We assume that bond ratings are determined solely by the interest coverage ratio, which is defined as:

Interest Coverage Ratio = Earnings before interest & taxes / Interest Expense

We chose the interest coverage ratio for three reasons. First, it is a ratio[10] used by both Standard and Poor's and Moody's to determine ratings. Second, there is significant correlation not only between the interest coverage ratio and bond ratings, but also between the interest coverage ratio and other ratios used in analysis, such as the debt coverage ratio and the funds flow ratios. Third, the interest coverage ratio changes as a firm changes is financing mix and decreases as the debt ratio increases. The ratings

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[9] Consider, for instance, a debt ratio of 40%. At this level the firm's debt will take on some of the characteristics of equity Assume that the beta of debt at a 0% debt ratio is 0.40. The equity beta at that debt ratio can be computed as follows:
Levered beta = 1.0674 (1 + (1-.373)(40/60)- 0.40 (1-.373) (40/60) = 1.335
In the unadjusted approach, the levered beta would have been 1.5136.

[10] S&P lists interest coverage ratio first among the nine ratios that it reports for different ratings classes on its web site.

agencies would argue, however, that subjective factors, such as the perceived quality of management, are part of the ratings process. One way to build these factors into the analysis would be to modify the ratings obtained from the financial ratio analysis across the board to reflect the ratings agencies' subjective concerns[11].

The data in table 8.3 were obtained based upon an analysis of the interest coverage ratios of large manufacturing firms in different ratings classes.

Table 8.3: Bond Ratings and Interest Coverage Ratios

Interest Coverage Ratio	*Rating*
> 8.5	AAA
6.50 - 6.50	AA
5.50 – 6.50	A+
4.25 – 5.50	A
3.00 – 4.25	A-
2.50 – 3.00	BBB
2.05 - 2.50	BB+
1.90 – 2.00	BB
1.75 – 1.90	B+
1.50 - 1.75	B
1.25 – 1.50	B-
0.80 – 1.25	CCC
0.65 – 0.80	CC
0.20 – 0.65	C
< 0.20	D

Source: Compustat

Using this table as a guideline, a firm with an interest coverage ratio of 1.65 would have a rating of B for its bonds.

The relationship between bond ratings and interest rates in March 2004 was obtained by looking at the typical default spreads[12] for bonds in different ratings classes. Table 8.4 summarizes the interest rates/rating relationship and reports the spread for these

[11] For instance, assume that a firm's current rating is AA, but that its financial ratios would result in an A rating. It can then be argued that the ratings agencies are, for subjective reasons, rating the company one notch higher than the rating obtained from a purely financial analysis. The ratings obtained for each debt level can then be increased by one notch across the board to reflect these subjective considerations.

[12] These default spreads were estimated from bondsonline.com, a service that provides, among other data on fixed income securities, updated default spreads for each ratings class.

bonds over treasury bonds and the resulting interest rates, based upon the treasury bond rate of 4%.

Table 8.4: Bond Ratings And Market Interest Rates, March 2004

Rating	*Typical default spread*	*Market interest rate on debt*
AAA	0.35%	4.35%
AA	0.50%	4.50%
A+	0.70%	4.70%
A	0.85%	4.85%
A-	1.00%	5.00%
BBB	1.50%	5.50%
BB+	2.00%	6.00%
BB	2.50%	6.50%
B+	3.25%	7.25%
B	4.00%	8.00%
B-	6.00%	10.00%
CCC	8.00%	12.00%
CC	10.00%	14.00%
C	12.00%	16.00%
D	20.00%	24.00%

Source: bondsonline.com

Since Disney's capacity to borrow is determined by its earnings power, we will begin by looking at the company's income statements in 2002 and 2003 in table 8.5. In 2003, Disney had operating income of $2.713 billion and net income of $1,267 billion.

Table 8.5: Disney's Income Statement for2002 & 2003

	2003	*2002*
Revenues	27061	25329
- Operating expenses (other than depreciation)	23289	21924
EBITDA	3772	3405
- Depreciation and Amortization	1059	1021
EBIT	2713	2384
- Interest Expenses	666	708
+ Interest Income	127	255
Taxable Income	2174	1931
- Taxes	907	695
Net Income	1267	1236

Based upon the earnings before interest and taxes (EBIT) of $2,713 million and interest expenses of $ 666 million, Disney has an interest coverage ratio of 4.07 and should command a rating of A-, a notch above it's actual rating of BBB+. This income statement, however, is based upon treating operating leases as operating expenses. In chapter 4, we argued that operating leases should be considered part of debt and computed the present value of Disney's lease commitments to be $1,753 million. Consequently, we have to adjust the EBIT and EBITDA for the imputed interest expense on Disney's operating leases[13]; this results in an increase of $ 92 million in both numbers – to $ 2,805 million in EBIT and $ 3,864 million in EBITDA.

Adjusted EBIT = EBIT + Pre-tax cost of debt * Present value of operating leases

= 2713 + .0525 * 1753 = 2805

Note that 5.25% is Disney's current pre-tax cost of debt.

Finally, to compute Disney's ratings at different debt levels, we redo the operating income statement at each level of debt, compute the interest coverage ratio at that level of debt and find the rating that corresponds to that level of debt. For example, table 8.6 estimates the interest expenses, interest coverage ratios and bond ratings for Disney at 0% and 10% debt ratios, at the existing level of operating income.

Table 8.6: Effect of Moving to Higher Debt Ratios: Disney

D/(D+E)	*0.00%*	*10.00%*
D/E	0.00%	11.11%
$ Debt	$0	$6,977
EBITDA	$3,882	$3,882
Depreciation	$1,077	$1,077
EBIT	$2,805	$2,805
Interest	$0	$303
Pre-tax Int. cov	∞	9.24
Likely Rating	AAA	AAA
Pre-tax cost of debt	4.35%	4.35%

[13] Multiplying the pre-tax cost of debt by the present value of operating leases yields an approximation. The full adjustment would require us to add back the entire operating lease expense and to subtract out the depreciation on the leased asset.

The dollar debt is computed to be 10% of the current value of the firm, which we compute by adding the current market values of debt ($14,668) and equity ($55,101):

Dollar Debt at 10% debt ratio = .10 (55,101 + 14,668) = $ 6,977 million

Note that the EBITDA and EBIT remain fixed as the debt ratio changes. We ensure this by using the proceeds from the debt to buy back stock. This is called a recapitalization, where the assets of the firm remain unchanged but the financing mix is changed. This allows us to isolate the effect of just changing the debt ratio.

There is circular reasoning involved in estimating the interest expense. The interest rate is needed to calculate the interest coverage ratio, and the coverage ratio is necessary to compute the interest rate. To get around the problem, we began our analysis by assuming that you could borrow $ 6,977 billion at the AAA rate of 4.35%; we then computed an interest expense and interest coverage ratio using that rate, and estimated a new rating of AAA for Disney. This process is repeated for each level of debt from 10% to 90%, and the after-tax costs of debt are obtained at each level of debt in Table 8.7.

Table 8.7: Disney: Cost of Debt and Debt Ratios

Debt Ratio	*Debt*	*Interest expense*	*Interest Coverage Ratio*	*Bond Rating*	*Interest rate on debt*	*Tax Rate*	*Cost of Debt (after-tax)*
0%	$0	$0	∞	AAA	4.35%	37.30%	2.73%
10%	$6,977	$303	9.24	AAA	4.35%	37.30%	2.73%
20%	$13,954	$698	4.02	A-	5.00%	37.30%	3.14%
30%	$20,931	$1,256	2.23	BB+	6.00%	37.30%	3.76%
40%	$27,908	$3,349	0.84	CCC	12.00%	31.24%	8.25%
50%	$34,885	$5,582	0.50	C	16.00%	18.75%	13.00%
60%	$41,861	$6,698	0.42	C	16.00%	15.62%	13.50%
70%	$48,838	$7,814	0.36	C	16.00%	13.39%	13.86%
80%	$55,815	$8,930	0.31	C	16.00%	11.72%	14.13%
90%	$62,792	$10,047	0.28	C	16.00%	10.41%	14.33%

There are two points to make about this computation. We assume that at every debt level, all existing debt will be refinanced at the new interest rate that will prevail after the capital structure change. For instance, Disney's existing debt, which has a BBB+ rating, is assumed to be refinanced at the interest rate corresponding to a BBB rating when Disney moves to a 30% debt ratio. This is done for two reasons. The first is that existing debt-holders might have protective puts that enable them to put their bonds back

to the firm and receive face value.[14] The second is that the refinancing eliminates "wealth expropriation" effects — the effects of stockholders expropriating wealth from bondholders when debt is increased, and vice versa, when debt is reduced. If firms can retain old debt at lower rates, while borrowing more and becoming riskier, the lenders of the old debt will lose wealth. If we lock in current rates on existing bonds and recalculate the optimal debt ratio, we will allow for this wealth transfer.[15]

While it is conventional to leave the marginal tax rate unchanged as the debt ratio is increased, we adjust the tax rate to reflect the potential loss of the tax benefits of debt at higher debt ratios, where the interest expenses exceed the earnings before interest and taxes. To illustrate this point, note that the earnings before interest and taxes at Disney is $2,805 million. As long as interest expenses are less than $ 2,703 million, interest expenses remain fully tax deductible and earn the 37.30% tax benefit. For instance, at a 40% debt ratio, the interest expenses are $1,865 million and the tax benefit is therefore 37.30% of this amount. At a 50% debt ratio, however, the interest expenses balloon to $3,349 million, which is greater than the earnings before interest and taxes of $ 2,805 million. We consider the tax benefit on the interest expenses up to this amount:

Maximum Tax Benefit = EBIT * Marginal Tax Rate = $2,805 million * .373 = $ 1,046 million

As a proportion of the total interest expenses, the tax benefit is now only 31.24%:

Adjusted Marginal Tax Rate = Maximum Tax Benefit / Interest Expenses = $1046/$3,349= 31.24%

This, in turn, raises the after-tax cost of debt. This is a conservative approach, since losses can be carried forward. Given that this is a permanent shift in leverage, it does make sense to be conservative.

III. Leverage and Cost of Capital

Now that we have estimated the cost of equity and the cost of debt at each debt level, we can compute Disney's cost of capital. This is done for each debt level in Table

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[14] If they do not have protective puts, it is in the best interests of the stockholders not to refinance the debt (as in the leveraged buyout of RJR Nabisco) if debt ratios are increased.

[15] This will have the effect of reducing interest cost, when debt is increased, and thus interest coverage ratios. This will lead to higher ratings, at least in the short term, and a higher optimal debt ratio.

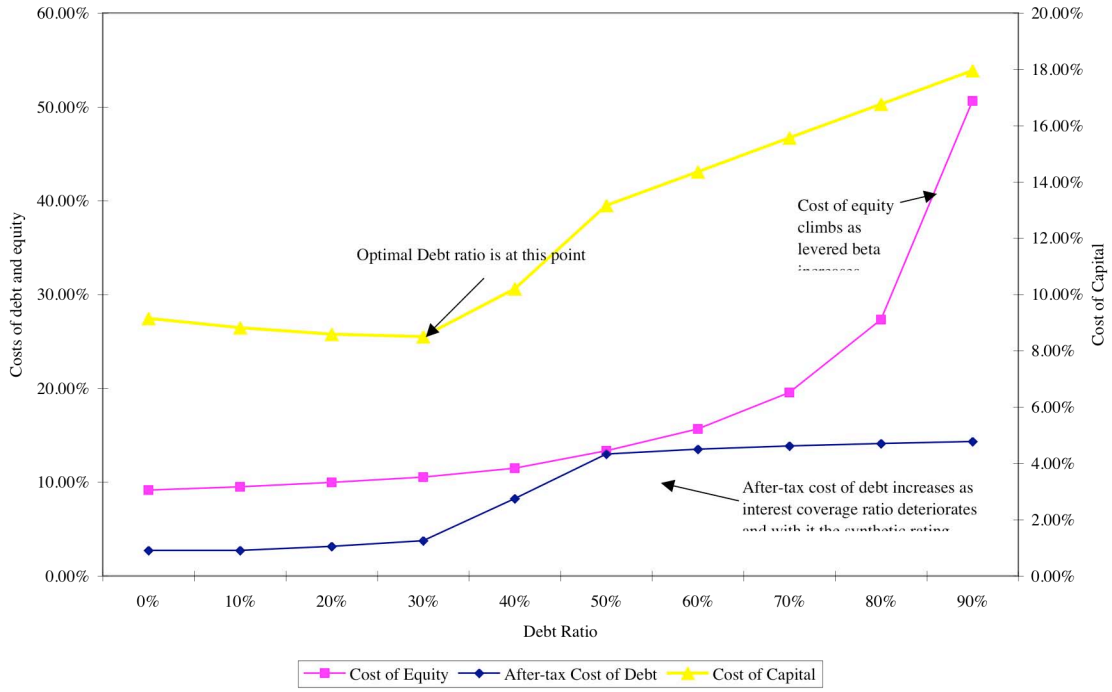
8.8. The cost of capital, which is 9.15%, when the firm is unlevered, decreases as the firm initially adds debt, reaches a minimum of 8.50% at 30% debt and then starts to increase again.

Table 8.8: Cost of Equity, Debt and Capital, Disney

Debt Ratio	Cost of Equity	Cost of Debt (after-tax)	Cost of Capital
0%	9.15%	2.73%	9.15%
10%	9.50%	2.73%	8.83%
20%	9.95%	3.14%	8.59%
30%	10.53%	3.76%	8.50%
40%	11.50%	8.25%	10.20%
50%	13.33%	13.00%	13.16%
60%	15.66%	13.50%	14.36%
70%	19.54%	13.86%	15.56%
80%	27.31%	14.13%	16.76%
90%	50.63%	14.33%	17.96%

The optimal debt ratio is shown graphically in Figure 8.3.

Figure 8.3: Disney Cost of Capital at different Debt Ratios



To illustrate the robustness of this solution to alternative measures of levered betas, we re-estimate the costs of debt, equity and capital under the assumption that debt bears some market risk, and the results are summarized in Table 8.9.

Table 8.9: Costs of Equity, Debt and Capital with Debt carrying Market Risk- Disney

Debt Ratio	*Beta of equity*	*Cost of Equity*	*Interest rate on debt*	*Tax Rate*	*Cost of Debt (after-tax)*	*Beta of debt*	*Cost of Capital*
0%	1.07	9.15%	4.35%	37.30%	2.73%	0.02	9.15%
10%	1.14	9.50%	4.35%	37.30%	2.73%	0.02	8.82%
20%	1.23	9.91%	5.00%	37.30%	3.14%	0.05	8.56%
30%	1.33	10.39%	6.00%	37.30%	3.76%	0.10	8.40%
40%	1.37	10.59%	12.00%	31.24%	8.25%	0.41	9.65%
50%	1.43	10.89%	16.00%	18.75%	13.00%	0.62	11.94%
60%	1.63	11.86%	16.00%	15.62%	13.50%	0.62	12.84%
70%	1.97	13.48%	16.00%	13.39%	13.86%	0.62	13.74%
80%	2.64	16.72%	16.00%	11.72%	14.13%	0.62	14.64%
90%	4.66	26.44%	16.00%	10.41%	14.33%	0.62	15.54%

If the debt holders bear some market risk[16], the cost of equity is lower at higher levels of debt and Disney's optimal debt ratio is still 30%, which is unchanged from the optimal calculated under the conventional calculation of the levered beta.

IV. Firm Value and Cost of Capital

The reason for minimizing the cost of capital is that it maximizes the value of the firm. To illustrate the effects of moving to the optimal on Disney's firm value, we start off with a simple valuation model, designed to value a firm in stable growth.

Firm Value = Cashflow to Firm (1 + g) / (Cost of Capital -g)

where

g = Growth rate in the cashflow to the firm (in perpetuity)

We begin by computing Disney's current free cash flow using its current earnings before interest and taxes of $2,805 million, its tax rate of 37.30%, and its reinvestment in 1998 in working capital and net fixed assets:

EBIT (1- tax rate) = 2805 (1 – 0.373) =	$	1,759
+ Depreciation & Amortization =	$	1,077

[16] To estimate the beta of debt, we used the default spread at each level of debt, and assumed that 25% this risk is market risk. Thus, at a C rating, the default spread is 12%. Based upon the market risk premium of 4.82% that we used elsewhere, we estimated the beta at a C rating to be:

Imputed Debt Beta at a C rating =(12%/4.82%)*0.25 = 0.62

The assumption that 25% of the default risk is market risk is made to ensure that at a D rating, the beta of debt (1.02) is roughly equal to the unlevered beta of Disney (1.09).

- Capital Expenditures =	$ 1,049
- Change in Non-cash Working Capital	$ 64
Free Cash Flow to the Firm =	$ 1,722

The market value of the firm at the time of this analysis was obtained by adding up the estimated market values of debt and equity:

Market Value of Equity =	$ 55,101
+ Market Value of Debt =	$ 14,668
= Value of the Firm	$ 69,769

Based upon the current cost of capital of 8.59%, we solve for the implied growth rate:

Growth rate = (Firm Value * Cost of Capital- CF to Firm)/(Firm Value + CF to Firm)

= (69,769*.0859-1,722)/(69,769+1,722) = .0598 or 5.98%

Now assume that Disney shifts to 30% Debt and a WACC of 8.50%. The firm can now be valued using the following parameters:

Cash flow to Firm = $1,722 million

WACC = 8.50%

Growth rate in Cash flows to Firm = 5.98%

Firm Value = 1,722 *1.0598/(.0850-.0598) = $ 72,419 million

The value of the firm will increase from $69,769 million to $72,419 million if the firm moves to the optimal debt ratio:

Increase in firm value = $ 72,419 mil - $ 69,769 mil = $ 2,650 million

With 2047.6 million shares outstanding, assuming that stockholders can evaluate the effect of this refinancing, we can calculate the increase in the stock price:

Increase in stock price = Increase in Firm Value / Number of shares outstanding

= $ 2,650/2,047.6 = $ 1.29 /share

Since the current stock price is $ 26.91, the stock price can be expected to increase to $28.20, which translates into about a 5% increase in the price.

The limitation of this approach is that the growth rate that we have assumed in perpetuity may be too high; a good rule of thumb for stable growth is that it should not

exceed the riskfree rate[17]. We can use an alternate and more conservative approach to estimate the change in firm value. Consider first the change in the cost of capital from 8.59% to 8.50%, a drop of 0.09%. This change in the cost of capital should result in the firm saving on its annual cost of financing its business:

Cost of financing Disney at existing debt ratio = 69,769 * .0859 = $5,993 million

Cost of financing Disney at optimal debt ratio = 69,769 * .0850 = $5,930 million

Annual savings in cost of financing =$5,993 million - $5,930 million = $ 63 million

Note that most of these savings are implicit rather than explicit. [18] The present value of these savings over time can now be estimated using the new cost of capital of 8.50% and the capped growth rate of 4% (set equal to the riskfree rate);

Present value of savings in perpetuity = Expected savings next year / (Cost of capital – g)

= 63 /(.085-.04) = $ 1,400 million

Since this increase in value accrues entirely to stockholders, we can estimate the increase in value per share by dividing by the total number of shares outstanding:

Increase in value per share = $ 1,400/2047.6 = $ 0.68

New stock price = $26.91+ $0.68 = $ 27.59

Using this approach, we estimated the firm value and cost of capital at different debt ratios in Figure 8.4.

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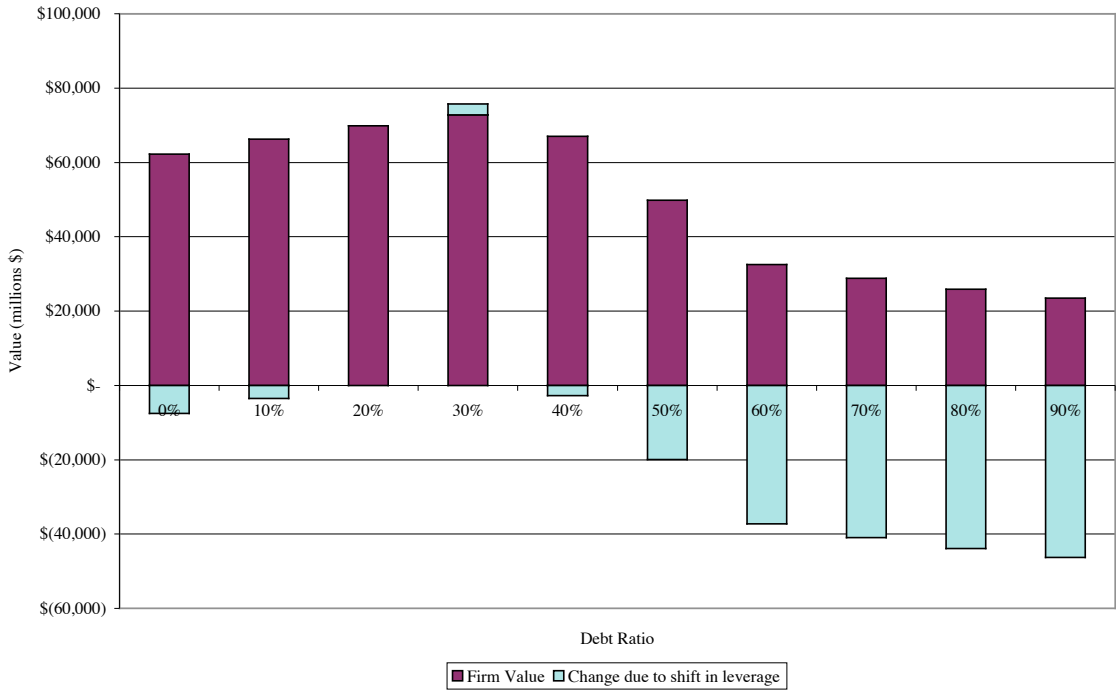
[17] No company can grow at a rate higher than the long term nominal growth rate of the economy. The riskfree rate is a reasonable proxy for the long term nominal growth rate in the economy because it is composed of two components – the expected inflation rate and the expected real rate of return. The latter has to equate to real growth in the long term.

[18] The cost of equity is an implicit cost and does not show up in the income statement of the firm. The savings in the cost of capital are therefore unlikely to show up as higher aggregate earnings. In fact, as the firm's debt ratio increases the earnings will decrease but the per share earnings will increase.

Figure 8.4: Disney Firm Value at Different Debt Ratios



Since the asset side of the balance sheet is kept fixed and changes in capital structure are made by borrowing funds and repurchasing stock, this analysis implies that the stock price would increase to $27.59 on the announcement of the repurchase. Implicit in this analysis is the assumption that the increase in firm value will be spread evenly across both the stockholders who sell their stock back to the firm and those who do not. To the extent that stock can be bought back at the current price of $ 26.91 or some value lower than $ 27.59, the change in stock price will be larger. For instance, if Disney could have bought stock back at the existing price of $ 26.91, the increase[19] in value per share would be $ 0.77.

8.3. ☞ **: Rationality and Stock Price Effects**

Assume that Disney does make a tender offer for it's shares but pays $28 per share. What will happen to the value per share for the shareholders who do not sell back?

[19] To compute this change in value per share, we first compute how many shares we would buy back with the additional debt taken on of $ 6,263 billion (Debt at 30% optimal – Current Debt) and the stock price of $ 26.91. We then divide the increase in firm value of $ 1,400 million by the remaining shares outstanding: Change in stock price = $ 1400 million / (2047.6 – (6263/26.91)) = $ 0.77 per share

a. The share price will drop below the pre-announcement price of $26.91
b. The share price will be between $26.91 and the estimated value (above) or $27.59
c. The share price will be higher than $27.59

 This spreadsheet allows you to compute the optimal debt ratio firm value for any firm, using the same information used for Disney. It has updated interest coverage ratios and spreads built in.

Table 8.10: Cost of Capital Worksheet for Disney

D/(D+E)	0.00%	10.00%	20.00%	30.00%	40.00%	50.00%	60.00%	70.00%	80.00%	90.00%
D/E	0.00%	11.11%	25.00%	42.86%	66.67%	100.00%	150.00%	233.33%	400.00%	900.00%
$ Debt	$0	$6,977	$13,954	$20,931	$27,908	$34,885	$41,861	$48,838	$55,815	$62,792
Beta	1.07	1.14	1.23	1.35	1.56	1.93	2.42	3.22	4.84	9.67
EBITDA	$3,882	$3,882	$3,882	$3,882	$3,882	$3,882	$3,882	$3,882	$3,882	$3,882
Depreciation	$1,077	$1,077	$1,077	$1,077	$1,077	$1,077	$1,077	$1,077	$1,077	$1,077
EBIT	$2,805	$2,805	$2,805	$2,805	$2,805	$2,805	$2,805	$2,805	$2,805	$2,805
Interest	∞	9.24	4.02	2.23	0.84	0.50	0.42	0.36	0.31	0.28
Pre-tax Int. cov	∞	0.38	0.17	0.10	0.03	-0.02	-0.03	-0.04	-0.05	-0.06
Likely Rating	AAA	AAA	A-	BB+	CCC	C	C	C	C	C
Pre-tax cost of debt	4.35%	4.35%	5.00%	6.00%	12.00%	16.00%	16.00%	16.00%	16.00%	16.00%
Adj Marginal Tax Rate	37.30%	37.30%	37.30%	37.30%	31.24%	18.75%	15.62%	13.39%	11.72%	10.41%
Cost of equity	9.15%	9.50%	9.95%	10.53%	11.50%	13.33%	15.66%	19.54%	27.31%	50.63%
Cost of debt	2.73%	2.73%	3.14%	3.76%	8.25%	13.00%	13.50%	13.86%	14.13%	14.33%
Cost of Capital	9.15%	8.83%	8.59%	8.50%	10.20%	13.16%	14.36%	15.56%	16.76%	17.96%
Value (perpetual growth)	$62,279	$66,397	$69,837	$71,239	$51,661	$34,969	$30,920	$27,711	$25,105	$22,948

Constrained Cost of Capital Approaches

The cost of capital approach that we have described is unconstrained, since our only objective is to minimize the cost of capital. There are several reasons why a firm may choose not to view the debt ratio that emerges from this analysis as optimal. First, the firm's default risk at the point at which the cost of capital is minimized may be high enough to put the firm's survival at jeopardy. Stated in terms of bond ratings, the firm may have a below-investment grade rating. Second, the assumption that the operating income is unaffected by the bond rating is a key one. If the operating income declines as default risk increases, the value of the firm may not be maximized where the cost of capital is minimized. Third, the optimal debt ratio was computed using the operating income from the most recent financial year. To the extent that operating income is volatile and can decline, firms may want to curtail their borrowing. In this section, we will consider ways in which we can bring each of these considerations into the cost of capital analysis.

Investment Grade Bonds: An investment grade bond is one with a rating greater than BBB. Some institutional investors, such as pension funds, are constrained from holding bonds with lower ratings.

Bond Rating Constraint

One way of using the cost of capital approach, without putting firms into financial jeopardy, is to impose a "bond rating constraint" on the cost of capital analysis. Once this constraint has been imposed, the optimal debt ratio is the one that has the lowest cost of capital, subject to the constraint that the bond rating meets or exceeds a certain level.

While this approach is simple, it is essentially subjective and is therefore open to manipulation. For instance, the management at Disney could insist on preserving a AA rating and use this constraint to justify reducing its debt ratio. One way to make managers more accountable in this regard is to measure the cost of a rating constraint.

Cost of Rating Constraint = Maximum Firm Value without constraints
- Maximum Firm Value with constraints

If Disney insisted on maintaining a AA rating, its constrained optimal debt ratio would be 10%. The cost of preserving the constraint can then be measured as the difference between firm value at 30% and at 20%.

Cost of Rating Constraint = Value at 30% Debt - Value at 10% Debt
= $71,239 - $ 66,397
= $ 4,842 million

This loss in value is probably overstated since we are keeping operating income fixed. Notwithstanding this concern, the loss in value that can accrue from having an unrealistically high rating constraint can be viewed as the cost of being too conservative when it comes to debt policy.

8.4. ☞: **Agency Costs and Financial Flexibility**

In the last chapter, we consider agency costs and lost flexibility as potential costs of using debt. Where in the cost of capital approach do we consider these costs?

a. These costs are not considered in the cost of capital approach
b. These costs are fully captured in the cost of capital through the costs of equity and debt, which increase as you borrow more money.
c. These costs are partially captured in the cost of capital through the costs of equity and debt, which increase as you borrow more money.

Sensitivity Analysis

The optimal debt ratio we estimate for a firm is a function of all the inputs that go into the cost of capital computation – the beta of the firm, the riskfree rate, the risk premium and the default spread. It is also, indirectly, a function of the firm's operating income, since interest coverage ratios are based upon this income, and these ratios are used to compute ratings and interest rates.

The determinants of the optimal debt ratio for a firm can be divided into variables specific to the firm, and macro economic variables. Among the variables specific to the firm that affect its optimal debt ratio are the tax rate, the firm's capacity to generate operating income and its cash flows. In general, the tax benefits from debt increase as the tax rate goes up. In relative terms, firms with higher tax rates will have higher optimal debt ratios than will firms with lower tax rates, other things being equal. It also follows

that a firm's optimal debt ratio will increase as its tax rate increases. Firms that generate higher operating income and cash flows, as a percent of firm market value, also can sustain much more debt as a proportion of the market value of the firm, since debt payments can be met much more easily from prevailing cash flows.

The macroeconomic determinants of optimal debt ratios include the level of interest rates and default spreads. As interest rates increase, the costs of debt and equity both increase. However, optimal debt ratios tend to be lower when interest rates are higher, perhaps because interest coverage ratios drop at higher rates. The default spreads commanded by different ratings classes tend to increase during recessions and decrease during recoveries. Keeping other things constant, as the spreads increase, optimal debt ratios decrease, for the simple reason that higher default spreads result in higher costs of debt.

How does sensitivity analysis allow a firm to choose an optimal debt ratio? After computing the optimal debt ratio with existing inputs, firms may put it to the test by changing both firm-specific inputs (such as operating income) and macro-economic inputs (such as default spreads). The debt ratio the firm chooses as its optimal then reflects the volatility of the underlying variables, and the risk aversion of the firm's management.

Illustration 8.4: Sensitivity Analysis on Disney's Optimal Debt Ratio

In the base case, in illustration 8.2, we used Disney's operating income in 2003 to find the optimal debt ratio. We could argue that Disney's operating income is subject to large swings, depending upon the vagaries of the economy and the fortunes of the entertainment business, as shown in Table 8.11.

Table 8.11: Disney's Operating Income History: 1987 – 2003

Year	EBIT	% Change in EBIT
1987	756	
1988	848	12.17%
1989	1177	38.80%
1990	1368	16.23%
1991	1124	-17.84%
1992	1287	14.50%
1993	1560	21.21%

1994	1804	15.64%
1995	2262	25.39%
1996	3024	33.69%
1997	3945	30.46%
1998	3843	-2.59%
1999	3580	-6.84%
2000	2525	-29.47%
2001	2832	12.16%
2002	2384	-15.82%
2003	2713	13.80%

There are several ways of using the information in such historical data to modify the analysis. One approach is to look at the firm's performance during previous downturns. In Disney's case, the operating income in 2002 dropped by 15.82% as the firm struggled with the aftermath of terrorism. In 2000, Disney's self-inflicted wounds, from over investment in the internet business and poor movies, caused operating income to plummet almost 30%. A second approach is to obtain a statistical measure of the volatility in operating income, so that we can be more conservative in choosing debt levels for firms with more volatile earnings. In Disney's case, the standard deviation in percentage changes in operating income is 19.54%. Table 8.12 illustrates the impact of lowering operating from current levels on the optimal debt level.

Table 8.12: Effects Of Operating Income On Optimal Debt Ratio

% Drop in EBITDA	*EBIT*	*Optimal Debt Ratio*
0%	$ 2,805	30%
5%	$ 2,665	20%
10%	$ 2,524	20%
15%	$ 2385	20%
20%	$ 2,245	20%

The optimal debt ratio declines to 20% when the operating income decreases by 5% but the optimal stays at 20% for larger decreases in operating income (up to 40%).

In Practice: EBIT versus EBITDA

In recent years, analysts have increasingly turned to using EBITDA as a measure of operating cashflows for a firm. It may therefore seem surprising that we focus on operating income or EBIt far more than EBITDA when computing the optimal capital

structure. The interest coverage ratios, for instance, are based upon operating income and not EBITDA. While it is true that depreciation and amortization are non-cash expenses and should be added back to cash flows, it is dangerous for a firm with ongoing operations to depend upon the cashflows generated by these items to service debt payments. After all, firms with high depreciation and amortization expenses usually have high ongoing capital expenditures. If the cash inflows from depreciation and amortization are redirected to make interest payments, the reinvestment made by firms will be insufficient to generate future growth or to maintain existing assets.

Normalized Operating Income

A key input that drives the optimal capital structure is the current operating income. If this income is depressed, either because the firm is a cyclical firm or because there are firm-specific factors that are expected to be temporary, the optimal debt ratio that will emerge from the analysis will be much lower than the firm's true optimal. For example, automobile manufacturing firms would have had very low debt ratios if the optimal debt ratios had been computed based upon the operating income in 2001 and 2002, which were recession years. If the drop in operating income is permanent, however, this lower optimal debt ratio is, in fact, the correct estimate.

Normalized Income: This is a measure of the income that a firm can make in a normal year, where there are no extraordinary gains or losses either from firm-specific factors (such as write offs and one-time sales) or macro economic factors (such as recessions and economic booms).

When evaluating a firm with depressed current operating income, we must first decide whether the drop in income is temporary or permanent. If the drop is temporary, we must estimate the normalized operating income for the firm. The *normalized operating income* is an estimate of how much the firm would earn in a normal year, i.e., a year without the specific events that are depressing earnings this year. Most analysts normalize earnings by taking the average earnings over a period of time (usually 5 years).

 *mgnroc.xls*: There is a dataset on the web that summarizes operating margins and returns on capital by industry group in the United States for the most recent quarter.

Operating Income as a Function of Default Risk

In the analysis we just completed for the Disney, we assumed that operating income would remain constant while the debt ratios changed. While this assumption simplifies our analysis substantially, it is not realistic. The operating income, for many firms, will drop as the default risk increases; this, in fact, is the cost we labeled as an indirect bankruptcy cost in the last chapter. The drop is likely to become more pronounced as the default risk falls below an acceptable level; for instance, a bond rating below investment grade may trigger significant losses in revenues and increases in expenses.

A general model for optimal capital structure would allow both operating income and cost of capital to change as the debt ratio changes. We have already described how we can estimate cost of capital at different debt ratios, but we could also attempt to do the same with operating income. For instance, we could estimate how the operating income for the Aracruz would change as debt ratios and default risk changes by looking at the effects of rating downgrades on the operating income of other paper and pulp companies.

If both operating income and cost of capital change, the optimal debt ratio may no longer be the point at which the cost of capital is minimized. Instead, the optimal has to be defined as that debt ratio at which the value of the firm is maximized. We will consider an example of such an analysis in a few pages, when we estimate the optimal debt ratio for J.P. Morgan.

Illustration 8.5: Applying the Cost of Capital Approach with Normalized Operating Income to Aracruz Cellulose

Aracruz Cellulose, the Brazilian pulp and paper manufacturing firm, reported operating income of 887 million BR on revenues of 3176 million BR in 2003. This was significantly higher than it's operating income of 346 million BR in 2002 and 196 million Br in 2001. We estimated the optimal debt ratio for Aracruz, based upon the following information:

- In 2003, Aracruz had depreciation of 553 million BR and capital expenditures amounted to 661 million BR.
- Aracruz had debt outstanding of 4,094 million BR with a dollar cost of debt of 7.25%.

- The corporate tax rate in Brazil is estimated to be 34%.
- Aracruz had 859.59 million shares outstanding, trading 10.69 BR per share. The beta of the stock is estimated, using comparable firms, to be 0.70.

In chapter 4, we estimated Aracruz's current dollar cost of capital to be 10.33%, using an equity risk premium of 12.49% for Brazil:

Current $ Cost of Equity = 4% + 0.70 (12.49%) = 12.79%

Market Value of Equity = 10.69 BR/share * 859.59= 9,189 million BR

Current $ Cost of Capital

= 12.79% (9,189/(9,189+4,094)) + 7.25% (1-.34) (4,094/(9189+4,094) = 10.33%

We made three significant changes in applying the cost of capital approach to Aracruz as opposed to Disney:

- The operating income at Aracruz is a function of the price of paper and pulp in global markets. While 2003 was a very good year for the company, its income history over the last decade reflects the volatility created by pulp prices. We computed Aracruz's average pre-tax operating margin over the last 10 years to be 25.99%. Applying this lower average margin to 2003 revenues generates a normalized operating income of 796.71 million BR. We will compute the optimal debt ratio using this normalized value.
- In chapter 4, we noted that Aracruz's synthetic rating of BBB, based upon the interest coverage ratio, is much higher than its actual rating of B- and attributed the difference to Aracruz being a Brazilian company, exposed to country risk. Since we compute the cost of debt at each level of debt using synthetic ratings, we run to risk of understating the cost of debt. The difference in interest rates between the synthetic and actual ratings is 1.75% and we add this to the cost of debt estimated at each debt ratio from 0% to 90%. You can consider this a country-risk adjusted cost of debt for Aracruz.
- Aracruz has a market value o equity of about $3 billion (9 billion BR). We used the interest coverage ratio/ rating relationship for smaller companies to estimate synthetic ratings at each level of debt. In practical terms, the rating that we assign to Aracruz for any given interest coverage ratio will generally be lower than the rating that Disney, a much larger company, would have had with the same ratio.

Using the normalized operating income, we estimated the costs of equity, debt and capital in table 8.13 for Aracruz at different debt ratios.

Table 8.13: Aracruz Cellulose: Cost of Capital, Firm Value and Debt Ratios

Debt Ratio	*Beta*	*Cost of Equity*	*Bond Rating*	*Interest rate on debt*	*Tax Rate*	*Cost of Debt (after-tax)*	*WACC*	*Firm Value in BR*
0%	0.54	10.80%	AAA	6.10%	34.00%	4.03%	10.80%	12,364
10%	0.58	11.29%	AAA	6.10%	34.00%	4.03%	10.57%	12,794
20%	0.63	11.92%	A	6.60%	34.00%	4.36%	10.40%	13,118
30%	0.70	12.72%	BBB	7.25%	34.00%	4.79%	10.34%	13,256
40%	0.78	13.78%	CCC	13.75%	34.00%	9.08%	11.90%	10,633
50%	0.93	15.57%	CCC	13.75%	29.66%	9.67%	12.62%	9,743
60%	1.20	19.04%	C	17.75%	19.15%	14.35%	16.23%	6,872
70%	1.61	24.05%	C	17.75%	16.41%	14.84%	17.60%	6,177
80%	2.41	34.07%	C	17.75%	14.36%	15.20%	18.98%	5,610
90%	4.82	64.14%	C	17.75%	12.77%	15.48%	20.35%	5,138

The optimal debt ratio for Aracruz using the normalized operating income is 30%, a shade below it's current debt ratio of 30.82% but the cost of capital at the optimal is almost identical to it's current cost of capital. This indicates that Aracruz is at it's optimal debt ratio. There are two qualifiers we would add to this conclusion. The first is that the volatility in paper and pulp prices will undoubtedly cause big swings in operating income over time, and with it the optimal debt ratio. The second is that as an emerging market company, Aracruz is particularly exposed to political or economic risk in Brazil in particular and Latin America in general. . It is perhaps because of this fear of market crises that Aracruz has a cash balance amounting to more than 7% of the total firm value. In fact, the net debt ratio for Aracruz is only about 23%.

In Practice: Normalizing Operating Income

In estimating optimal debt ratios, it is always more advisable to use normalized operating income, rather than current operating income. Most analysts normalize earnings by taking the average earnings over a period of time (usually 5 years). Since this holds the scale of the firm fixed, it may not be appropriate for firms that have changed in size over time. The right way to normalize income will vary across firms:

1. For cyclical firms, whose current operating income may be overstated (if the economy is booming) or understated (if the economy is in recession), the operating

income can be estimated using the average operating margin over an entire economic cycle (usually 5 to 10 years)

Normalized Operating Income = Average Operating Margin (Cycle) * Current Sales

2. For firms which have had a bad year in terms of operating income, due to firm-specific factors (such as the loss of a contract), the operating margin for the industry in which the firm operates can be used to calculate the normalized operating income:

Normalized Operating Income = Average Operating Margin (Industry) * Current Sales

The normalized operating income can also be estimated using returns on capital across an economic cycle (for cyclical firms) or an industry (for firms with firm-specific problems), but returns on capital are much more likely to be skewed by mismeasurement of capital than operating margins.

Extensions of the Cost of Capital Approach

The cost of capital approach, which works so well for manufacturing firms that are publicly traded, may need to be adjusted when we are called upon to compute optimal debt ratios for private firms or for financial service firms, such as banks and insurance companies.

Private Firms

There are three major differences between public and private firms in analyzing optimal debt ratios. One is that unlike the case for publicly traded firms, we do not have a direct estimate of the market value of a private firm. Consequently, we have to estimate firm value before we move to subsequent stages in the analysis. The second difference relates to the cost of equity and how we arrive at that cost. While we use betas to estimate the cost of equity for a public firm, that usage might not be appropriate when we are computing the optimal debt ratio for a private firm, where the owner may not be well diversified. Finally, while publicly traded firms tend to think of their cost of debt in terms of bond ratings and default spreads, private firms tend to borrow from banks. Banks assess default risk and charge the appropriate interest rates.

To analyze the optimal debt ratio for a private firm, we make the following adjustments. First, we estimate the value of the private firm, by looking at how publicly traded firms in the same business are priced by the market. Thus, if publicly traded firms in the business have market values that are roughly three times revenues, we would multiply the revenues of the private firm by this number to arrive at an estimated value. Second, we continue to estimate the costs of debt for a private firm using a bond rating, but the rating is a synthetic rating, based on interest coverage ratios. We tend to require much higher interest coverage ratios to arrive at the same rating, to reflect the fact that banks are likely to be more conservative in assessing default risk at small, private firms.

Illustration 8.6: Applying the Cost of Capital Approach to a Private Firm: Bookscape

Bookscapes as a private firm, has neither a market value for its equity nor a rating for its debt. In chapter 4, we assumed that Bookscape would have a debt to capital ratio of 16.90%, similar to that of publicly traded book retailers, and that the tax rate for the firm is 40%. We computed a cost of capital based on that assumption. We also used a "total beta"of 2.0606 to measure the additional risk that the owner of Bookscape is exposed to because of his lack of diversification.

Cost of equity = Risfree Rate + Total Beta * Risk Premium

= 4% + 2.0606 * 4.82% = 13.93%

Pre-tax Cost of debt = 5.5% (based upon synthetic rating of BBB)

Cost of capital = 13.93% (.8310) + 5.5% (1-.40) (.1690) = 12.14%

In order to estimate the optimal capital structure for Bookscape, we made the following assumptions:

- While Bookscapes has no conventional debt outstanding, it does have one large operating lease commitment. Given that the operating lease has 25 years to run and that the lease commitment is $500,000 for each year, the present value of the operating lease commitments is computed using Bookscape's pre-tax cost of debt of 5.5%:

  Present value of Operating Lease commitments (in thousands) = $500 (PV of annuity, 5.50%, 20 years) = 6,708

Note that Bookscape's pre-tax cost of debt is based upon their synthetic rating of BBB, which we estimated in chapter 4.

- Bookscape had operating income before taxes of $ 2 million in the most recent financial year, after depreciation charges of $400,000 and operating lease expenses of $ 600,000. Since we consider the present value of operating lease expenses to be debt, we add back the imputed interest expense on the present value of lease expenses to the earnings before interest and taxes to arrive at an adjusted earnings before interest and taxes. For the rest of the analysis, operating lease commitments are treated as debt and the interest expense estimated on the present value of operating leases:

  Adjusted EBIT (in '000s) = EBIT + Pre-tax cost of debt * PV of operating lease expenses = $ 2,000+ .055 * $6,7078 = $2,369

- To estimate the market value of equity, we looked at publicly traded book retailers and computed an average price to earnings ratio of 16.31 for these firms. Applying this multiple of earnings to Bookscape's net income of $1,320,000 in 2003 yielded an estimate of Bookscape's market value of equity.

  Estimated Market Value of Equity (in '000s) = Net Income for Bookscape * Average PE for publicly traded book retailers = 1,320 * 16.31 = $21,525

- The interest rates at different levels of debt will be estimated based upon a "synthetic" bond rating. This rating will be assessed using table 8.14, which summarizes ratings and default spreads over the long-term bond rate as a function of interest coverage ratios for small firms that are rated by S&P as of January 2004.

Table 8.14: Interest Coverage Ratios, Rating and Default Spreads: Small Firms

Interest Coverage Ratio	*Rating*	*Spread over T Bond Rate*
> 12.5	AAA	0.35%
9.50-12.50	AA	0.50%
7.5 - 9.5	A+	0.70%
6.0 - 7.5	A	0.85%
4.5 - 6.0	A-	1.00%
4.0 - 4.5	BBB	1.50%
3.5 – 4.0	BB+	2.00%
3.0 - 3.5	BB	2.50%
2.5 - 3.0	B+	3.25%
2.0 - 2.5	B	4.00%

1.5 - 2.0	B-	6.00%
1.25 - 1.5	CCC	8.00%
0.8 - 1.25	CC	10.00%
0.5 - 0.8	C	12.00%
< 0.5	D	20.00%

Note that smaller firms need higher coverage ratios than the larger firms to get the same rating.

- The tax rate used in the analysis is 40% and the long term bond rate at the time of this analysis was 4%.

Based upon this information and using the same approach that we used for Disney, the cost of capital and firm value are estimated for Bookscape at different debt ratios. The information is summarized in Table 8.15.

Table 8.15: Costs of Capital and Firm Value for Bookscape

Debt Ratio	*Total Beta*	*Cost of Equity*	*Bond Rating*	*Interest rate on debt*	*Tax Rate*	*Cost of Debt (after-tax)*	*WACC*	*Firm Value (G)*
0%	1.84	12.87%	AAA	4.35%	40.00%	2.61%	12.87%	$25,020
10%	1.96	13.46%	AAA	4.35%	40.00%	2.61%	12.38%	$26,495
20%	2.12	14.20%	A+	4.70%	40.00%	2.82%	11.92%	$28,005
30%	2.31	15.15%	A-	5.00%	40.00%	3.00%	11.51%	$29,568
40%	2.58	16.42%	BB	6.50%	40.00%	3.90%	11.41%	$29,946
50%	2.94	18.19%	B	8.00%	40.00%	4.80%	11.50%	$29,606
60%	3.50	20.86%	CC	14.00%	39.96%	8.41%	13.39%	$23,641
70%	4.66	26.48%	CC	14.00%	34.25%	9.21%	14.39%	$21,365
80%	7.27	39.05%	C	16.00%	26.22%	11.80%	17.25%	$16,745
90%	14.54	74.09%	C	16.00%	23.31%	12.27%	18.45%	$15,355

The firm value is maximized (and the cost of capital is minimized) at a debt ratio of 40%, though the firm value is relatively flat between 30% and 50%. The default risk increases significantly at the optimal debt ratio, as evidenced by the synthetic bond rating of BB, and the total beta increases to 2.58.

In Practice: Optimal Debt Ratios for Private Firms

Although the trade off between the costs and benefits of borrowing remain the same for private and publicly traded firms, there are differences between the two kinds of firms that may result in private firms borrowing less money.

- Increasing debt increases default risk and expected bankruptcy cost much more substantially for small private firms than for larger publicly traded firms. This is partly because the owners of private firms may be exposed to unlimited liability, and partly because the perception of financial trouble on the part of customers and suppliers can be much more damaging to small, private firms.
- Increasing debt yields a much smaller advantage in terms of disciplining managers in the case of privately run firms, since the owners of the firm tend to be the top managers, as well.
- Increasing debt generally exposes small private firms to far more restrictive bond covenants and higher agency costs than it does large publicly traded firms.
- The loss of flexibility associated with using excess debt capacity is likely to weigh much more heavily on small, private firms than on large, publicly traded firms, due to the former's lack of access to public markets.

All the factors mentioned above would lead us to expect much lower debt ratios at small private firms.

8.5. ☞**: Going Public: Effect on Optimal Debt Ratio**

Assume that Bookscape is planning to make an initial public offering in six months. How would this information change your assessment of the optimal debt ratio?

a. It will increase the optimal debt ratio because publicly traded firms should be able to borrow more than private businesses
b. It will reduce the optimal debt ratio because only market risk counts for a publicly traded firm
c. It may increase or decrease the optimal debt ratio, depending on which effect dominates

Banks and Insurance Companies

There are several problems in applying the cost of capital approach to financial service firms, such as banks and insurance companies[20]. The first is that the interest coverage ratio spreads, which are critical in determining the bond ratings, have to be estimated separately for financial service firms; applying manufacturing company spreads will result in absurdly low ratings for even the safest banks, and very low optimal debt ratios. Furthermore, the relationship between interest coverage ratios and ratings tend to be much weaker for financial service firms than it is for manufacturing firms. The second is a measurement problem that arises partly from the difficulty in estimating the debt on a financial service company's balance sheet.

Given the mix of deposits, repurchase agreements, short term financing and other liabilities that may appear on a financial service firm's balance sheet, one solution is to focus only on long term debt, defined tightly, and to use interest coverage ratios defined using only long term interest expenses. The third problem is that financial service firms are regulated, and have to meet capital ratios that are defined in terms of book value. If, in the process of moving to an optimal market value debt ratio, these firms violate the book capital ratios, they could put themselves in jeopardy.

Illustration 8.7: Applying the Cost of Capital Approach to Deutsche Bank

We analyze the optimal capital structure for Deutsche Bank using data from 2004. To begin, we make the following assumptions:

- The earnings before long-term interest expenses and taxes amounted to 7,405 million Euros in 2003.
- Deutsche Bank was ranked AA- and paid 5.05% on its long-term debt in 2004. It had 82 billion in long term-debt outstanding at the end of the year.
- Deutsche Bank had 581.85 million shares outstanding, trading at 70.40 Euros per share, and the bottom-up beta of 0.98 that we estimated for the company in chapter 4 is the current beta. The tax rate for the firm is 38% and the riskless Euro rate is 4.05%.

[20] Davis and Lee (1997) consider some of the issues related to estimating the optimal debt ratio for a bank.

- The interest coverage ratios used to estimate the bond ratings are adjusted to reflect the ratings of financial service firms.
- The operating income for Deutsche Bank is assumed to drop if its rating drops. Table 8.16 summarizes the interest coverage ratios and estimated operating income drops for different ratings classes.

Table 8.16: Interest Coverage Ratios, Ratings and Operating Income Declines

Long Term Interest Coverage Ratio	*Rating is*	*Spread is*	*Operating Income Decline*
< 0.05	D	16.00%	-50.00%
0.05 – 0.10	C	14.00%	-40.00%
0.10 – 0.20	CC	12.50%	-40.00%
0.20 - 0.30	CCC	10.50%	-40.00%
0.30 – 0.40	B-	6.25%	-25.00%
0.40 – 0.50	B	6.00%	-20.00%
0.50 – 0.60	B+	5.75%	-20.00%
0.60 – 0.75	BB	4.75%	-20.00%
0.75 – 0.90	BB+	4.25%	-20.00%
0.90 – 1.20	BBB	2.00%	-20.00%
1.20 – 1.50	A-	1.50%	-17.50%
1.50 – 2.00	A	1.40%	-15.00%
2.00 – 2.50	A+	1.25%	-10.00%
2.50 – 3.00	AA	0.90%	-5.00%
> 3.00	AAA	0.70%	0.00%

Thus, we assume that the operating income will drop 5% if Deutsche Bank's rating drops to AA and 20% if it drops to BBB. The drops in operating income were estimated by looking at the effects of ratings downgrades on banks[21].

Based upon these assumptions, the optimal long term debt ratio for Deutsche Bank is estimated to be 40%, lower than it's current long term debt ratio of 67%. Table 8.17 below summarizes the cost of capital and firm values at different debt ratios for the firm.

Table 8.17: Debt Ratios, Cost of Capital and Firm Value: Deutsche Bank

Debt Ratio	*Beta*	*Cost of Equity*	*Bond Rating*	*Interest rate on debt*	*Tax Rate*	*Cost of Debt (after-tax)*	*WACC*	*Firm Value (G)*
0%	0.44	6.15%	AAA	4.75%	38.00%	2.95%	6.15%	$111,034

[21] We were able to find a few down-graded banks upto BBB. Below BBB, we found no banks that remained independent, since the FDIC stepped in to protect depositors. We made the drop in operating income large enough to rule out ratings below BBB.

10%	0.47	6.29%	AAA	4.75%	38.00%	2.95%	5.96%	$115,498
20%	0.50	6.48%	AAA	4.75%	38.00%	2.95%	5.77%	$120,336
30%	0.55	6.71%	AAA	4.75%	38.00%	2.95%	5.58%	$125,597
40%	0.62	7.02%	AAA	4.75%	38.00%	2.95%	5.39%	$131,339
50%	0.71	7.45%	A+	5.30%	38.00%	3.29%	5.37%	$118,770
60%	0.84	8.10%	A	5.45%	38.00%	3.38%	5.27%	$114,958
70%	1.07	9.19%	A	5.45%	38.00%	3.38%	5.12%	$119,293
80%	1.61	11.83%	BB+	8.30%	32.43%	5.61%	6.85%	$77,750
90%	3.29	19.91%	BB	8.80%	27.19%	6.41%	7.76%	$66,966

The optimal debt ratio is the point at which the firm value is maximized. Note that the cost of capital is actually minimized at 70% debt but the firm value is highest at a 40% debt ratio. This is so because the operating income changes as the debt ratio changes. While the cost of capital continues to decline as the debt ratio increases beyond 40%, the decline in operating income more that offsets this drop.

In Practice: Building in Regulatory, Self Imposed and Lender Constraints

In most analyses of optimal capital structure, an analyst will be faced with a series of constraints, some of which come from regulatory requirements, some of which are self imposed and some of which are imposed by existing lenders to the firm. One very common constraint imposed by all three is a constraint that the book value debt ratio not exceed a specified number. Since the analysis we have done so far has focused on market value debt ratios, there is the risk that the book value constraint may be violated. There are two solutions:

1. The first is to do the entire analysis using book value of debt and equity, looking for the optimal debt ratio. Since the approach we have described is driven by cash flows, the optimal dollar debt that is computed should not be affected significantly by doing this.
2. The second and more general approach (since it can be used to analyze any kind of constraint) is to keep track of the book value debt ratio in the traditional analysis, and view the optimal capital structure as the one the minimizes the cost of capital subject to the book value debt ratio being lesser than the specified constraint.

8.6. ☞**: Bankruptcy Costs and Debt Ratios**

The optimal debt ratio obtained by minimizing the cost of capital is too high because it does not consider bankruptcy costs.

a. True

b. False

Explain.

Determinants of Optimal Debt Ratio

The preceding analysis highlights some of the determinants of the optimal debt ratio. We can then divide these determinants into firm-specific and macroeconomic factors.

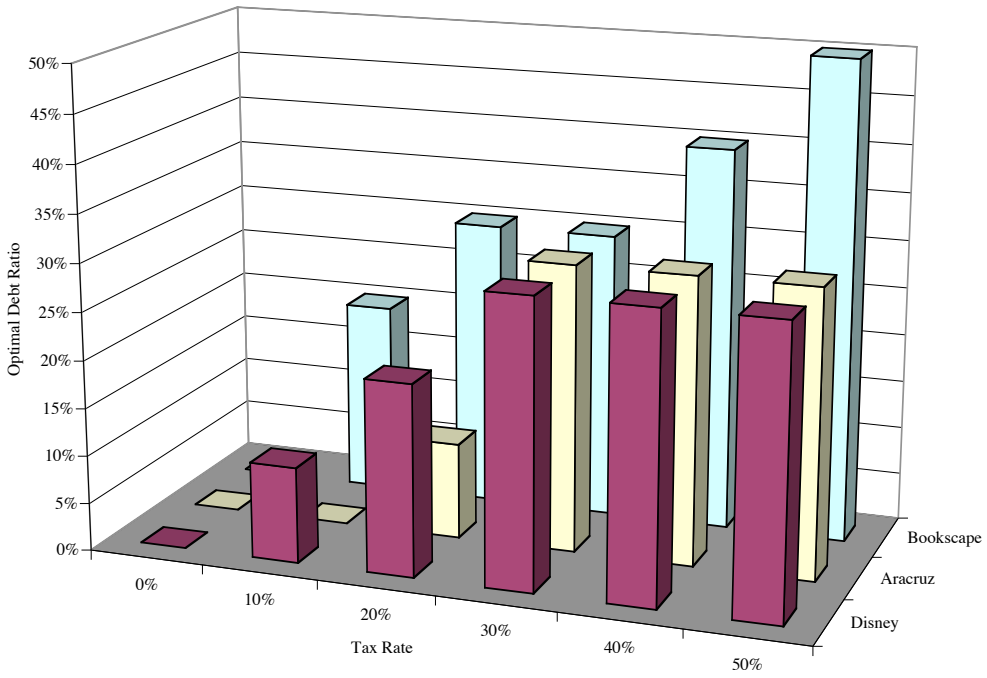
Firm-Specific Factors

Determinants specific to the firm include the firm's tax rate, pre-tax returns and variance in operating income.

(a) Firm's tax rate:

In general, the tax benefits from debt increase as the tax rate goes up. In relative terms, firms with higher tax rates have higher optimal debt ratios than do firms with lower tax rates, other things being equal. It also follows that a firm's optimal debt ratio will increase as its tax rate increases. We can illustrate this by computing the optimal debt ratio for Disney, Aracruz and Bookscape, holding all else constant and just changing the tax rate in Figure 8.4

Figure 8.4: Optimal Debt Ratio and Tax Rate



At a 0% tax rate, the optimal debt ratio is zero for all three firms. Without the benefits that accrue from taxes, the rationale for using debt disappears. As the tax rate increases, the optimal debt ratios increase for all three firms but at different rates. For Aracruz and Disney, the optimal debt ratio does not increase above 30% even if the tax rate increases because the operating income at both firms is not high enough to sustain much higher debt ratios; in other words, there is not enough earnings to claim additional tax benefits. For Bookscape, though, the optimal continues to increase and reaches 50% when the tax rate is 50%.

(b) Pre-Tax Returns on the Firm (in Cash Flow Terms):

The most significant determinant of the optimal debt ratio is a firm's earnings capacity. In fact, the operating income as a percentage of the market value of the firm (debt plus equity) is usually good indicator of the optimal debt ratio. When this number is high (low), the optimal debt ratio will also be high (low). A firm with higher pre-tax earnings can sustain much more debt as a proportion of the market value of the firm, since debt payments can be met much more easily from prevailing earnings. Disney, for example, has operating income of $2,805 million, which is 4.02 % of the market value of

the firm of $69,769 million in the base case, and an optimal debt ratio of 30%. Doubling this to 8.04% will increase the optimal debt ratio to 50%.

(c) Variance in Operating Income

The variance in operating income enters the base case analysis in two ways. First, it plays a role in determining the current beta: firms with high (low) variance in operating income have high (low) betas. Second, the volatility in operating income can be one of the factors determining bond ratings at different levels of debt: ratings drop off much more dramatically for higher variance firms as debt levels are increased. It follows that firms with higher (lower) variance in operating income will have lower (higher) optimal debt ratios. The variance in operating income also plays a role in the constrained analysis, since higher variance firms are much more likely to register significant drops in operating income. Consequently, the decision to increase debt should be made much more cautiously for these firms.

Macro-economic Factors

Should macroeconomic conditions affect optimal debt ratios? Obviously. In good economic times, firms will generate higher earnings and be able to service more debt. In recessions, earnings will decline and with it the capacity to service debt. That is why prudent firms borrow based upon normalized earnings rather than current earnings. Holding operating income constant, macroeconomic variables can still affect optimal debt ratios. In fact, both the level of riskfree rate and the magnitude of default spreads can affect optimal debt ratios.

(a) Level of Rates

As interest rates decline, the conventional wisdom is that debt should become cheaper and more attractive for firms. While this may seem intuitive, the effect is muted by the fact that lower interest rates also reduce the cost of equity. In fact, changing the riskfree rate has a surprisingly small effect on the optimal debt ratio, as long as interest rates

move within a normal range.[22] When interest rates exceed normal levels, optimal debt ratios do decline partly because we keep operating income fixed. The higher interest payments at every debt ratio reduce bond ratings and affect the capacity of firms to borrow more.

(b) Default Spreads

The default spreads for different ratings classes tend to increase during recessions and decrease during recoveries. Keeping other things constant, as the spreads increase (decrease) optimal debt ratios decrease (increase), for the simple reason that higher spreads penalize firms which borrow more money and have lower ratings. In fact, the default spreads on corporate bonds between 1992 and 2000, leading to higher optimal debt ratios for all firms. In 2001 and 2002, as the economy slowed, default spreads widened again, leading to lower optimal debt ratios.

 There is a dataset on the web that summarizes operating margins and returns on capital by industry group in the United States for the most recent quarter.

Adjusted Present Value Approach

In the adjusted present value (APV) approach, we begin with the value of the firm without debt. As we add debt to the firm, we consider the net effect on value by considering both the benefits and the costs of borrowing. The value of the levered firm can then be estimated at different levels of the debt, and the debt level that maximizes firm value is the optimal debt ratio.

Steps in the Adjusted Present Value approach

In the Adjusted Present Value approach, we assume that the primary benefit of borrowing is a tax benefit, and that the most significant cost of borrowing is the added

[22] The normal range for long term interest rates in the United States for the last 40 years has been between 4 and 8%. There was a short period between 1978 and 1982 when long term interest rates were much higher.

risk of bankruptcy. To estimate the value of the firm, with this assumption, we proceed in three steps. We begin by estimating the value of the firm with no leverage. We then consider the present value of the interest tax savings generated by borrowing a given amount of money. Finally, we evaluate the effect of borrowing the amount on the probability that the firm will go bankrupt, and the expected cost of bankruptcy.

Step 1: Estimate the value of the firm with no debt: The first step in this approach is the estimation of the value of the unlevered firm. This can be accomplished by valuing the firm as if it had no debt, i.e., by discounting the expected after-tax operating cash flows at the unlevered cost of equity. In the special case where cash flows grow at a constant rate in perpetuity,

$$\text{Value of Unlevered Firm} = FCFF_o\ (1+g)/(\rho_u - g)$$

where $FCFF_0$ is the current after-tax operating cash flow to the firm, ρ_u is the unlevered cost of equity, and g is the expected growth rate. The inputs needed for this valuation are the expected cashflows, growth rates and the unlevered cost of equity. To estimate the latter, we can draw on our earlier analysis and compute the unlevered beta of the firm –

$$\beta_{unlevered} = \beta_{current}/[1+(1-t)D/E]$$

where

$\beta_{unlevered}$ = Unlevered beta of the firm,

$\beta_{current}$ = Current equity beta of the firm,

t = Tax rate for the firm and

D/E = Current debt/equity ratio.

This unlevered beta can then be used to arrive at the unlevered cost of equity. Alternatively, we can take the current market value of the firm as a given and back out the value of the unlevered firm by subtracting out the tax benefits and adding back the expected bankruptcy cost from the existing debt.

Current Firm Value = Value of Unlevered firm + PV of tax benefits – Expected Bankruptcy cost

Value of Unlevered firm = Current Firm Value – PV of tax benefits + Expected Bankruptcy costs

Step 2: Estimate the present value of tax benefits from debt: The second step in this approach is the calculation of the expected tax benefit from a given level of debt. This tax benefit is a function of the tax rate of the firm and is discounted at the cost of debt to reflect the riskiness of this cash flow. If the tax savings are viewed as a perpetuity,

Value of Tax Benefits =[Tax Rate * Cost of Debt * Debt] / Cost of Debt

= Tax Rate * Debt

= t_c D

The tax rate used here is the firm's marginal tax rate, and it is assumed to stay constant over time. If we anticipate the tax rate changing over time, we can still compute the present value of tax benefits over time, but we cannot use the perpetual growth equation cited above.

Step 3: Estimate the expected bankruptcy costs as a result of the debt: The third step is to evaluate the effect of the given level of debt on the default risk of the firm and on expected bankruptcy costs. In theory, at least, this requires the estimation of the probability of default with the additional debt and the direct and indirect cost of bankruptcy. If π_a is the probability of default after the additional debt and BC is the present value of the bankruptcy cost, the present value of expected bankruptcy cost can be estimated–

Bankruptcy Cost: This is the cost associated with going bankruptcy. It includes both direct costs (from going bankrupt) and indirect costs (arising from the perception that a firm may go bankrupt).

PV of Expected Bankruptcy cost = Probability of Bankruptcy * PV of Bankruptcy Cost

= π_a BC

This step of the adjusted present value approach poses the most significant estimation problem, since neither the probability of bankruptcy nor the bankruptcy cost can be estimated directly. There are two basic ways in which the probability of bankruptcy can be estimated indirectly. One is to estimate a bond rating, as we did in the cost of capital approach, at each level of debt and use the empirical estimates of default probabilities for

each rating. For instance, table 8.18, extracted from a study by Altman and Kishore, summarizes the probability of default over ten years by bond rating class in 1998.[23]

Table 8.18: Default Rates by Bond Rating Classes

Bond Rating	*Default Rate*
D	100.00%
C	80.00%
CC	65.00%
CCC	46.61%
B-	32.50%
B	26.36%
B+	19.28%
BB	12.20%
BBB	2.30%
A-	1.41%
A	0.53%
A+	0.40%
AA	0.28%
AAA	0.01%

Source: Altman and Kishore (1998)

The other is to use a statistical approach, such as a probit to estimate the probability of default, based upon the firm's observable characteristics, at each level of debt.

The bankruptcy cost can be estimated, albeit with considerable error, from studies that have looked at the magnitude of this cost in actual bankruptcies. Studies that have looked at the direct cost of bankruptcy conclude that they are small[24], relative to firm value. The indirect costs of bankruptcy can be substantial, but the costs vary widely across firms. Shapiro and Titman speculate that the indirect costs could be as large as 25 to 30% of firm value but provide no direct evidence of the costs.

The net effect of adding debt can be calculated by aggregating the costs and the benefits at each level of debt.

$$\text{Value of Levered Firm} = FCFF_o\,(1+g)/(\rho_u - g) + t_c\,D - \pi_a\,BC$$

We compute the value of the levered firm at different levels of debt. The debt level that maximizes the value of the levered firm is the optimal debt ratio.

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[23] This study estimated default rates over ten years only for some of the ratings classes. We extrapolated the rest of the ratings.

In Practice: Using a Probit to Estimate the Probability of Bankruptcy

It is possible to estimate the probability of default using statistical techniques, when there is sufficient data avaialble. For instance, if we have a database that lists all firms that went bankrupt during a period of time, as well as firms that did not go bankrupt during the same period, together with descriptive characteristics on these firms, a probit analysis can be used to estimate the likelihood of bankruptcy as a function of these characteristics. The steps involved in a probit analysis are as follows:

1. Identify the event of interest: Probits work best when the event either occurs or it does not. For bankruptcy, the event might be the filing for bankruptcy protection under the law.
2. Over a specified time period, collect information on all the firms that were exposed to the event. In the bankruptcy case, this would imply collecting information on which firms that filed for bankruptcy over a certain period (say, 5 years).
3. Based upon your knowledge of the event, and other research on it, specify measurable and observable variables that are likely to be good predictors of that event. In the case of bankruptcy, these might include excessive debt ratios, declining income, poor project returns and small market capitalization.
4. Collect information on these variables for the firms that filed for bankruptcy, at the time of the filing. Collect the same information for all other firms that were in existence at the same time, and which have data available on them on these variables. (If this is too data intensive, a random sampling of the firms that were not exposed to the event can be used.) In the bankruptcy analysis, this would imply collecting information on debt ratios, income trends, project returns and market capitalization on the firms that filed for bankruptcy at the time of the filing, and all other firms across the period.
5. In a probit, the dependent variable is the occurrence of the specified event (1 if it occurs, 0 if it does not) and the independent variables are the variables specified in step 3. The output from the probit looks very much like the output from a multiple regression, with statistical significance attached to each of the independent variables.

[24] In Warner's study of railroad bankruptcies, the direct cost of bankruptcy seems to be about 5%.

Once the probit has been done, the probability of a firm defaulting can be estimated by plugging in that firm's values for the independent variables into the probit. The predicted value that emerges from the probit is the probability of default.

Illustration 8.8: Using the Adjusted Present Value Approach to calculate Optimal Debt Ratio for Disney in 2004

This approach can be applied to estimating the optimal capital structure for Disney. The first step is to estimate the value of the unlevered firm. To do so, we start with the firm value of Disney in 2004 and net out the effect of the tax savings and bankruptcy costs arising from the existing debt.

Current Market Value of Disney = Value of Equity + Value of Debt = \$55,101+\$14,668 = \$ 69,789

We first compute the present value of the tax savings from the existing debt, assuming that the interest payment on the debt constitutes a perpetuity, using a marginal tax rate for Disney of 37.30%.

PV of Tax Savings from Existing Debt = Existing Debt * Tax Rate
= \$14,668* 0.373 = \$ 5,479 million

Based upon Disney's current rating of BBB+, we estimate a probability of bankruptcy of 1.41% from Table 8.18. The bankruptcy cost is assumed to be 25% of the firm value, prior to the tax savings.[25] Allowing for a range of 10-40% for bankruptcy costs, we have put Disney's exposure to expected bankruptcy costs in the middle of the range. There are some businesses that Disney is in where the perception of distress can be damaging – theme parks, for instance – but the movie and broadcasting businesses are less likely to be affected since projects tend be shorter term and on a smaller scale.

PV of Expected Bankruptcy Cost = Probability of Default * Bankruptcy cost
= 1.41% * (0.25* 69,789) = \$ 984 million

We then compute the value of Disney as an unlevered firm.

Value of Disney as an Unlevered Firm
= Current Market Value – PV of Tax Savings + Expected Bankruptcy Costs

= $ 69,789 + $ 5,479 - $ 984

= $ 65,294 million

The next step in the process is to estimate the tax savings in table 8.19 at different levels of debt. While we use the standard approach of assuming that the present value is calculated over a perpetuity, we reduce the tax rate used in the calculation, if interest expenses exceed the earnings before interest and taxes. The adjustment to the tax rate was described more fully earlier in the cost of capital approach.

Table 8.19: Tax Savings From Debt ($t_c D$): Disney

Debt Ratio	*$ Debt*	*Tax Rate*	*Tax Benefits*
0%	$0	37.30%	$0
10%	$6,979	37.30%	$2,603
20%	$13,958	37.30%	$5,206
30%	$20,937	37.30%	$7,809
40%	$27,916	31.20%	$8,708
50%	$34,894	18.72%	$6,531
60%	$41,873	15.60%	$6,531
70%	$48,852	13.37%	$6,531
80%	$55,831	11.70%	$6,531
90%	$62,810	10.40%	$6,531

The final step in the process is to estimate the expected bankruptcy cost, based upon the bond ratings, the probabilities of default, and the assumption that the bankruptcy cost is 25% of firm value. Table 8.20 summarizes these probabilities and the expected bankruptcy cost, computed based on the levered firm value

Expected Bankruptcy Cost at x% debt

= (Unlevered firm value + Tax benefits from debt at x% debt) * (Bankruptcy cost as % of firm value) * Probability of bankruptcy

Table 8.20: Expected Bankruptcy Cost, Disney

Debt Ratio	Bond Rating	Probability of Default	Expected Bankruptcy Cost
0%	AAA	0.01%	$2
10%	AAA	0.01%	$2
20%	A-	1.41%	$246

[25] This estimate is based upon the Warner study, which estimates bankruptcy costs for large companies to be 10% of the value, and upon the qualitative analysis of indirect bankruptcy costs in Shapiro and Cornell.

30%	BB	7.00%	$1,266
40%	CCC	50.00%	$9,158
50%	C	80.00%	$14,218
60%	C	80.00%	$14,218
70%	C	80.00%	$14,218
80%	C	80.00%	$14,218
90%	C	80.00%	$14,218

The value of the levered firm is estimated in Table 8.21 by aggregating the effects of the tax savings and the expected bankruptcy costs.

Table 8.21: Value of Disney with Leverage

Debt Ratio	$ Debt	Unlevered Firm Value	Tax Benefits	Expected Bankruptcy Cost	Value of Levered Firm
0%	$0	$65,294	$0	$2	$64,555
10%	$6,979	$65,294	$2,603	$2	$67,158
20%	$13,958	$65,294	$5,206	$246	$69,517
30%	$20,937	$65,294	$7,809	$1,266	$71,099
40%	$27,916	$65,294	$8,708	$9,158	$64,107
50%	$34,894	$65,294	$6,531	$14,218	$56,870
60%	$41,873	$65,294	$6,531	$14,218	$56,870
70%	$48,852	$65,294	$6,531	$14,218	$56,870
80%	$55,831	$65,294	$6,531	$14,218	$56,870
90%	$62,810	$65,294	$6,531	$14,218	$56,870

The firm value is maximized at between 20 and 30% debt, which is consistent with the results of the other approaches. These results are, however, very sensitive to both the estimate of bankruptcy cost as a percent of firm value and the probabilities of default.


apv.xls: This spreadsheet allows you to compute the value of a firm, with leverage, using the adjusted present value approach.

Benefits and Limitations of the Adjusted Present Value Approach

The advantage of the APV approach is that it separates the effects of debt into different components and allows the analyst to use different discount rates for each component. In this method, we do not assume that the debt ratio stays unchanged forever, which is an implicit assumption in the cost of capital approach. Instead, we have the

flexibility to keep the dollar value of debt fixed and to calculate the benefits and costs of the fixed dollar debt.

These advantages have to be weighed against the difficulty of estimating probabilities of default and the cost of bankruptcy. In fact, many analyses that use the adjusted present value approach ignore the expected bankruptcy costs, leading them to the conclusion that firm value increases as firms borrow money. Not surprisingly, they conclude that the optimal debt ratio for a firm is 100% debt.

In general, with the same assumptions, the APV and the Cost of Capital conclusions give identical answers. However, the APV approach is more practical when firms are evaluating a dollar amount of debt, while the cost of capital approach is easier when firms are analyzing debt proportions.[26]

 This spreadsheet allows you to compute the value of a firm, with leverage, using the adjusted present value approach.

Comparative Analysis

The most common approach to analyzing the debt ratio of a firm is to compare its leverage to that of similar firms. A simple way to perform this analysis is to compare a firm's debt ratio to the average debt ratio for the industry in which the firm operates. A more complete analysis would consider the differences between a firm and the rest of the industry, when determining debt ratios. We will consider both ways below.

Comparing to Industry Average

Firms sometimes choose their financing mixes by looking at the average debt ratio of other firms in the industry in which they operate. For instance, the table below compares the debt ratios[27] at Disney and Aracruz to other firms in their industries:

	Disney	*Entertainment*	*Aracruz*	*Paper and Pulp (Emerging Market)*

[26] See Inselbag and Kaufold (1997).

[27] For purposes of this analysis, we looked at debt without operating leases being capitalized because of the difficulty of doing this for all of the comparable firms.

Market Debt Ratio	21.02%	19.56%	30.82%	27.71%
Book Debt Ratio	35.10%	28.86%	43.12%	49.00%

Source: Value Line

Based on this comparison, Disney is operating at a debt ratio slightly higher than those of other firms in the industry in both market and book value terms, while Aracruz has a market debt ratio slightly higher than the average firm but a book debt ratio slightly lower.

Comparable (Firm): This is a firm that is similar to the firm being analyzed in terms of underlying characteristics - risk, growth and cash flow patterns. The conventional definition of comparable firm is one which is the same business as the one being analyzed, and of similar size.

The underlying assumptions in this comparison are that firms within the same industry are comparable, and that, on average, these firms are operating at or close to their optimal. Both assumptions can be questioned, however. Firms within the same industry can have different product mixes, different amounts of operating risk, different tax rates, and different project returns. In fact, most do. For instance, Disney is considered part of the entertainment industry, but its mix of businesses is very different from that of Lion's Gate, which is primarily a movie company, or Liberty Media. Furthermore, Disney's size and risk characteristics are very different from that of Pixar, which is also considered part of the same industry group. There is also anecdotal evidence that since firms try to mimic the industry average, the average debt ratio across an industry might not be at or even close to its optimal.

dbtfund.xls: There is a dataset on the web that summarizes market value and book value debt ratios, by industry, in addition to other relevant characteristics.

Controlling for Differences between Firms

Firms within the same industry can exhibit wide differences on tax rates, capacity to generate operating income and cash flows, and variance in operating income. Consequently, it can be dangerous to compare a firm's debt ratio to the industry, and draw conclusions about the optimal financing mix. The simplest way to control for differences across firms, while using the maximum information available in the market, is

to run a regression, regressing debt ratios against these variables, across the firms in a industry:

Debt Ratio = $\alpha_0 + \alpha_1$ Tax Rate $+ \alpha_2$ Pre-tax Returns + α_3 Variance in operating income

There are several advantages to the crosssectional approach. Once the regression has been run and the basic relationship established (i.e., the intercept and coefficients have been estimated), the predicted debt ratio for any firm can be computed quickly using the measures of the independent variables for this firm. If a task involves calculating the optimal debt ratio for a large number of firms in a short time period, this may be the only practical way of approaching the problem, since the other chapters described in this chapter are time intensive.[28]

There are also limitations to this approach. The coefficients tend to shift over time. Besides some standard statistical problems and errors in measuring the variables, these regressions also tend to explain only a portion of the differences in debt ratios between firms.[29] However, the regressions provide significantly more information than does a naive comparison of a firm's debt ratio to the industry average.

Illustration 8.9: Estimating Disney's debt ratio using the cross sectional approach

This approach can be applied to look at differences within a industry or across the entire market. We can illustrate looking at the Disney against firms in the entertainment sector first and then against the entire market.

To look at the determinants of debt ratios within the entertainment industry, we regressed debt ratios of firms in the industry against two variables – the growth in sales over the previous five years and the EBITDA as a percent of the market value of the firm. Based on our earlier discussion of the determinants of capital structure, we would expect firms with higher operating cashflows (EBITDA) as a percent of firm value to borrow more money. We would also expect higher growth firms to weigh financial flexibility

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[28] There are some who have hypothesized that under-leveraged firms are much more likely to be taken over than firms that are over-leveraged or correctly leveraged. If we want to find the 100 firms on the New York Stock Exchange that are most under-leveraged, the cross-sectional regression and the predicted debt ratios that come out of this regression can be used to find this group.

[29] The independent variables are correlated with each other. This multi-collinearity makes the coefficients unreliable and they often have signs that go counter to intuition.

more in their debt decision and borrow less. The results of the regression are reported below, with t statistics in brackets below the coefficients:

Debt to Capital = 0.2156 - 0.1826 (Growth in Sales) + 0.6797 (EBITDA/ Firm Value)

(4.91) (1.91) (2.05)

The dependent variable is the market debt to capital ratio, and the regression has an R-squared of 14%. While there is statistical significance, it is worth noting that the predicted debt ratios will have substantial standard errors associated with them. Even so, if we use the current values for these variables for Dinsey in this regression, we get a predicted debt ratio:

DFR_{Disney}= 0.2156 - 0.1826 (.0668) + 0.6797 (.0767) = 0.2555 or 25.55%

At their existing debt ratio of 21%, Disney is slightly under levered. Thus, relative to the industry in which it operates and its specific characteristics, Disney could potentially borrow more.

One of the limitations of this analysis is that there are only a few firms within each industry. This analysis can be extended to all firms in the market. While firms in different businesses differ in terms of risk and cash flows, and these differences can translate into differences in debt ratios, we can control for the differences in the regression. To illustrate, we regressed debt ratios of all listed firms in the United States against four variables –

- The effective tax rate of the firm, as a proxy for the tax advantages associated with debt.
- Closely held shares as a percent of shares outstanding (CLSH) as a measure of how much separation there is between managers and stockholders (and hence as a proxy for debt as a disciplinary mechanism).
- EBITDA as a percent of enterprise value (E/V) as a measure of the cash flow generating capacity of a firm
- Capital expenditures as a percent of total assets (CPXFR) as a measure of how much firms value flexibility

The results of the regression are presented below[30]:

DFR = 0.0488 + 0.810 Tax Rate –0.304 CLSH + 0.841 E/V –2.987 CPXFR

(1.41[a]) (8.70[a]) (3.65[b]) (7.92[b]) (13.03[a])

where DFR is debt as a percentage of the market value of the firm (debt + equity). The R-Squared for this regression is 53.3%. If we plug in the values for Disney into this regression, we get a predicted debt ratio:

DFR_{Disney}= 0.0488 + 0.810 (0.3476) –0.304 (0.022) + 0.841 (.0767) –2.987 (.0209)

= 0.3257 or 32.57%

Based upon the debt ratios of other firms in the market and Disney's financial characteristics, we would expect Disney to have a debt ratio of 32.57%. Since its actual debt ratio is 21.02%, Disney is under levered.

8.7. ☞**: Optimal Debt Ratios based upon Comparable Firms**

The predicted debt ratio from the regression shown above will generally yield

(a) a debt ratio similar to the optimal debt ratio from the cost of capital approach

(b) a debt ratio higher than the optimal debt ratio from the cost of capital approach

(c) a debt ratio lower than the optimal debt ratio from the cost of capital approach

(d) any of the above, depending upon ...

Explain.

dbtreg.xls: There is a dataset on the web that summarizes the latest debt ratio regression across the entire market.

Selecting the Optimal Debt Ratio

Using the different approaches for estimating optimal debt ratios, we do come up with different estimates of the right financing mix for Disney and Aracruz. Table 8.22 summarizes them:

[30] The numbers in brackets below the coefficients represent t statistics. The * indicates statistical significance.

Table 8.22: Summary of Predicted Debt Ratios

	Disney	*Aracruz*
Actual Debt Ratio	21.02%	30.82%
Optimal		
I. Operating Income	30.00%	-
II. Cost of Capital		
With no constraints	30.00%	30.00%
With BBB constraint	30.00%	30.00%
III. APV	30.00%	30.00%
V. Comparable		
To Industry	25.55%	28.56%
To Market	32.57%	-

While there are differences in the estimates across the different approaches, a few consistent conclusions emerge: Disney, at its existing debt ratio, is slightly underlevered, though the increase in value from moving to the optimal is small. Aracruz is slightly over levered, based upon normalized operating income.

Bookscape also has excess debt capacity, if we estimate the optimal debt ratio using the cost of capital approach. However, bankruptcy may carry a larger cost to the private owner of Bookscape than it would to the diversified investors of the Disney or Aracruz. We would therefore be cautious about using this excess debt capacity.

Conclusion

This chapter has provided background on four tools that can be used to analyze capital structure.

- The first approach is based upon operating income. Using historical data or forecasts, we develop a distribution of operating income across both good and bad scenarios. We then use a pre-defined acceptably probability of default to specify the maximum borrowing capacity.
- The second approach is the cost of capital – the weighted average of the costs of equity, debt, and preferred stock, where the weights are market value weights and the costs of financing are current costs. The objective is to minimize the cost of capital,

which also maximizes the value of the firm. A general framework is developed to use this model in real-world applications and applied to find the optimal financing mix for Disney. We find that Disney, which had almost about $ 14 billion in debt in 2004, would minimize its cost of capital at a debt level of 30%, leading to an increase in market value of the firm of about $ 3 billion. Even allowing for a much diminished operating income, we find that Disney has excess debt capacity.

- The third approach estimates the value of the firm at different levels of debt by adding the present value of the tax benefits from debt to the unlevered firm's value, and then subtracting out the present value of expected bankruptcy costs. The optimal debt ratio is the one that maximizes firm value.
- The final approach is to compare a firm's debt ratio to 'similar' firms. While comparisons of firm debt ratios to an industry average are commonly made, they are generally not very useful in the presence of large differences among firms within the same industry. A cross-sectional regression of debt ratios against underlying financial variables brings in more information from the general population of firms and can be used to predict debt ratios for a large number of firms.

The objective in all of these analyses is to come up with a mix of debt and equity that will maximize the value of the firm.

Live Case Study

The Optimal Financing Mix

Objective: To estimate the optimal mix of debt and equity for your firm, and to evaluate the effect on firm value of moving to that mix.

Key Questions:

- Based upon the cost of capital approach, what is the optimal debt ratio for your firm?
- Bringing in reasonable constraints into the decision process, what would your recommended debt ratio be for this firm?
- Does your firm have too much or too little debt
  - relative to the industry in which they operate?
  - relative to the market?

Framework for Analysis

1. *Cost of Capital Approach*
   - What is the current cost of capital for the firm?
   - What happens to the cost of capital as the debt ratio is changed?
   - At what debt ratio is the cost of capital minimized and firm value maximized? (If they are different, explain)
   - What will happen to the firm value if the firm moves to its optimal?
   - What will happen to the stock price if the firm moves to the optimal, and stockholders are rational?
2. *Building Constraints into the Process*
   - What rating does the company have at the optimal debt ratio? If you were to impose a rating constraint, what would it be? Why? What is the optimal debt ratio with this rating constraint?
   - How volatile is the operating income? What is the "normalized" operating income of this firm and what is the optimal debt ratio of the firm at this level of income?
3. *Relative Analysis*

- Relative to the industry to which this firm belongs, does it have too much or too little in debt? (Do a regression, if necessary)
- Relative to the rest of the firms in the market, does it have too much or too little in debt? (Use the market regression, if necessary)

Getting Information about optimal capital structure

To get the inputs needed to estimate the optimal capital structure, examine the 10-K report or the annual report. The ratings and interest coverage ratios can be obtained from the ratings agencies (S&P, Moody's) and default spreads can be estimated by finding traded bonds in each ratings class.

You can download information on other firms in the industry individually or look at databases such as Value Line.

Online sources of information:

http://www.stern.nyu.edu/~adamodar/cfin2E/project/data.htm

Problems

1. Rubberman Corporation, a manufacturer of consumer plastic products, is evaluating its capital structure. The balance sheet of the company is as follows (in millions):

Assets		Liabilities	
Fixed Assets	4000	Debt	2500
Current Assets	1000	Equity	2500

In addition, you are provided the following information:

(a) The debt is in the form of long term bonds, with a coupon rate of 10%. The bonds are currently rated AA and are selling at a yield of 12% (the market value of the bonds is 80% of the face value).

(b) The firm currently has 50 million shares outstanding, and the current market price is $80 per share. The firm pays a dividend of $4 per share and has a price/earnings ratio of 10.

(c) The stock currently has a beta of 1.2. The six-month Treasury bill rate is 8%.

(d) The tax rate for this firm is 40%.

I. What is the debt/equity ratio for this firm in book value terms? in market value terms?

II. What is the debt/(debt+equity) ratio for this firm in book value terms? in market value terms?

III. What is the firm's after-tax cost of debt?

IV. What is the firm's cost of equity?

V. What is the firm's current cost of capital?

2. Now assume that Rubberman Corporation is considering a project that requires an initial investment of $100 million and has the following projected income statement:

EBIT	$20 million
- Interest	$ 4 million
EBT	$16 million
Taxes	$ 6.40 million
Net Income	$ 9.60 million

(Depreciation for the project is expected to be $5 million a year forever.)

This project is going to be financed at the same debt/equity ratio as the overall firm and is expected to last forever. Assume that there are no principal repayments on the debt (it too is perpetual).

I. Evaluate this project from the equity investors' standpoint. Does it make sense?

II. Evaluate this project from the firm's standpoint. Does it make sense?

III. In general, when would you use the cost of equity as your discount rate/benchmark?

IV. In general, when would you use the cost of capital as your benchmark?

V. Assume, for economies of scale, that this project is going to be financed entirely with debt. What would you use as your cost of capital for evaluating this project?

3. Rubberman is considering a major change in its capital structure. It has three options:

Option 1: Issue $1 billion in new stock and repurchase half of its outstanding debt. This will make it a AAA rated firm (AAA rated debt is yielding 11% in the market place).

Option 2: Issue $1 billion in new debt and buy back stock. This will drop its rating to A-. (A- rated debt is yielding 13% in the market place).

Option 3: Issue $3 billion in new debt and buy back stock. This will drop its rating to CCC (CCC rated debt is yielding 18% in the market place).

I. What is the cost of equity under each option?

II. What is the after-tax cost of debt under each option?

III. What is the cost of capital under each option?

IV. What would happen to (a) the value of the firm; (b) the value of debt and equity; and (c) the stock price under each option , if you assume rational stockholders?

V. From a cost of capital standpoint, which of the three options would you pick, or would you stay at your current capital structure?

VI. What role (if any) would the variability in XYZ's income play in your decision?

VII. How would your analysis change (if at all) if the money under the three options listed above were used to take new investments (instead of repurchasing debt or equity)?

VIII. What other considerations (besides minimizing the cost of capital) would you bring to bear on your decision?

IX. Intuitively, why doesn't the higher rating in option 1 translate into a lower cost of capital?

4. Rubberman Corporation is interested in how it compares with its competitors in the same industry.

	XYZ Corporation	Other Competitors
Debt/Equity Ratio	*50%*	*25%*
Variance in EBITDA	20%	40%
EBITDA/MV of Firm	25%	15%
Tax Rate	40%	30%
R&D/ Sales	2%	5%

a. Taking each of these variables, explain at an intuitive level whether you would expect XYZ Corporation to have more more or less debt than its competitors and why.

b. You have also run a regression of debt/equity ratios against these variables for all the firms on the New York Stock Exchange and have come up with the following regression equation:

D/E = .10 - .5 (Variance in EBITDA) + 2.0 (EBITDA/MV) + .4 (Tax rate) + 2.5 (R&D/Sales)

(All inputs to the regression were in decimals, i.e. 20% was inputted as .20 ....)

Given this cross-sectional relationship, what would you expect XYZ's debt/equity ratio to be?

5. As CEO of a major corporation, you have to make a decision on how much you can afford to borrow. You currently have 10 million shares outstanding, and the market price per share is $50. You also currently have about $200 million in debt outstanding (market value). You are rated as a BBB corporation now.

(a) Your stock has a beta of 1.5 and the six-month T.Bill rate is 8%.

(b) Your marginal tax rate is 46%.

(c) You estimate that your rating will change to a B if you borrow $100 million. The BBB rate now is 11%. The B rate is 12.5%.

I. Given the marginal costs and benefits of borrowing the $100 million, should you go ahead with it ?

II. What is your best estimate of the weighted average cost of capital with and without the $100 million in borrowing ?

III. If you borrow the $100 million, what will the price per share be after the borrowing

IV. Assume that you have a project that requires an investment of $100 million. It has expected before-tax revenues of $50 million, and costs of $30 million a year in perpetuity. Is this a desirable project by your criteria? Why or Why not?

V. Does it make a difference in your decision if you were told that the cash flows from the project in (IV) are certain?

6. You have been hired as a management consultant by AD Corporation to evaluate whether it has an appropriate amount of debt (the company is worried about a leveraged buyout). You have collected the following information on AD's current position:

(a) There are 100,000 shares outstanding, at $20/share. The stock has a beta of 1.15.

(b) The company has $500,000 in long-term debt outstanding and is currently rated 'BBB'. The current market interest rate is 10% on BBB bonds and 6% on T.Bills.

(c) The company's marginal tax rate is 40%.

You proceed to collect the data on what increasing debt will do to the company's ratings:

Additional debt*	New Rating	Interest Rate
$500,000	BB	10.5
$1,000,000	B	11.5
$1,500,000	B-	13.5
$2,000,000	C	15

* In addition to the existing debt of $500,000

I. How much additional debt should the company take on?

II. What will the price per share be after the company takes on new debt?

III. What is the weighted average cost of capital before and after the additional debt?

IV. Assume that you are considering a project that has the following earnings in perpetuity and is of comparable risk to existing projects.

Revenues/year	$1,000,000
Cost of goods sold	$ 400,000 (Includes depreciation of $100,000)
EBIT	$ 600,000

Debt payments	$ 100,000 (All Interest payments)
Taxable Income	$ 500,000
Tax	$ 200,000
After-tax profit	$ 300,000

If this project requires an investment of $ 3,000,000, what is its NPV?

7. UB Inc. is examining its capital structure, with the intent of arriving at an optimal debt ratio. It currently has no debt and has a beta of 1.5. The riskless interest rate is 9%. Your research indicates that the debt rating will be as follows at different debt levels:

D/(D+E)	Rating	Interest rate
0%	AAA	10%
10%	AA	10.5%
20%	A	11%
30%	BBB	12%
40%	BB	13%
50%	B	14%
60%	CCC	16%
70%	CC	18%
80%	C	20%
90%	D	25%

The firm currently has 1 million shares outstanding at $ 20 per share (tax rate = 40%).

a. What is the firm's optimal debt ratio?

b. Assuming that the firm restructures by repurchasing stock with debt, what will the value of the stock be after the restructuring?

8. GenCorp, an automorive parts manufacturer, currently has $25 million in outstanding debt and has 10 million shares outstanding. The book value per share is $10, while the market value is $ 25. The company is currently rated A, its bonds have a yield to maturity of 10%, and the current beta of the stock is 1.06. The six-month T.Bill rate is 8% now, and the company's tax is 40%.

a. What is the company's current weighted average cost of capital?

b. The company is considering a repurchase of 4 million shares at $25 per share with new debt. It is estimated that this will push the company's rating down to a B (with a yield to

maturity of 13%). What will the company's weighted average cost of capital be after the stock repurchase?

9. You have been called in as a consultant for Herbert's Inc., a sporting good retail firm, which is examining its debt policy. The firm currently has a balance sheet as follows:

Liability		*Assets*	
LT Bonds	$100	Fixed Assets	300
Equity	$300	Current Assets	100
Total	$400	Total	400

The firm's income statement is as follows:

Revenues	250
COGS	175
Depreciation	25
EBIT	50
LT Interest	10
EBT	40
Taxes	16
Net Income	24

The firm currently has 100 shares outstanding, selling at a market price of $5 per share and the bonds are selling at par. The firm's current beta is 1.12, and the six-month T.Bill rate is 7%.

a. What is the firm's current cost of equity?

b. What is the firm's current cost of debt?

c. What is the firm's current weighted average cost of capital?

Assume that management of Herbert's Inc. is considering doing a debt-equity swap (i.e. borrowing enough money to buy back 70 shares of stock at $5 per share). It is believed that this swap will lower the firm's rating to C and raise the interest rate on the company's debt to 15%.

d. What is the firm's new cost of equity?

e. What is the effective tax rate (for calculating the after-tax cost of debt) after the swap?

f. What is the firm's new cost of capital?

11. Terck Inc., a leading pharmaceutical company, currently has a balance sheet that is as follows:

Liability		Assets	
LT Bonds	$1000	Fixed Assets	1700
Equity	$1000	Current Assets	300
Total	$1000	Total	1000

The firm's income statement looks as follows:

Revenues	1000
COGS	400
Depreciation	100
EBIT	500
LT Interest	100
EBT	400
Taxes	200
Net Income	200

The firm's bonds are all 20-year bonds with a coupon rate of 10% which are selling at 90% of face value (the yield to maturity on these bonds is 11%). The stocks are selling at a PE ratio of 9 and have a beta of 1.25. The six-month T.Bill rate is 6%.

a. What is the firm's current cost of equity?

b. What is the firm's current after-tax cost of debt?

c. What is the firm's current weighted average cost of capital?

Assume that management of Terck Inc., which is very conservative, is considering doing an equity-for-debt swap (i.e. issuing $200 more of equity to retire $200 of debt). This action is expected to lower the firm's interest rate by 1%.

d. What is the firm's new cost of equity?

e. What is the new WACC?

f. What will the value of the firm be after the swap?

11. You have been asked to analyze the capital structure of DASA Inc, an environmental waste disposal firm, and make recommendations on a future course of action. DASA Inc. has 40 million shares outstanding, selling at $20 per share, and a debt-equity ratio (in market value terms) of 0.25. The beta of the stock is 1.15, and the firm currently has a AA rating, with a corresponding market interest rate of 10%. The firm's income statement is as follows:

EBIT	$150 million
Interest Exp.	$ 20 million
Taxable Inc.	$130 million
Taxes	$ 52 million
Net Income	$ 78 million

The current T.Bill rate is 8%.

a. What is the firm's current weighted average cost of capital?
b. The firm is proposing borrowing an additional $200 million in debt and repurchasing stock. If it does so, its rating will decline to A, with a market interest rate of 11%. What will the weighted average cost of capital be if they make this move?
c. What will the new stock price be if the firm borrows $200 million and repurchases stock (assuming rational investors)?
d. Now assume that the firm has another option to raise its debt/equity ratio (instead of borrowing money and repurchasing stock). It has considerable capital expenditures planned for the next year ($150 million). The company also currently pays $1 in dividends per share. If the company finances all its capital expenditures with debt and doubles its dividend yield from the current level for the next year, what would you expect the debt/equity ratio to be at the end of the next year.

12. You have been asked by JJ Corporation, a California-based firm that manufacturers and services digital satellite television systems, to evaluate its capital structure. They currently have 70 million shares outstanding trading at $10 per share. In addition, it has 500,000 convertible bonds, with a coupon rate of 8%, trading at $ 1000 per bond. JJ Corporation is rated BBB and the interest rate on BBB straight bonds is currently 10%. The beta for the company is 1.2, and the current risk-free rate is 6%. The tax rate is 40%.
a. What is the firm's current debt/equity ratio?
b. What is the firm's current weighted average cost of capital?
JJ Corporation is proposing to borrow $250 million and use it for the following purposes:

Buy back $100 million worth of stock

Pay $100 million in dividends

Invest $ 50 million in a project with a NPV of $25 million.

The effect of this additional borrowing will be a drop in the bond rating to B, which currently carries an interest rate of 11%.

c. What will the firm's cost of equity be after this additional borrowing?

d. What will the firm's weighted average cost of capital be after this additional borrowing?

e. What will the value of the firm be after this additional borrowing?

13. Baldor Electric, a company which gets 85% of its revenues from industrial electric motors, had 27.5 million shares at $ 25 per share, and $ 25 million in debt outstanding at the end of 1995. The firm has a beta of 0.70, had earnings before interest and taxes of $63.3 million and a book value of equity of $200 million. The following table summarizes the ratings and interest rates for Baldor Electric at different levels of debt.

Debt Ratio	Bond Rating	Interest Rate on Debt
0%	AA	6.70%
10%	A+	7.00%
20%	A-	7.50%
30%	BBB	8.00%
40%	BB	8.50%
50%	B+	9.00%
60%	B	10.00%
70%	B-	11.00%
80%	CCC	12.00%
90%	C	15.00%

The tax rate is 35%.

a. Estimate the cost of equity at each level of debt.

b. Estimate the return on equity at each level of debt.

c. Estimate the optimal debt ratio based upon the differential return.

d. Will the value of the firm be maximized at this level of debt. Why or why not?

14. Pfizer, one of the largest pharmaceutical companies in the United States, is considering what its debt capacity is. In March 1995, Pfizer had an outstanding market value of equity of $ 24.27 billion, debt of $ 2.8 billion and a AAA rating. Its beta was 1.47, and it faced a marginal corporate tax rate of 40%. The treasury bond rate at the time of the analysis was 6.50%, and AAA bonds trade at a spread of 0.30% over the treasury rate.

a. Estimate the current cost of capital for Pfizer.

b. It is estimated that Pfizer will have a BBB rating if it moves to a 30% debt ratio, and that BBB bonds have a spread of 2% over the treasury rate. Estimate the cost of capital if Pfizer moves to its optimal.
c. Assuming a constant growth rate of 6% in the firm value, how much will firm value change if Pfizer moves its optimal? What will the effect be on the stock price?
d. Pfizer has considerable research and development expenses. Will this fact affect whether Pfizer takes on the additional debt?

15. Upjohn, another major pharmaceutical company, is also considering whether it should borrow more. It has $ 664 million in book value of debt outstanding, and 173 million shares outstanding at $ 30.75 per share. The company has a beta of 1.17, and faces a tax rate of 36%. The treasury bond rate is 6.50%.
a. If the interest expense on the debt is $ 55 million, the debt has an average maturity of 10 years, and the company is currently rated AA- (with a market interest rate of 7.50%), estimate the market value of the debt.
b. Estimate the current cost of capital.
c. It is estimated that if Upjohn moves to its optimal debt ratio, and no growth in firm value is assumed, the value per share will increase by $ 1.25. Estimate the cost of capital at the optimal debt ratio.

16. Nucor, an innovative steel company, has had a history of technical innovation and financial conservatism. In 1995, Nucor had only $ 210 million in debt outstanding (book as well as market value), and $ 4.2 billion in market value of equity (with a book value of $ 1.25 billion). In the same year, Nucor had earnings before interest and taxes of $ 372 million, and faced a corporate tax rate of 36%. The beta of the stock is 0.75, and the company is AAA rated (with a market interest rate of 6.80%).
a. Estimate the return differential between return on equity and cost of equity at the current level of debt.
b. Estimate the return differential at a debt ratio of 30%, assuming that the bond rating will drop to A-, leading to market interest rate of 8.00%.

17. Bethlehem Steel, one of the oldest and largest steel companies in the United States, is considering the question of whether it has any excess debt capacity. The firm has $ 527 million in market value of debt outstanding, and $ 1.76 billion in market value of equity. The firm has earnings before interest and taxes of $ 131 million, and faces a corporate tax rate of 36%. The company's bonds are rated BBB, and the cost of debt is 8%. At this rating, the firm has a probability of default of 2.30%, and the cost of bankruptcy is expected to be 30% of firm value.

a. Estimate the unlevered value of the firm.

b. Estimate the levered value of the firm, using the adjusted present value approach, at a debt ratio of 50%. At that debt ratio, the firm's bond rating will be CCC, and the probability of default will increase to 46.61%.

18. Kansas City Southern, a railroad company, had debt outstanding of $ 985 million and 40 million shares trading at $ 46.25 per share in March 1995. It earned $ 203 million in earnings before interest and taxes, and faced a marginal tax rate of 36.56%. The firm was interested in estimating its optimal leverage using the adjusted present value approach. The following table summarizes the estimated bond ratings, and probabilities of default at each level of debt from 0% to 90%.

Debt Ratio	Bond Rating	Probability of Default
0%	AAA	0.28%
10%	AAA	0.28%
20%	A-	1.41%
30%	BB	12.20%
40%	B-	32.50%
50%	CCC	46.61%
60%	CC	65.00%
70%	C	80.00%
80%	C	80.00%
90%	D	100.00%

The direct and indirect bankruptcy cost is estimated to be 25% of the firm value. Estimate the optimal debt ratio of the firm, based upon levered firm value.

19. In 1995, an analysis of the capital structure of Reebok provided the following results on the weighted average cost of capital and firm value.

	Actual	Optimal	Change
Debt Ratio	4.42%	60.00%	55.58%
Beta for the Stock	1.95	3.69	1.74
Cost of Equity	18.61%	28.16%	9.56%
Bond Rating	A-	B+	
After-tax Cost of Debt	5.92%	6.87%	0.95%
WACC	18.04%	15.38%	-2.66%
Firm Value (with no growth)	$ 3,343 mil	$ 3,921 mil	$ 578 mil
Stock Price	$ 39.50	$ 46.64	$ 7.14

This analysis was based upon the 1995 earnings before interest and taxes of $ 420 million, and a tax rate of 36.90%.

a. Why is the optimal debt ratio for Reebok so high?

b. What might be some of your concerns in moving to this optimal?

20. Timberland Inc., a manufacturer and retailer of footwear and sportswear, is considering is highly levered status. In 1995, the firm had $ 237 million in market value of debt outstanding, and 11 million shares outstanding at $ 19.88 per share. The firm had earnings before interest and taxes of $ 44 million, a book value of capital of $ 250 million and a tax rate of 37%. The treasury bond rate is 7.88%, and the stock has a beta of 1.26. The following table summarizes the estimated bond ratings and interest rates at different levels of debt for Timberland –

Debt Ratio	Bond Rating	Interest Rate on Debt
0%	AAA	8.18%
10%	AAA	8.18%
20%	A+	8.88%
30%	A	9.13%
40%	A-	9.38%
50%	BB	10.38%
60%	BB	10.38%

70%	B	11.88%
80%	B-	12.88%
90%	CCC	13.88%

a. Estimate the optimal debt ratio, using the cost of capital approach.

b. Estimate the optimal debt ratio, using the return differential approach.

c. Will the two approaches always give you identical results? Why or why not?

21. You are trying the evaluate whether United Airlines has any excess debt capacity. In 1995, UAL had 12.2 million shares outstanding at $ 210 per share, and debt outstanding of approximately $ 3 billion (book as well as market value). The debt had a rating of B, and carried a market interest rate of 10.12%. In addition, the firm had leases outstanding, with annual lease payments anticipated to by $ 150 million. The beta of the stock is 1.26, and the firm faces a tax rate of 35%. The treasury bond rate is 6.12%.

a. Estimate the current debt ratio for UAL.

b. Estimate the current cost of capital.

c. Based upon 1995 operating income, the optimal debt ratio is computed to be 30%, at which point the rating will be BBB, and the market interest rate is 8.12%.

d. Would the fact that 1995 operating income for airlines was depressed alter your analysis in any way? Explain why.

22. Intel has earnings before interest and taxes of $ 3.4 billion, and faces a marginal tax rate of 36.50%. It currently has $ 1.5 billion in debt outstanding, and a market value of equity of $ 51 billion. The beta for the stock is 1.35, and the pre-tax cost of debt is 6.80%. The treasury bond rate is 6%. Assume that the firm is considering a massive increase in leverage to a 70% debt ratio, at which level the bond rating will be C (with a pre-tax interest rate of 16%).

a. Estimate the current cost of capital.

b. Assuming that all debt gets refinanced at the new market interest rate, what would your interest expenses be at 70% debt? Would you be able to get the entire tax benefit? Why or why not?

c. Estimate the beta of the stock at 70% debt, using the conventional levered beta calculation. Reestimate the beta, on the assumption that C rated debt has a beta of 0.60. Which one would you use in your cost of capital calculation?

d. Estimate the cost of capital at 70% debt.

e. What will happen to firm value if Intel moves to a 70% debt ratio?

f. What general lessons on capital structure would you draw for other growth firms?

23. NYNEX, the phone utility for the New York Area, has approached you for advice on its capital structure. In 1995, NYNEX had debt outstanding of $ 12.14 billion and equity outstanding of $ 20.55 billion. The firm had earnings before interest and taxes of $ 1.7 billion, and faced a corporate tax rate of 36%. The beta for the stock is 0.84, and the bonds are rated A- (with a market interest rate of 7.5%). The probability of default for A-rated bonds is 1.41%, and the bankruptcy cost is estimated to be 30% of firm value.

a. Estimate the unlevered value of the firm.

b. Value the firm, if it increases its leverage to 50%. At that debt ratio, its bond rating would be BBB, and the probability of default would be 2.30%.

c. Assume now that NYNEX is considering a move into entertainment, which is likely to be both more profitable and riskier than the phone business. What changes would you expect in the optimal leverage?

24. A small, private firm has approached you for advice on its capital structure decision. It is in the specialty retailing business, and it had earnings before interest and taxes last year of $ 500,000.

- The book value of equity is $ 1.5 million, but the estimated market value is $ 6 million.
- The firm has $ 1 million in debt outstanding, and paid an interest expense of $ 80,000 on the debt last year. (Based upon the interest coverage ratio, the firm would be rated AA, and would be facing an interest rate of 8.25%.)
- The equity is not traded, but the average beta for comparable traded firms is 1.05, and their average debt/equity ratio is 25%.

a. Estimate the current cost of capital for this firm.

b. Assume now that this firm doubles it debt from $ 1 million to $ 2 million, and that the interest rate at which it can borrow increases to 9%. Estimate the new cost of capital, and the effect on firm value.

c. You also have a regression that you have run of debt ratios of publicly traded firms against firm characteristics –

DBTFR = 0.15 + 1.05 (EBIT/FIRM VALUE) - 0.10 (BETA)

Estimate the debt ratio for the private firm, based upon this regression.

d. What are some of the concerns you might have in extending the approaches used by large publicly traded firms to estimate optimal leverage to smaller firms?

25. XCV Inc., which manufactures automobile parts for assembly, is considering the costs and the benefits of leverage. The CFO notes that the return on equity of the firm, which is only 12.75% now, based upon the current policy of no leverage, could be increased substantially by borrowing money. Is this true? Does it follow that the value of the firm will increase with leverage? Why or why not?