CHAPTER 15

Firm Valuation: Cost of Capital and Adjusted Present Value Approaches

The preceding two chapters examined two approaches to valuing the equity in the firm—the dividend discount model and the free cash flow to equity (FCFE) valuation model. This chapter ~~develops another approach~~ to valuation where the entire firm is valued, by either discounting the cumulated cash flows to all claim holders in the firm by the weighted average cost of capital (the cost of capital approach) or by adding the marginal impact of debt on value to the unlevered firm value—the adjusted present value (APV) approach).

In the process of looking at firm valuation, we also look at how leverage may or may not affect firm value. We note that in the presence of default risk, taxes, and agency costs, increasing leverage can sometimes increase firm value and sometimes decrease it. In fact, we argue that the optimal financing mix for a firm is the one that maximizes firm value.

FREE CASH FLOW TO THE FIRM

The free cash flow to the firm (FCFF) is the sum of the cash flows to all claim holders in the firm, including stockholders, bondholders, and preferred stockholders. There are two ways of measuring the free cash flow to the firm.

One is to add up the cash flows to the claim holders, which would include cash flows to equity (defined either as free cash flow to equity or dividends), cash flows to lenders (which would include principal payments, interest expenses, and new debt issues), and cash flows to preferred stockholders (usually preferred dividends):

$$\begin{aligned}\text{FCFF} = {} & \text{Free cash flow to equity} + \text{Interest expense}(1 - \text{Tax rate}) \\ & + \text{Principal repayments} - \text{New debt issues} + \text{Preferred dividends}\end{aligned}$$

Note, however, that we are reversing the process that we used to get to free cash flow to equity, where we subtracted out payments to lenders and preferred stockholders to estimate the cash flow left for stockholders. A simpler way of getting to free cash flow to the firm is to estimate the cash flows prior to any of these claims. Thus we could begin with the earnings before interest and taxes, net out taxes and reinvestment needs, and arrive at an estimate of the free cash flow to the firm:

$$\text{FCFF} = \text{EBIT}(1 - \text{Tax rate}) + \text{Depreciation} - \text{Capital expenditure} - \Delta\ \text{Working capital}$$

Since this cash flow is prior to debt payments, it is often referred to as an unlevered cash flow. Note that this free cash flow to the firm does not incorporate any of the tax benefits due to interest payments. This is by design, because the use of the after-tax cost of debt in the cost of capital already considers this benefit, and including it in the cash flows would double count it.

FCFF and Other Cash Flow Measures

The differences between FCFF and FCFE arise primarily from cash flows associated with debt—interest payments, principal repayments, and new debt issues—and other nonequity claims, such as preferred dividends. For firms at their desired debt level, which finance their capital expenditures and working capital needs with this mix of debt and equity and use debt issues to finance principal repayments, the free cash flow to the firm will exceed the free cash flow to equity.

One ~~measure~~ that is widely used in valuation is the earnings before interest, taxes, depreciation, and amortization (EBITDA). The free cash flow to the firm is a ~~closely~~ related concept but it takes into account the potential tax liability from the earnings as well as capital expenditures and working capital requirements.

~~Three measures of earnings are also often used to derive cash flows~~. ~~The amount of~~ earnings before interest and taxes (EBIT) or operating income comes directly from a firm's income statements. Adjustments to EBIT yield the net operating profit or loss after taxes (NOPLAT) or the net operating income (NOI). The net operating income is defined to be the income from operations prior to taxes and nonoperating expenses.

Each of these measures is used in valuation models, and each can be related to the free cash flow to the firm. Each, however, makes some assumptions about the relationship between depreciation and capital expenditures that are made explicit in Table 15.1.

Growth in FCFE versus Growth in FCFF

Will equity cash flows and firm cash flows grow at the same rate? Consider the starting point for the two cash flows. Equity cash flows are based on net income or earnings per share—measures of equity income. Firm cash flows are based on operating income (i.e., income prior to debt payments). As a general rule, you would expect growth in operating income to be lower than growth in net income, because financial leverage can augment the latter. To see why, let us go back to the fundamental growth equations laid out in Chapter 11:

$$\text{Expected growth in net income} = \text{Equity reinvestment rate} \times \text{Return on equity}$$

$$\text{Expected growth in operating income} = \text{Reinvestment rate} \times \text{Return on capital}$$

TABLE 15.1 Free Cash Flows to the Firm: Comparison to Other Measures

Cash Flow Used	Definition	Use in Valuation
FCFF	Free cash flow to firm	Discounting free cash flow to the firm at the cost of capital will yield the value of the operating assets of the firm. To this, you would add on the value of nonoperating assets to arrive at firm value.
FCFE	FCFF – Interest (1 – t) – Principal repaid + New debt issued – Preferred dividend	Discounting free cash flows to equity at the cost of equity will yield the value of equity in a business.
EBITDA	FCFF + EBIT(t) + Capital expenditures + Change in working capital	If you discount EBITDA at the cost of capital to value an asset, you are assuming that there are no taxes and that the firm will actively disinvest over time. It would be inconsistent to assume a growth rate or an infinite life for this firm.
EBIT (1 – t) (NOPLAT is a slightly modified version of this estimate and it removes any nonoperating items that might affect the reported EBIT.)	FCFF + Capital expenditures – Depreciation + Change in working capital	If you discount after-tax operating income at the cost of capital to value a firm, you are assuming no reinvestment. The depreciation is reinvested back into the firm to maintain existing assets. You can assume an infinite life but no growth.

We also defined the return on equity in terms of the return on capital:

$$\text{Return on equity} = \text{Return on capital} + \frac{\text{Debt}}{\text{Equity}} \times (\text{Return on capital} - \text{After-tax cost of debt})$$

When a firm borrows money and invests in projects that earn more than the after-tax cost of debt, the return on equity will be higher than the return on capital. This, in turn, will translate into a higher growth rate in equity income at least in the short term.

In stable growth, though, the growth rates in equity income and operating income have to converge. To see why, assume that you have a firm whose revenues and operating income and growing at 5 percent a year forever. If you assume that the same firm's net income grows at 6 percent a year forever, the net income will catch up with operating income at some point in time in the future and exceed revenues at a later point in time. In stable growth, therefore, even if return on equity exceeds the return on capital, the expected growth will be the same in all measures of income.[1]

FIRM VALUATION: THE COST OF CAPITAL APPROACH

The value of the firm is obtained by discounting the free cash flow to the firm at the weighted average cost of capital. Embedded in this value are the tax benefits of debt (in the use of the after-tax cost of debt in the cost of capital) and expected additional risk associated with debt (in the form of higher costs of equity and debt at higher debt ratios). Just as with the dividend discount model and the FCFE model, the version of the model used will depend on assumptions made about future growth.

Stable Growth Firm

As with the dividend discount and FCFE models, a firm that is growing at a rate that it can sustain in perpetuity—a stable growth rate—can be valued using a stable growth model.

The Model A firm with free cash flows to the firm growing at a stable growth rate can be valued using the following equation:

$$\text{Value of firm} = \frac{\text{FCFF}_1}{(\text{WACC} - g_n)}$$

where FCFF_1 = Expected FCFF next year
WACC = Weighted average cost of capital
g_n = Growth rate in the FCFF forever

The Caveats There are two conditions that need to be met in using this model. First, the growth rate used in the model has to be less than or equal to the growth rate in the economy—nominal growth, if the cost of capital is in nominal terms, or real growth, if the cost of capital is a real cost of capital. Second, the characteristics of the firm have to be consistent with assumptions of stable growth. In particular, the reinvestment rate used to estimate free cash flows to the firm should be consistent with the stable growth rate. The best way of enforcing this consistency is to derive the reinvestment rate from the stable growth rate:

$$\text{Reinvestment rate in stable growth} = \frac{\text{Growth rate}}{\text{Return on capital}}$$

If reinvestment is estimated from net capital expenditures and change in working capital, the net capital expenditures should be similar to those other firms in the

[1]The equity reinvestment rate and firm reinvestment rate will adjust to ensure that this happens. The equity reinvestment rate will be a lower number than the firm reinvestment rate in stable growth for any levered firm.

industry (perhaps by setting the ratio of capital expenditures to depreciation at industry averages) and the change in working capital should generally not be negative. A negative change in working capital creates a cash inflow, and while this may, in fact, be viable for a firm in the short term, it is dangerous to assume it in perpetuity.[2] The cost of capital should also be reflective of a stable growth firm. In particular, the beta should be close to 1—the rule of thumb presented in the earlier chapters that the beta should be between 0.8 and 1.2 still holds. While stable growth firms tend to use more debt, this is not a prerequisite for the model, since debt policy is subject to managerial discretion.

Limitations Like all stable growth models, this one is sensitive to assumptions about the expected growth rate. This is accentuated, however, by the fact that the discount rate used in valuation is the WACC, which is significantly lower than the cost of equity for most firms. Furthermore, the model is sensitive to assumptions made about capital expenditures relative to depreciation. ~~If~~ the inputs for reinvestment are not a function of expected growth the free cash flow to the firm can be inflated (deflated) by reducing (increasing) capital expenditures relative to depreciation. ~~If the reinvestment rate is estimated from the return on capital, changes in the return on capital can have significant effects on firm value.~~

ILLUSTRATION 15.1: Valuing a Firm with Stable Growth FCFF Model—Telesp (Brazil)

Telesp provides local telecommunication services to the Brazilian state of Sao Paulo. In 2010, the company had operating income (EBIT) of 3,544 million BRL and faced an effective tax rate of 30%. In 2010, the firm reported capital expenditures of 1,659 million BRL and depreciation of 1,914 million BRL and an increase in working capital of 1,119 million BRL. Consequently, its reinvestment in 2010 can be computed as follows:

$$\text{Reinvestment} = \frac{\text{Capital expenditures} - \text{Depreciation} + \text{Change in noncash WC}}{\text{EBIT}(1-t)}$$

$$= \frac{1{,}659 - 1{,}914 + 1{,}119}{3{,}544\,(1 - .30)} = 34.82\%$$

The return on capital generated by the company in 2010 was computed using the operating income for the year and the book value of capital invested at the end of the previous year (2009):

$$\text{Return on capital} = \frac{\text{EBIT}_{2010}\,(1-t)}{\text{BV of equity}_{2009} + \text{BV of debt}_{2009} - \text{Cash}_{2009}}$$

$$= \frac{3{,}544\,(1 - .30)}{10{,}057 + 8{,}042 - 12{,}277} = 15.68\%$$

The expected growth rate that emerges from these inputs is:

$$\text{Expected growth rate} = 34.82\% \times 15.68\% = 5.46\%$$

[2] Carried to its logical extreme, this will push net working capital to a very large (potentially infinite) negative number.

While this would be too high a growth rate for stable growth in a developed market with low expected inflation, the risk-free rate in BRL in May 2011 was 7%. In conjunction with a beta of 0.8 and an equity risk premium for Brazil of 8% (composed of a mature market premium of 5% and an additional country risk premium of 3% for Brazil), this yields a cost of equity of 13.40%. Incorporating a pretax cost of debt of 9.50% and a debt ratio of 20% (based upon current market values for equity and debt) results in a cost of capital of 12.05% for Telesp:

$$\text{Debt to capital ratio} = \frac{\text{Debt}}{\text{Debt} + \text{Market value of equity}}$$

$$= \frac{5{,}519}{5{,}519 + 21{,}982} = 12.05\%$$

$$\text{Cost of capital} = 13.40\%\,(.80) + 9.50\%(1 - .30)(.20) = 12.05\%$$

The value for the operating assets can then be estimated as follows:

$$\text{FCFF} = \text{EBIT}\,(1 - t) + \text{Depreciation} - \text{Capital Expenditures} - \text{Change in noncash WC}$$
$$= 3{,}544\,(1 - .30) + 1{,}914 - 1{,}659 - 1{,}119 = 1{,}617 \text{ million BRL}$$

$$\text{Value of operating assets} = \frac{\text{Expected FCFF next year}}{\text{Cost of capital} - \text{Expected growth rate}}$$

$$= \frac{1{,}617}{.1205 - .0546} = 25{,}854 \text{ million BRL}$$

Adding the cash and marketable securities (1,557 million BRL) and subtracting the debt (5,519 million BRL) at the end of 2010 yields a value for the equity:

$$\text{Value of equity} = \text{Value of operating assets} + \text{Cash} - \text{Debt}$$
$$= 25{,}854 + 1{,}557 - 5{,}519 = 21{,}892 \text{ million BRL}$$

The company's market capitalization in May 2011 was 21,982 million BRL, making it fairly priced.

General Version of the FCFF Model

Rather than break the free cash flow model into two-stage and three-stage models and risk repeating what was said in the preceding chapter, we present the general version of the model in this section. We follow up by examining a range of companies—a traditional manufacturing firm, a firm with operating leases, and a firm with substantial R&D investments—to illustrate the differences and similarities between this approach and the FCFE approach.

The Model The value of the firm, in the most general case, can be written as the present value of expected free cash flows to the firm:

$$\text{Value of firm} = \sum_{t=1}^{t=\infty} \frac{\text{FCFF}_t}{(1 + \text{WACC})^t}$$

where FCFF_t = Free cash flow to firm in year t
WACC = Weighted average cost of capital

MARKET VALUE WEIGHTS, COST OF CAPITAL, AND CIRCULAR REASONING

To value a firm, you first need to estimate a cost of capital. Every textbook is categorical that the weights in the cost of capital calculation be market value weights. The problem, however, is that the cost of capital is then used to estimate new values for debt and equity that might not match the values used in the original calculation. One defense that can be offered for this inconsistency is that if you bought all of the debt and equity in a publicly traded firm, you would pay current market value and not your estimated value, and your cost of capital reflects this.

For those who are bothered by this inconsistency, there is a way out. You could do a conventional valuation using market value weights for debt and equity, but then use the estimated values of debt and equity from the valuation to reestimate the cost of capital. This, of course, will change the values again, but you could feed the new values back and estimate cost of capital again. Each time you do this, the differences between the values you use for the weights and the values you estimate will narrow, and the values will converge sooner rather than later.

How much of a difference will it make in your ultimate value? The greater the difference between market value and your estimates of value, the greater the difference this iterative process will make. In the valuation of ~~Tube Investments~~, we began with a market ~~price~~ of ~~Rs 92.70 per share~~ and estimated a value of ~~Rs 63.36~~. If we substituted back this estimated value and iterated to a solution, we would arrive at an estimate of value of ~~$70.66 per share~~.[3]

If the firm reaches steady state after n years and starts growing at a stable growth rate g_n after that, the value of the firm can be written as:

$$\text{Value of firm} = \sum_{t=1}^{t=n} \frac{\text{FCFF}_t}{(1+\text{WACC}_{hg})^t} + \frac{[\text{FCFF}_{n+1}/(\text{WACC}_{st} - g_n)]}{(1+\text{WACC}_{hg})^n}$$

where WACC = Cost of capital (hg: high growth; st: stable growth)

Firms Model Best Suited For Firms that either have very high leverage or are in the process of changing their leverage are best valued using the FCFF approach. The calculation of FCFE is much more difficult in these cases because of the volatility induced by debt payments (or new issues), and the value of equity, which ~~is~~ a small slice of the total value of the firm, is more sensitive to assumptions about growth and risk. It is worth noting, though, that in theory the two approaches should yield the same value for the equity. Getting them to agree in practice is an entirely different challenge and we will return to examine it later in this chapter.

[3]In Microsoft Excel, it is easy to set this process up. You should first go into calculation options and put a check in iteration box. You can then make the cost of capital a function of your estimated values for debt and equity.

Problems There are three problems that we see with the free cash flow to the firm model. The first is that the free cash flows to equity are a much more intuitive measure of cash flows than cash flows to the firm. When asked to estimate cash flows, most of us look at cash flows after debt payments (free cash flows to equity), because we tend to think like business owners and consider interest payments and the repayment of debt as cash outflows. Furthermore, the free cash flow to equity is a real cash flow that can be traced and analyzed in a firm. The free cash flow to the firm is the answer to a hypothetical question: What would this firm's cash flow be if it had no debt (and associated payments)?

The second is that its focus on predebt cash flows can sometimes blind us to real problems with survival. To illustrate, assume that a firm has free cash flows to the firm of $100 million but that its large debt load makes its free cash flows to equity equal to –$50 million. This firm will have to raise $50 million in new equity to survive, and if it cannot, all cash flows beyond this point are put in jeopardy. Using free cash flows to equity would have alerted you to this problem, but free cash flows to the firm are unlikely to reflect this.

The final problem is that the use of a debt ratio in the cost of capital to incorporate the effect of leverage requires us to make implicit assumptions that might not be feasible or reasonable. For instance, assuming that the market value debt ratio is 30 percent will require a growing firm to issue large amounts of debt in future years to reach that ratio. In the process, the book debt ratio might reach stratospheric proportions and trigger covenants or other negative consequences. In fact, we count the expected tax benefits from future debt issues implicitly in the value of equity today.

ILLUSTRATION 15.2: Valuing Target—Dealing with Operating Leases

In 2010, Target reported $5,252 million in pretax operating income on revenues of $67,390 million. While its high growth days are behind it, there is some potential for growth, and we will attempt to value the firm using a two stage FCFF model.

The first step in this valuation is to recognize that the financial statement numbers for Target are skewed by the failure to consider lease commitments as debt. Using the annual report for 2010, we obtained the lease commitments for the next five years and beyond, which we discounted at Target's pretax cost of debt of 4.5% (estimated based on its S&P bond rating of A) to convert the commitments to debt:

Year	*Commitment*	*Present Value @ 4.5%*
1	$190.00	$ 181.82
2	$189.00	$ 173.07
3	$187.00	$ 163.87
4	$147.00	$ 123.27
5	$141.00	$ 113.15
6–23	$172.22	$1,680.51
Debt value of leases =		$2,435.68

Note that Target reported a lump sum of $3,100 million for commitments beyond year 5, which we have converted into annual commitments of $172.22 million a year for 18 years (a judgment call based on the annual average commitment for years 1–5). We will adjust the stated debt and operating income to reflect the decision to treat lease commitments as debt:

$$\begin{aligned}\text{Adjusted operating income} &= \text{Stated operating income} + \text{Current year's lease expense} \\ &\quad - \text{Depreciation on leased asset} \\ &= \$5{,}252 \text{ million} + 200 \text{ million} - (2{,}454/23) = \$5{,}346 \text{ million} \\ \text{Adjusted debt} &= \text{Stated debt} + \text{Debt value of leases} \\ &= \$15{,}726 + \$2{,}436 = \$18{,}162 \text{ million}\end{aligned}$$

To estimate the expected growth rate, we estimated the return on capital and reinvestment rate for Target in 2010, again staying true to the decision to capitalize leases:

$$\text{Return on capital} = \frac{\text{Adjusted EBIT}_{2010}(1-t)}{(\text{BV of debt}_{2009} + \text{PV of leases}_{2009} + \text{BV of equity}_{2009} - \text{Cash}_{2009})}$$

$$= \frac{\$5{,}346(1-.35)}{(16{,}814 + 2{,}353 + 15{,}347 - 2{,}200)} = 10.75\%$$

$$\text{Reinvestment Rate} = \frac{\text{Capital Expenditures} - \text{Depreciation} + \text{Change in PV of leases} + \text{Change in noncash WC}}{\text{Adjusted EBIT}(1-t)}$$

$$= \frac{2{,}129 - 2{,}084 + (2{,}436 - 2{,}353) + 332}{5346\ (1 - .35)} = 5.58\%$$

Note that we computed the present value of lease commitments at the end of 2009 by going back to the annual report for that year, extracting the lease commitments and computing the present value of the commitments using the pretax cost of debt at the end of 2009.

Target pulled back on reinvestment in 2010 but we expect the reinvestment rate to bounce back to 40% (close to the average for the last five years) in the next five years, yielding an expected growth rate of 4.30% each year for that period:

$$\begin{aligned}\text{Expected growth rate} &= \text{Return on capital} \times \text{Reinvestment rate} \\ &= 10.75\% \times 40\% = 4.30\%\end{aligned}$$

To compute the cost of capital over this period, we estimated a beta of 1.05 for Target (based on the average beta across general retailers) and used an equity risk premium of 5% (the riskfree rate was 3.5%):

$$\begin{aligned}&\text{Cost of equity} = 3.5\% + 1.05(5\%) = 8.75\% \\ &\text{Cost of debt} = 4.5\%(1 - .35) = 2.93\% \\ &\text{Debt to capital ratio} = \$18{,}162 / (\$18{,}162 + \$34{,}346) = 34.59\% \\ &\text{Cost of capital} = 8.75\%\ (1 - .3459) + 2.93\%(.3459) = 6.74\%\end{aligned}$$

The resulting free cash flows to the firm for the following five years are reported in the table, with the present value computed using the cost of capital:

	1	*2*	*3*	*4*	*5*
Expected growth rate	4.30%	4.30%	4.30%	4.30%	4.30%
Cumulated growth	104.30%	108.79%	113.47%	118.35%	123.44%
Reinvestment rate	40.00%	40.00%	40.00%	40.00%	40.00%
EBIT × (1 – tax rate)	$3,624	$3,780	$3,943	$4,113	$4,289
– Reinvestment	$1,449	$1,512	$1,577	$1,645	$1,715
Free cashflow to firm	$2,175	$2,268	$2,366	$2,468	$2,574
Cost of capital	6.74%	6.74%	6.74%	6.74%	6.74%
Present value	$2,037	$1,991	$1,946	$1,901	$1,858

At the end of year 5, we assume that Target will be a mature firm, with a growth rate of 3% in perpetuity and a return on capital equal to its cost of capital. The resulting reinvestment rate and terminal value are estimated in the following calculations:

$$\text{Return on capital in stable growth} = \text{Cost of capital in stable growth} = 6.74\%$$
$$\text{Reinvestment rate in stable growth} = \text{Stable growth rate/ Stable ROC} = 3\%/\ 6.74\% = 44.54\%$$

$$\text{Terminal value} = \frac{\text{EBIT}(1-t)_6(1 - \text{Reinvestment rate})}{\text{Cost of capital} - \text{Stable growth rate}} = \frac{\$4{,}289(1.03)(1 - .4454)}{.0674 - .03} = \$65{,}597 \text{ million}$$

Adding the present value of the terminal value to the present value of the free cash flows to the firm for the next five years, we arrive at the value of the operating assets:

$$\text{Value of operating assets} = \text{PV of FCFF} + \text{PV of terminal value} = \$9{,}733 + \$65{,}597/1.0674^5 = \$57{,}086 \text{ million}$$

Adding the cash balance ($1,712 million) and subtracting debt inclusive of the operating leases ($18,162 million) yields a value of equity of $40,636 million. Dividing by the number of shares (689.13 million) results in a value per share of $58.97, about 20% higher than the prevailing market price of $49 in May 2011.

As a final part of the analysis, we examined the effect that treating leases as debt had on the valuation. As the following table makes clear, staying with the current accounting treatment of operating leases as operating expenses would have resulted in a higher return on capital, a higher cost of capital, and a slightly higher value of equity per share.

	Operating Expense	*Financial Expense*
Operating income	$5,252.00	$5,346.00
Debt	$16,814.00	$19,250.00
ROIC	11.39%	10.75%
Reinvestment rate	40%	40%
Expected growth rate	4.56%	4.30%
Debt to capital ratio	31.41%	34.59%
Cost of capital	6.92%	6.74%
Value of firm	$56,731.00	$58,795.00
Value of equity	$41,005.00	$40,633.00
Value/share	$59.50	$58.97

While the value per share effect is small in the case of Target, it will be larger for firms with more substantial lease commitments (relative to conventional debt). A key number to track is the excess return (return on capital – cost of capital) earned by the firm. For Target, converting leases to debt lowers the excess return slightly from 4.47% (11.39% minus 6.92%) to 4.01% (10.75% minus 6.74%), which also lowers the value per share. The greater the change in the excess returns from the lease adjustment, the greater will be the impact of converting leases to debt on value per share.

ILLUSTRATION 15.3: Valuing Amgen in March 2009: The Effect of R&D Capitalization

In Illustration 9.2, we used Amgen to illustrate the effects of capitalizing R&D, using a 10-year amortizable life for R&D. Using data through 2008, we estimated the capital invested in R&D and the amortization as follows:

Year	*R&D Expense*	*Unamortized Portion*		*Amortization This Year*
Current	3030.00	1.00	3030.00	
–1	3266.00	0.90	2939.40	$ 326.60
–2	3366.00	0.80	2692.80	$ 336.60
–3	2314.00	0.70	1619.80	$ 231.40
–4	2028.00	0.60	1216.80	$ 202.80
–5	1655.00	0.50	827.50	$ 165.50
–6	1117.00	0.40	446.80	$ 111.70
–7	864.00	0.30	259.20	$ 86.40
–8	845.00	0.20	169.00	$ 84.50
–9	823.00	0.10	82.30	$ 82.30
–10	663.00	0.00	0.00	$ 66.30
			$13283.60	$1,694.10

Using the financial statements from 2008, we computed the adjusted operating income and return on capital at the firm.

$$\text{Adjusted Operating Income} = \text{Operating income}_{2008} + \text{R\&D expense}_{2008} - \text{Depreciation on R\&D asset}_{2008}$$
$$= \$5{,}594 + 3{,}030 - 1{,}694 = \$\ 6.930 \text{ million}$$

$$\text{Adjusted after-tax operating income} = \text{Operating income}_{2008}(1-t) + \text{R\&D expense}_{2008} - \text{Depreciation on R\&D asset}_{2008}$$
$$= \$5{,}594\ (1 - .20) + 3{,}030 - 1{,}694 = \$\ 5{,}811 \text{ million}$$

$$\text{Adjusted pretax ROIC} = \frac{\text{Adjusted operating income}_{2008}}{\text{BV of debt}_{2007} + \text{BV of equity}_{2007} + \text{Capitalized R\&D}_{2007} - \text{Cash}_{2007}}$$
$$= \frac{\$6{,}930}{\$11{,}177 + \$17{,}869 + \$11{,}948 - \$7{,}151} = 20.48\%$$

$$\text{Adjusted after-tax ROIC} = \frac{\text{Adjusted after-tax operating income}_{2008}}{\text{BV of debt}_{2007} + \text{BV of equity}_{2007} + \text{Capitalized R\&D}_{2007} - \text{Cash}_{2007}}$$
$$= \frac{\$5{,}811}{\$11{,}177 + \$17{,}869 + \$11{,}948 - \$7{,}151} = 17.17\%$$

Note that the capitalized R&D used in the return on capital computation was based upon the R&D expenses through 2007 and that the adjusted after-tax earnings reflect the tax benefits of R&D expensing.

We used the restated numbers to estimate the value of the firm and equity per share. The valuation, where we assume ten years of high growth, is summarized in Figure 15.1:

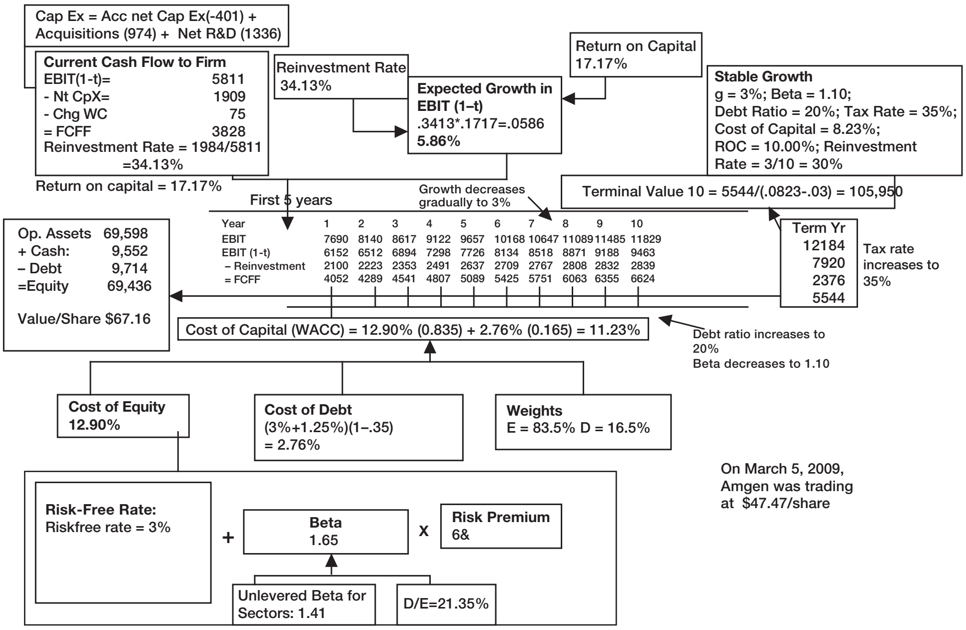

FIGURE 15.1 Valuing Amgen—March 2009

The transition period, as in the prior chapter, exists primarily so as to allow us to adjust our high growth inputs to stable growth levels. The cost of capital for instance, which is 11.23 percent for the next five years drops in linear increments to the stable growth cost of capital of 8.23 percent; the compounded cost of capital is therefore used to discount cash flows in those years. Our estimate of value of equity per share is $67.16 a share, well above the prevailing stock price of $47.47 in March 2009.

An intriguing question is how the capitalization of R&D expenses affected value. To investigate, we compared the valuation fundamentals for Amgen, with conventional accounting, and with R&D treated as capital expenses in the following table:

Valuation Fundamentals—With and Without R&D Capitalization

	Conventional	*Capitalized R&D*
After-tax ROC	20.44%	17.17%
Reinvestment rate	14.47%	34.13%
Growth rate	2.96%	5.86%
Value per share	$48.24	$67.17

We then revalued the firm, using both sets of fundamentals. As the table indicates, the value per share would have been $48.24, if we had used conventional accounting numbers. Clearly, capitalization matters, and the degree to which it matters will vary across firms. In general, the effect will be negative for firms that invest large amounts in R&D, with little to show (yet) in terms of earnings and cash flows in subsequent periods. It will be positive for firms that reinvest large amounts in R&D and report large increases in earnings in subsequent periods. In the case of Amgen, capitalizing R&D has a positive effect on value per share, because of its track record of successful R&D.

ILLUSTRATION 15.4: Valuing an Emerging Market Company with Developed Market Exposure: Gerdau Steel (Brazil) in March 2009

Gerdau Steel is a Brazilian steel company that derived about 51% of its revenues in Brazil in 2008 and the rest in North America. We chose to value Gerdau Steel in U.S. dollars, partly because of the difficulties we faced in estimating risk free rates and risk premiums in Brazilian reais (R$).

To estimate the cost of capital in U.S. dollar terms, we started with the U.S. Treasury bond rate of 3%. In March 2009, the equity risk premium that we were using for mature markets (like the United States) was 6% and the additional country risk premium for Brazil was 4.75%. For Gerdau Steel, we used the average unlevered beta of 1.01 for steel companies listed globally, using the argument that steel is a commodity that is bought and sold on a world market. Since Gerdau has a very high market debt to equity ratio (138.89%), the resulting levered beta is 1.94 (with 34% being the marginal tax rate for Brazil):

$$\text{Levered beta}_{\text{Gerdau}} = 1.01\ [1 + (1 - .34)\ (1.3889)] = 1.94$$

To reflect the fact that Gerdau Steel derives almost half its revenues in emerging markets, we estimated a lambda to measure exposure to Brazilian country risk, using two approaches:

1. Revenue-based approach: Dividing Gerdau's Brazilian revenue proportion (51 percent) by the average revenue proportion for a Brazilian company (72 percent) yields a lambda of 0.79.
2. Price-based approach: Regressing the weekly returns on Gerdau stock, between January 2007 and January 2009, on the weekly returns on the Brazilian government dollar-denominated bond yields a lambda of 0.625:

$$\text{Return}_{\text{Gerdau}} = 0.045\% + 0.6250\ \text{Return}_{\text{Brazil \$ Bond}}$$

We used the latter estimate to compute a US$ cost of equity for Gerdau Steel of 17.61%:

$$\text{Cost of equity for Gerdau} = 3.00\% + 1.94(6\%) + 0.625(4.75\%) = 17.61\%$$

To estimate the cost of debt for Gerdau, we began with the interest coverage ratio for the firm, using the 2008 income statement:

$$\text{Interest coverage ratio} = \frac{\text{Operating income}}{\text{Interest expenses}} = \frac{8005}{1620} = 4.94$$

This interest coverage ratio, in conjunction with Table 8.1 (from Chapter 8), yields a rating of A– and a default spread of 3% (based on March 2009 spreads). Adding the default spread for Brazil (3%) at the time, we get a pretax cost of debt of 9% for Gerdau:

$$\begin{aligned}\text{Pretax cost of debt} &= \text{Risk-free rate} + \text{Default spread}_{\text{Country}} + \text{Default spread}_{\text{Company}}\\ &= 3\% + 3\% + 3\% = 9\%\end{aligned}$$

Finally, incorporating Gerdau's current market debt to capital ratio of 58.45%, we estimate a US$ cost of capital of 10.79%:

$$\text{Cost of capital} = 17.61\%\ (.4155) + 9\%\ (1 - .34)\ (.5845) = 10.79\%$$

We used the 2008 financial statements and exchange rates at the time of the statements to estimate the cashflows in R$ and then convert these cash flows to U.S. dollars.

- *Base year numbers:* In the 2008 financial year, Gerdau reported operating income of R$ 8,005 million, after depreciation of R$ 1,896 million. During the year, acquisitions and internal investments combined to create capital expenditures of R$ 6,818 million and noncash working capital increased by R$ 1,083 million. Gerdau earned an after-tax return on capital of 18.68%, based upon a marginal tax rate (for Brazil) of 34%, and start-of-the-year book values for equity of R$17,449 million, book value of debt of R$ 15,979 million and a cash balance of R$ 5,139 million:

$$\text{Return on capital} = \frac{8005(1 - .34)}{17449 + 15979 - 5139} = .1868$$

$$\text{Reinvestment rate} = \frac{6818 - 1896 + 1083}{8005(1 - .34)} = 113.66\%$$

- *Forecasted growth and cash flows:* We do not believe that either the return on capital or the reinvestment rate is sustainable in the long term. Consequently, we use a reinvestment rate of 60% and a return on capital of 16% to estimate the expected growth rate of 9.60%, in R$, for the next five years.

$$\text{Expected growth rate} = \text{Reinvestment rate} \times \text{Return on capital} = .60 \times .16 = .096$$

We use this expected growth rate to estimate expected cash flows for the next five years, in R$, in the following table:

Expected Free Cash flows in R$: Gerdau Steel

Year	*1*	*2*	*3*	*4*	*5*
EBIT (1 – t)	R$5,790	R$6,346	R$6,956	R$7,623	R$8,355
–Reinvestment	R$3,474	R$3,808	R$4,173	R$4,574	R$5,013
FCFF	R$2,316	R$2,539	R$2,782	R$3,049	R$3,342

Again, the reinvestment each year is the consolidated value of net capital expenditures, acquisitions and investments in working capital, and amounts to 60% of after-tax operating income each year.

- *Conversion to U.S. dollars:* To convert the cash flows in R$ to U.S. dollars, we start with the prevailing exchange rate (in March 2009) of R$ 2.252/$ but forecast exchange rates for future years based upon expected inflation rates of 2% in U.S. dollars and 5% in BR. The resulting expected exchange rates and cash flows in U.S. dollars are reported in the following table:

Expected Free Cash Flows in U.S. dollars: Gerdau Steel

Year	*1*	*2*	*3*	*4*	*5*
FCFF (in R$)	R$2,316	R$2,539	R$2,782	R$3,049	R$3,342
Expected exchange rate	2.32	2.39	2.46	2.53	2.60
FCFF (In US$)	R$ 999	R$1,064	R$1,133	R$1,206	R$1,284

The difference in expected inflation results in R$ depreciating in value, relative to the U.S. dollar, over the five-year period.

- *Stable growth:* In stable growth, we assume that Gerdau will grow 3% a year, in dollar terms, and that its return on capital in stable growth will converge on its cost of capital (also in dollar terms). To estimate the dollar cost of capital in stable growth, we assume that the stock will have a beta of 1.20 and that the country risk premium will decline to 3%. Using a debt ratio of 50% and a cost of debt of 8%, we estimate a cost of capital of 8.68%.[4] To estimate the terminal value, we first compute the after-tax operating income in dollar terms in year 5:

$$\$\ \text{EBIT}(1 - t) = \frac{\text{EBIT}(1 - t) \text{ in R\$}}{\text{R\$/\$}_{\text{year 5}}} = \frac{8{,}355}{2.60} = \$3{,}213$$

[4]Cost of equity in stable growth = 3% + 1.20(6%) + 0.625(3%) = 12.08%
Cost of debt in stable growth = 8% (1 – .34) = 5.28%
Cost of capital in stable growth = 12.08%(.50) + 5.28%(.50) =

AU: Please fill in total here.

We then compute the reinvestment rate and terminal value:

$$\text{Reinvestment rate} = \frac{\text{Stable growth rate}}{\text{Stable ROC}} = \frac{3\%}{8.68\%} = 34.57\%$$

$$\text{Terminal value} = \frac{\text{After-tax operating income}_5(1 + g_{stable})(1 - \text{Reinvestment rate})}{\text{Cost of capital}_{stable} - g_{stable}}$$

$$= \frac{\$3{,}213(1.03)(1 - .3457)}{.0868 - .03} = \$38{,}096 \text{ million}$$

- *Firm and Equitey Valuation:* To complete the analysis, we first discount the expected cash flows in US dollars at the cost of capital of 10.79%:

Expected Cash Flows and Present Value

Year	1	2	3	4	5
FCFF (in U.S. $)	R$ 999	R$1,064	R$1,133	R$1,206	R$1,284
Terminal value					38,096
Present value @ 10.79%	$ 902	$ 867	$ 833	$ 800	$23,595
Value of operating assets	$26,996				

To get to firm value, we add in dollar value of the cash holdings of the firm ($2,404 million) and subtract out the dollar value of debt ($9.788 million), with the conversion at today's exchange rate. Since Gerdau has consolidated holdings, we subtract out the estimated market value of the minority interest in these holdings of $2,599 million (in dollar terms) and then divide by the number of shares outstanding (1681.12 million) to arrive at a dollar value per share of $10.12:[5]

$$\text{Value per share} = \frac{26{,}996 + 2{,}403 - 9.788 - 2{,}599}{449.82} = \text{R\$}10.12/\text{share}$$

Converted at the exchange rate of 2.252 R$/$, we arrive at an estimate of value of R$ 22.79/ shares, making it significantly undervalued at the price of R$9.32/share at which it was trading in March 2009.

As with the prior two valuations, it is worth exploring the effect of the choice we made to value Gerdau Steel in U.S. dollars. We could have valued Gerdau Steel in BRL by adjusting the U.S. dollar cost of capital for differential inflation:

$$\text{Cost of capital in BRL} = (1 + \text{Cost of capital}_{US\$}) = \frac{(1 + \text{Exp inflation}_{BRL})}{(1 + \text{Exp inflation}_{US\$})} - 1$$

$$= 1.1079\ \frac{(1.05)}{(1.02)} = 14.05\%$$

Making a similar adjustment to the stable period cost of capital yields a BRL cost of capital of 11.88%. Finally, we adjust the stable growth rate to reflect the higher inflation rate in BRL:

$$\text{Stable growth rate} = (1 + \text{Stable growth rate}_{US\$})\frac{(1 + \text{Exp Inflation}_{BRL})}{(1 + \text{Exp Inflation}_{US\$})} - 1$$

$$= 1.1079\left(\frac{1.05}{1.02}\right) = 14.05\%$$

[5]Optimally, we would have liked to value the consolidated holdings and estimate the value of the minority interests. Since we were missing much of the information necessary to do this, we applied a price-to-book ratio of 1.20 (based on the price to book ratio of businesses that the cross holdings were in) to the book value of the minority interests.

The terminal value in $R can then be estimated:

$$\text{Terminal value} = \frac{\text{After-tax operating income}_5(1 + g_{\text{stable}})(1 - \text{Reinvestement rate})}{(\text{Cost of capital}_{\text{stable}} - g_{\text{stable}})}$$

$$= \frac{\$R8{,}355(1.0603)(1 - .3457)}{(.1189 - .0603)} = R\$96{,}230 \text{ million}$$

The value of Gerdau Steel's operating assets in BRL can then be computed by discounting the BRL cash flows back at the BRL cost of capital:

Year	*1*	*2*	*3*	*4*	*5*
FCFF (in R$)	R$ 2,316	R$2,539	R$2,782	R$3,049	R$ 3,342
TV					R$96,230
PV	R$ 2,031	R$1,952	R$1,875	R$1,802	R$51,601
Value of operating assets =	R$59,261				

Converting the value into US$ at the prevailing exchange rate of 2.252 yields a dollar value for the operating assets of $26,315 million, very close to our dollar-based estimate of $26,996 million.

fcffginzu.xls: **This spreadsheet allows you to estimate the value of a firm using the FCFF approach.**

NET DEBT VERSUS GROSS DEBT

In valuing the companies in this chapter, we used total debt outstanding (gross debt) rather than net debt where cash was netted out against debt. What is the difference between the two approaches, and will the valuations from the two approaches agree?

A comparison of gross and net debt valuations reveals the differences in the way we approach the calculation of key inputs to the valuation, summarized as follows:

	Gross Debt	*Net Debt*
Levered beta	Unlevered beta is levered using gross debt to market equity ratio.	Unlevered beta is levered using net debt to market equity ratio.
Cost of capital	Debt-to-capital ratio used is based on gross debt.	Debt-to-capital ratio used is based on net debt.
Treatment of cash and debt	Cash is added to value of operating assets and gross debt is subtracted to get to equity value.	Cash is not added back to operating assets and net debt is subtracted to get to equity value.

While working with net debt in valuation is not difficult to do, the more interesting question is whether the value that emerges will be the same as the value that would have been estimated using gross debt. In general the answer

(continued)

is no, and the reason usually lies in the cost of debt used in the net debt valuation. Intuitively, what you are doing when you use net debt is break the firm into two parts—a cash business, which is funded 100 percent with riskless debt, and an operating business funded partly with risky debt. Carrying this to its logical conclusion, the cost of debt you would have for the operating business would be significantly higher than the firm's current cost of debt. This is because the current lenders to the firm will factor in the firm's cash holdings when setting the cost of debt.

To illustrate, assume that you have a firm with an overall value of $1 billion—$200 million in cash and $800 million in operating assets—with $400 million in debt and $600 million in equity. The firm's cost of debt is 7 percent, a 2 percent default spread over the risk-free rate of 5 percent; note that this cost of debt is set based on the firm's substantial cash holdings. If you net debt against cash, the firm would have $200 million in net debt and $600 million in equity. If you use the 7 percent cost of debt to value the firm now, you will overstate its value. Instead, the cost of debt you should use in the valuation is 9 percent:

$$\begin{aligned}\text{Cost of debt on net debt} &= (\text{Pretax cost of debt}_{\text{gross debt}} \times \text{Gross debt} \\ &\quad - \text{Risk rate}_{\text{net debt}} \times \text{Cash})/(\text{Gross debt} - \text{Cash}) \\ &= (.07 \times 400 - .05 \times 200)/(400 - 200) = .09\end{aligned}$$

In general, we would recommend using gross debt rather than net debt for two other reasons. First, the net debt can be a negative number if cash exceeds the gross debt. If this occurs, you should set the net debt to zero and consider the excess cash just as you would cash in a gross debt valuation. Second, maintaining a stable net debt ratio in a growing firm will require that cash balances increase as the firm value increases.

Will Equity Value Be the Same under Firm and Equity Valuation?

This model, unlike the dividend discount model or the FCFE model, values the firm rather than equity. The value of equity, however, can be extracted from the value of the firm by subtracting the market value of outstanding debt. Since this model can be viewed as an alternative way of valuing equity, two questions arise: Why value the firm rather than equity? Will the values for equity obtained from the firm valuation approach be consistent with the values obtained from the equity valuation approaches described in the previous chapter?

The advantage of using the firm valuation approach is that cash flows relating to debt do not have to be considered explicitly since the FCFF is a predebt cash flow, while they have to be taken into account in estimating FCFE. In cases where the leverage is expected to change significantly over time, this is a significant savings, since estimating new debt issues and debt repayments when leverage is changing can become increasingly messy the further into the future you go. The firm valuation approach does, however, require information about debt ratios and interest rates to estimate the weighted average cost of capital.

The value for equity obtained from the firm valuation and equity valuation approaches will be the same if you make consistent assumptions about financial leverage. Getting them to converge in practice is much more difficult. Let us begin with the simplest case—a no-growth, perpetual firm. Assume that the firm has $166.67 million in earnings before interest and taxes and a tax rate of 40 percent. Assume that the firm has equity with a market value of $600 million, with a cost of equity of 13.87 percent, and debt of $400 million, with a pretax cost of debt of 7 percent. The firm's cost of capital can be estimated as follows:

$$\text{Cost of capital} = 13.87\%(\sout{700}/1{,}000) + 7\%(1 - .4)(\sout{300}/1{,}000) = 10\%$$

$$\text{Value of the firm} = \text{Earnings before interest and taxes}(1 - t)/\text{Cost of capital}$$
$$= 166.67(1 - .4)/.10 = \$1{,}000$$

Note that the firm has no reinvestment and no growth. We can value equity in this firm by subtracting the value of debt:

$$\text{Value of equity} = \text{Value of firm} - \text{Value of debt} = \$1{,}000 - \$400 = \$600 \text{ million}$$

Now let us value the equity directly by estimating the net income:

$$\text{Net income} = (\text{EBIT} - \text{Pretax cost of debt} \times \text{Debt})(1 - t)$$
$$= (166.67 - .07 \times 400)(1 - .4) = \$83.202 \text{ million}$$

The value of equity can be obtained by discounting this net income at the cost of equity:

$$\text{Value of equity} = \text{Net income}/\text{Cost of equity} = 83.202/.1387 = \$600 \text{ million}$$

Even this simple example works because of the following three assumptions made implicitly or explicitly during the valuation:

1. The values for debt and equity used to compute the cost of capital were equal to the values obtained in the valuation. Notwithstanding the circularity in reasoning—you need the cost of capital to obtain the values in the first place—it indicates that a cost of capital based on market value weights will not yield the same value for equity as an equity valuation model if the firm is not fairly priced in the first place.
2. There are no extraordinary or nonoperating items that affect net income but not operating income. Thus, to get from operating to net income all we do is subtract interest expenses and taxes.
3. The interest expenses are equal to the pretax cost of debt multiplied by the market value of debt. If a firm has old debt on its books, with interest expenses that are different from this value, the two approaches will diverge.

If there is expected growth, the potential for inconsistency multiplies. You have to ensure that you borrow enough money to fund new investments to keep your debt ratio at a level consistent with what you are assuming when you compute the cost of capital.

fcffvsfcfe.xls: **This spreadsheet allows you to compare the equity values obtained using FCFF and FCFE models.**

FIRM VALUATION: THE ADJUSTED PRESENT VALUE APPROACH

The adjusted present value (APV) approach begins with the value of the firm without debt. As debt is added to the firm, the net effect on value is examined by considering both the benefits and the costs of borrowing. To do this, it is assumed that the primary benefit of borrowing is a tax benefit, and that the most significant cost of borrowing is the added risk of bankruptcy.

Mechanics of APV Valuation

We estimate the value of the firm in three steps:

1. Estimate the value of the firm with no leverage.
2. Consider the present value of the interest tax savings generated by borrowing a given amount of money.
3. Evaluate the effect of borrowing the amount on the probability that the firm will go bankrupt, and the expected cost of bankruptcy.

Value of Unlevered Firm 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 free cash flow to the firm at the unlevered cost of equity). In the special case where cash flows grow at a constant rate in perpetuity,

$$\text{Value of unlevered firm} = E(FCFF_1)/(\rho_u - g)$$

where $FCFF_1$ is the expected after-tax operating cash flow to the firm, ρ_u is the unlevered cost of equity, and g is the expected growth rate. In the more general case, you can value the firm using any set of growth assumptions you believe are reasonable for the firm.

The inputs needed for this valuation are the expected cash flows, growth rates, and the unlevered cost of equity. To estimate the unlevered cost of equity, 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
D/E = Current debt/equity ratio

This unlevered beta can then be used to arrive at the unlevered cost of equity.

Expected Tax Benefit from Borrowing 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 and interest payments 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,

$$\begin{aligned}\text{Value of tax benefits} &= (\text{Tax rate} \times \text{Cost of debt} \times \text{Debt})/\text{Cost of debt}\\ &= \text{Tax rate} \times \text{Debt} = t_c D\end{aligned}$$

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 earlier. In addition, you would have to modify this equation if the current interest expenses do not reflect the current cost of debt.

Estimating Expected Bankruptcy Costs and Net Effect 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 (PV) of expected bankruptcy cost can be estimated:

$$\text{PV of expected bankruptcy cost} = \text{Probability of bankruptcy} \times \text{PV of bankruptcy cost}$$
$$= \pi_a \text{BC}$$

This step of the adjusted present value approach poses the most significant estimation problems, 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 and use the empirical estimates of default probabilities for the rating. For instance, Table 15.2, extracted from a study by Altman ~~and Kishore~~, summarizes the probability of default over 10 years by bond rating class in ~~1998~~.[6]

TABLE 15.2 Ratings and Probability of Default

Rating	Probability of Default
AAA	0.07%
AA	0.51%
A+	0.60%
A	0.66%
A–	2.50%
BBB	7.54%
BB+	10.00%
BB	16.63%
B+	25.00%
B	36.80%
B–	45.00%
CCC	59.01%
CC	70.00%
C	85.00%
D	100.00%

Source: Altman (2009).

[6]This study estimated default rates over 10 years only for some of the ratings classes. We extrapolated the rest of the ratings.

The other way is to use a statistical approach such as a probit to estimate the probability of default, based on 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. Research that has looked at the direct cost of bankruptcy concludes that they are small[7] 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 percent of firm value but provide no direct evidence of the costs.

ILLUSTRATION 15.5: Valuing a Company Using APV: The Leveraged Acquisition of J. Crew

J. Crew is a U.S. retailer that sells clothes made under its brand name through its own stores and online. In 2010, the firm was acquired in a leveraged deal by Mickey Drexler, its CEO, and two private equity firms—TPG and Leonard Green—for $ 2.7 billion, with about $1.85 billion coming from debt (with a rating of BB and a pretax cost of debt of 7%).

To assess the value of the deal, using the APV approach, we first valued the firm as an all-equity funded (unlevered) firm. To estimate the value, we first computed a cost of equity using an unlevered beta of 1.00 for specialty retailers, in conjunction with a riskfree rate of 3.5% and mature market premium of 5%:

$$\text{Unlevered cost of equity} = 3.5\% + 1.00(5\%) = 8.5\%$$

J. Crew generated $230 million in operating income on revenues of $1,722 million in 2010. We assumed a 35% tax rate and a growth rate of 3.5% in perpetuity, with a return on capital of 14%, resulting in the following:

$$\text{Reinvestment rate in stable growth} = g/\text{ROC} = 3.5\%/14\% = 25\%$$

$$\begin{aligned}\text{FCFF in most recent year} &= \text{EBIT}(1-t)(1-\text{Reinvestment rate})\\ &= 230(1-.35)(1-.25) = \$112.125 \text{ million}\end{aligned}$$

$$\begin{aligned}\text{Unlevered firm value} &= \frac{\text{Expected FCFF next year}}{\text{Unlevered cost of equity} - \text{Stable growth rate}} - 1\\ &= \frac{\$112.125(1.035)}{.085 - .035} = \$2{,}321 \text{ million}\end{aligned}$$

To estimate the tax benefits from debt, we assumed that a debt schedule, where the dollar debt would be repaid in equal annual increments to a debt level of $500 million in year 10 and beyond. Using the 35 percent tax rate and the pretax cost of debt, we compute the interest expenses and tax benefits each year, and discount these benefits back to today, using the pretax cost of debt as the discount rate.

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

Year	*Debt Due at Start of Year*	*Interest Expense*	*Tax Benefit*	*PV @ Cost of Debt*
1	$1,850.00	$129.50	$45.33	$ 42.36
2	$1,700.00	$119.00	$41.65	$ 36.38
3	$1,550.00	$108.50	$37.98	$ 31.00
4	$1,400.00	$ 98.00	$34.30	$ 26.17
5	$1,250.00	$ 87.50	$30.63	$ 21.84
6	$1,100.00	$ 77.00	$26.95	$ 17.96
7	$ 950.00	$ 66.50	$23.28	$ 14.49
8	$ 800.00	$ 56.00	$19.60	$ 11.41
9	$ 650.00	$ 45.50	$15.93	$ 8.66
10	$ 500.00	$ 35.00	$12.25	$ 6.23
In perpetuity	$ 500.00	$ 35.00	$12.25	$ 88.96
Total				$305.45

Note that the value of tax benefits in perpetuity is computed in two steps. First, we compute the present value of $12.25 million in tax savings in perpetuity ($12.25/.07 = $175 million). Next, we discount that value back to today at the pretax cost of debt ($\$175/1.07^{10} = \$88.96$ million)

As the final piece of the analysis, we assumed that bankruptcy costs (BC), direct and indirect, would amount to 30% of firm value and that the high debt level taken in the deal increases the probability of bankruptcy (π_{BC}) to 20%. The expected bankruptcy cost is then:

$$\text{Expected Bankruptcy cost} = (\text{Unlevered firm value} + \text{PV of tax benefits}) \times \text{BC} \times \pi_{BC}$$
$$= (\$2{,}321 + \$305) \times .30 \times .20 = \$158 \text{ million}$$

The value for J.Crew can now be computed using all three components:

$$\text{Value of J.Crew} = \text{Unlevered firm value} + \text{PV of tax benefits from debt} - \text{Expected bankruptcy costs}$$
$$= \$2{,}321 + \$305 - \$158 = \$2{,}469 \text{ million}$$

At $2.7 billion, the private equity investors are paying too much for the firm.

Cost of Capital versus APV Valuation

In an APV valuation, the value of a levered firm is obtained by adding the net effect of debt to the unlevered firm value.

$$\text{Value of levered firm} = \text{FCFF}_o(1 + g)/(\rho_u - g) + t_cD - \pi_a\text{BC}$$

In the cost of capital approach, the effects of leverage show up in the cost of capital, with the tax benefit incorporated in the after-tax cost of debt and the bankruptcy costs in both the levered beta and the pretax cost of debt. Will the two approaches yield the same value? Not necessarily. The first reason for differences is that the models consider bankruptcy costs very differently, with the adjusted present value approach providing more flexibility in allowing you to consider indirect bankruptcy costs. To the extent that these costs do not show up or show up inadequately in the pretax cost of debt, the APV approach will yield a more conservative estimate of value. The second reason is that the APV approach considers the tax benefit from a dollar debt value, usually based on existing debt. The cost of capital approach estimates the tax benefit from a debt ratio that may require the firm to borrow increasing amounts in the future. For instance, assuming a market debt to

APV WITHOUT BANKRUPTCY COSTS

There are many who believe that adjusted present value is a more flexible way of approaching valuation than traditional discounted cash flow models. This may be true in a generic sense, but APV valuation in practice has significant flaws. The first and most important is that most practitioners who use the adjusted present value model ignore expected bankruptcy costs. Adding the tax benefits to unlevered firm value to get to levered firm value makes debt seem like an unmixed blessing. Firm value will be overstated, especially at very high debt ratios, where the cost of bankruptcy is clearly not zero.

capital ratio of 30 percent in perpetuity for a growing firm will require it to borrow more in the future, and the tax benefit from expected future borrowings is incorporated into value today. Generally speaking, the cost-of-capital approach is a more practical choice when valuing ongoing firms that are not going through contortions on financial leverage; it is easier to work with a debt ratio than with dollar-debt levels. The APV approach is more useful for transactions that are funded disproportionately with debt and where debt repayment schedules are negotiated or known; this is why it has acquired a footing in leveraged-buyout circles.

EFFECT OF LEVERAGE ON FIRM VALUE

Both the cost of capital approach and the APV approach make the value of a firm a function of its leverage. It follows directly, then, that there is some mix of debt and equity at which firm value is maximized. The rest of this chapter considers how best to make this link.

Cost of Capital and Optimal Leverage

In order to understand the relationship between the cost of capital and optimal capital structure, we rely on the relationship between firm value and the cost of capital. The earlier section noted that the value of the entire firm can be estimated by discounting the expected cash flows to the firm at the firm's cost of capital.

The firm value can then be written as follows:

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

and is a function of the firm's cash flows and its cost of capital. If we assume that the cash flows to the firm are unaffected by the choice of financing mix, and the cost of capital is reduced as a consequence of changing the financing mix, the value of the firm will increase. If the objective in choosing the financing mix for the firm is the maximization of firm value, we can accomplish it, 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 mix that maximizes firm value.[8]

[8]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.

ILLUSTRATION 15.6: WACC, Firm Value, and Leverage

Assume that you are given the costs of equity and debt at different debt levels for Strunks Inc., a leading manufacturer of chocolates and other candies, and that the cash flows to this firm are currently \$200 million. Strunks is in a relatively stable market, and these cash flows are expected to grow at 6% forever and to be unaffected by the debt ratio of the firm. The cost of capital schedule is provided in the following table, along with the value of the firm at each level of debt.

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

$$\text{Value of firm} = \text{Cash flows to firm} \times (1 + g)/(\text{Cost of capital} - g) = \$200 \times 1.06/(\text{Cost of capital} - .06)$$

The value of the firm increases as the cost of capital decreases, and decreases as the cost of capital increases. This is illustrated in Figure 15.2. While this illustration makes the choice of an optimal financing mix seem easy, it obscures problems that ~~may~~ arise in its practice. First, we typically do 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 at which we have information on the cost of debt and equity financing is the current level. Second, the analysis assumes implicitly that the level of operating income of 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 be in others. Firms that borrow too much might find that there are indirect bankruptcy costs that affect revenues and operating income.

Steps in 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. 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 market debt to equity ratio of a firm, the unlevered beta and the firm's marginal tax rate:

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

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.

$$\text{Cost of equity} = \text{Risk-free rate} + \beta_{\text{levered}}(\text{Risk premium})$$

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, 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, 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 on the estimated rating, is added to the risk-free rate to arrive at the pretax cost of debt. Applying the marginal tax rate to this pretax 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 on 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 pretax operating income is assumed to be unaffected by the firm's financing mix and, by extension, its bond rating. If the operating income

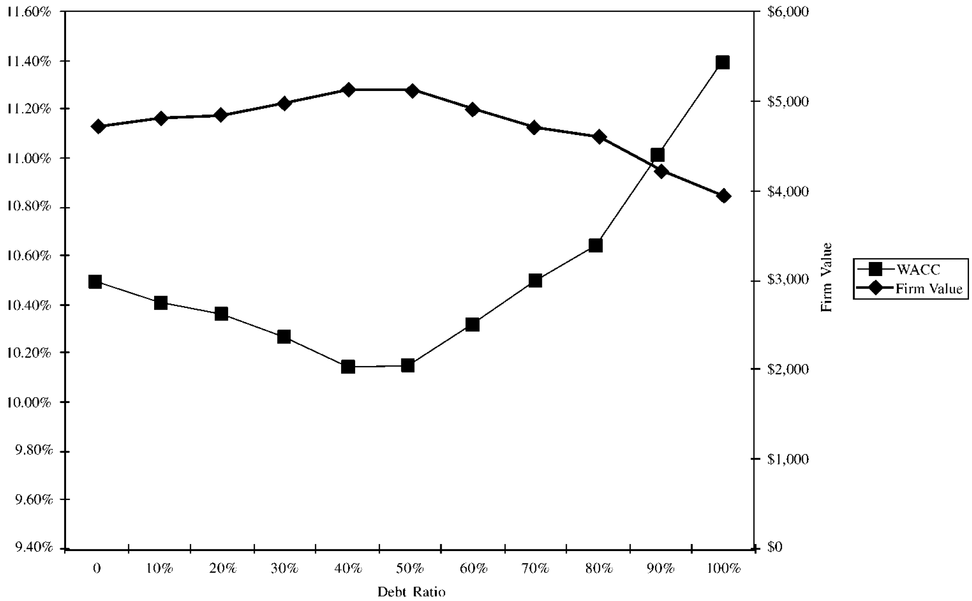

FIGURE 15.2 Cost of Capital and Firm Value

Source: ~~*Corporate Finance: Theory and Practice*~~, ~~Second Edition~~, by Aswath Damodaran, copyright © ~~2001~~, by John Wiley & Sons, Inc. This material is used by permission of John Wiley & Sons, Inc.

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 cash flows 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 15.7: Analyzing the Capital Structure for Disney: May 2009

The cost of capital approach can be used to find the optimal capital structure for a firm, as we will for Disney in May 2009. Disney had $14,962 million in interest-bearing debt on its books and adding the present value of operating lease commitments of $1,720 million to this value, we arrive at a total market value for the debt of $16,682 million. The market value of equity at the same time was $45,193 million; the market price per share was $24.34, and there were 1856.752 million shares outstanding. Proportionally, 26.96% of the overall financing mix was debt, and the remaining 73.04% was equity.

The unlevered beta for Disney's stock in May 2009, estimated by breaking it down into its constituent businesses and weighting the unlevered betas for each business, was 0.7333.

Business	*Revenues in 2008*	*EV/Sales*	*Estimated Value*	*Firm Value Proportion*	*Unlevered Beta*
Media networks	$16,116	2.13	$34,328	58.92%	0.7056
Parks and resorts	$11,504	1.51	$17,408	29.88%	0.5849
Studio entertainment	$ 7,348	0.78	$ 5,755	9.88%	1.3027
Consumer products	$ 2,875	0.27	$ 768	1.32%	1.0690
Disney operations	$37,843		$58,259	100.00%	0.7333

The Treasury bond rate at that time was 3.5%. Using an estimated equity risk premium of 6%, we estimated the cost of equity for Disney to be 8.91%:

$$\text{Levered beta} = 0.7333\,(1 + (1 - .38)(16{,}682/45{,}193)) = 0.9011$$

$$\text{Cost of equity} = \text{Risk-free rate} + \text{Beta} \times (\text{Market premium}) = 3.5\% + 0.9011(6\%) = 8.91\%$$

Disney's bond rating in May 2009 was A, and based on this rating, the estimated pretax cost of debt for Disney is 6%. Using a marginal tax rate of 38%, we estimate the after-tax cost of debt for Disney to be 3.72%.

$$\text{After-tax cost of debt} = \text{Pretax interest rate }(1 - \text{Tax rate}) = 6.00\%\,(1 - 0.38) = 3.72\%$$

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

$$\text{Cost of capital} = \text{Cost of equity}\ \frac{\text{Equity}}{\text{Debt} + \text{Equity}} + \text{Cost of debt }(1 - t)\frac{\text{Debt}}{\text{Debt} + \text{Equity}}$$

$$= 8.91\%\ \frac{45.193}{16{,}682 + 45{,}193} + 3.72\%\ \frac{16{,}682}{16{,}682 + 45{,}193}$$ [illegible]1%

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 levered beta at each debt ratio, using this unlevered beta and Disney's marginal tax rate of 38%:

$$\text{Levered Beta} = \sout{0.7033}\ [1 + (1 - .38)\ (\text{Debt/Equity})]$$

We continued to use the Treasury bond rate of 3.5% and the market premium of 6% to compute the cost of equity at each level of debt. If we keep the tax rate constant at 38%, we obtain the levered betas for Disney in the following table:

Levered Beta and Cost of Equity: Disney

Debt to Capital Ratio	*D/E Ratio*	*Levered Beta*	*Cost of Equity*
0%	0.00%	0.7333	7.90%
10%	11.11%	0.7838	8.20%
20%	25.00%	0.8470	8.58%
30%	42.86%	0.9281	9.07%
40%	66.67%	1.0364	9.72%
50%	100.00%	1.1879	10.63%
60%	150.00%	1.4153	11.99%
70%	233.33%	1.7941	14.26%
80%	400.00%	2.5519	18.81%
90%	900.00%	4.8251	32.45%

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 and that the firm will be able to get the full tax benefits of interest expenses even at very high debt ratios. 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 can be based on the rating of the bond, estimated by regressing past returns on bonds in each rating class against returns on a market index or backed out of the default spread. The levered betas estimated using this approach will generally be lower than those estimated with the conventional model.[9] We will also examine whether the full benefits of interest expenses will accrue at higher debt ratios.

DISNEY'S COST OF DEBT AND LEVERAGE

There are several financial ratios that are correlated with bond ratings, and we face two choices. One is to build a model that includes several financial ratios to estimate the synthetic ratings at each debt ratio. In addition to being more labor and data intensive, the approach will make the ratings process less transparent and more difficult to decipher. The other is to stick with the simplistic approach that we developed in Chapter 8, of linking the rating to the interest coverage ratio, with the ratio defined as:

$$\text{Interest coverage ratio} = \frac{\text{Earnings before interest and taxes}}{\text{Interest expenses}}$$

[9]Consider, for instance, a debt ratio of 40 percent. At this level the firm's debt will take on some of the characteristics of equity. Assume that the beta of debt at a 40 percent debt ratio is 0.10. The equity beta at that debt ratio can be computed as follows:

$$\text{Levered Beta} = 0.7333\ (1 + (1 - 0.38)(40/60) - 0.10\ (1 - 0.373)\ (40/60) = 0.99$$

In the unadjusted approach, the levered beta would have been 1.0364.

We will stick with the simpler approach for three reasons. First, we are not aiming for precision in the cost of debt, but an approximation. Given that the more complex approaches also give approximations, we will tilt in favor of transparency. 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. In other words, we may be adding little by adding other ratios that are correlated with interest coverage ratios, including EBITDA/Fixed Charges, to the mix. Third, the interest coverage ratio changes as a firm changes its financing mix and decreases as the debt ratio increases, a key requirement since we need the cost of debt to change as the debt ratio changes.

To make our estimates of the synthetic rating, we will use the lookup table that we introduced in Chapter 8, for large market capitalization firms (since Disney's market capitalization is greater than $ 5 billion) and use the default spreads from early 2009 to estimate the pre-tax cost of debt. The following table reproduces those numbers:

Interest Coverage Ratios, Ratings and Default Spreads—Early 2009

Interest Coverage Ratio	*Rating*	*Typical Default Spread*
>8.5	AAA	1.25%
6.5–8.5	AA	1.75%
5.5–6.5	A+	2.25%
4.25–5.5	A	2.50%
3–4.25	A–	3.00%
2.5–3.0	BBB	3.50%
2.25–2.5	BB+	4.25%
2.0–2.25	BB	5.00%
1.75–2.0	B+	6.00%
1.5–1.75	B	7.25%
1.25–1.5	B–	8.50%
0.8–1.25	CCC	10.00%
0.65–0.8	CC	12.00%
0.2–0.65	C	15.00%
<0.2	D	20.00%

Source: Capital IQ & Bondsonline.com

Using this table as a guideline, a firm with an interest coverage ratio of 2.75 would have a rating of BBB and a default spread of 3.50%, over the risk-free rate.

Because Disney's capacity to borrow is determined by its earnings power, we will begin by looking at key numbers from the company's income statements for the most recent fiscal year (July 2007–June 2008) and for the last four quarters (Calendar year 2008) in the table.

Disney's Key Operating Numbers

	Last Fiscal Year	*Trailing 12 Months*
Revenues	$37,843	$36,990
EBITDA	$ 8,986	$ 8,319
Depreciation & amortization	$ 1,582	$ 1,593
EBIT	$ 7,404	$ 6,726
Interest expenses	$ 712	$ 728
EBITDA (adjusted for leases)	$ 9,989	$ 8,422
EBIT (adjusted for leases)	$ 7,708	$ 6,829
Interest Expenses (adjusted for leases)	$ 815	$ 831

Note that converting leases to debt affects both the operating income and the interest expense; the imputed interest expense on the lease debt is added to both the operating income and interest expense numbers.[10] Since the trailing 12-month figures represent more recent information, we will use those numbers in assessing Disney's optimal debt ratio. Based on the EBIT (adjusted for leases) of $6,829 million and interest expenses of $831 million, Disney has an interest coverage ratio of 8.22 and should command a rating of AA, two notches above its actual rating of A.

To compute Disney's ratings at different debt levels, we start by assessing the dollar debt that Disney will need to issue to get to the specified debt ratio. This can be accomplished by multiplying the total market value of the firm today by the desired debt to capital ratio. To illustrate, Disney's dollar debt at a 10% debt ratio will be $6,188 million, computed thus:

$$\text{Value of Disney} = \text{Current market value of equity} + \text{Current market value of debt}$$
$$= 45{,}193 + \$16{,}682 = \$61{,}875 \text{ million}$$

$$\$\text{ Debt at 10\% Debt-to-capital ratio} = 10\% \text{ of } \$61{,}875 = \$6{,}188 \text{ million}$$

The second step in the process is to compute the interest expense that Disney will have at this debt level, by multiplying the dollar debt by the pretax cost of borrowing at that debt ratio. The interest expense is then used to compute an interest coverage ratio, which is employed to compute a synthetic rating. The resulting default spread, based on the rating, can be obtained from Table 8.3, and adding the default spread to the risk-free rate yields a pretax cost of borrowing. The following table 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.

Effect of Moving to Higher Debt Ratios: Disney

D/(D + E)	*0.00%*	*10.00%*
D/E	0.00%	11.11%
$ Debt	$ 0	$6,188
EBITDA	$8,422	$8,422
Depreciation	$1,593	$1,593
EBIT	$6,829	$6,829
Interest	$ 0	$ 294
Pretax coverage	∞	23.24
Likely rating	AAA	AAA
Pretax cost of debt	4.75%	4.75%

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, thus leaving operating assets untouched and isolating the effect of 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 Disney could borrow $6,188 billion at the AAA rate of 4.75%; we then compute an interest expense and interest coverage ratio using that rate. At the 10% debt ratio, our life was simplified by the fact that the rating remained unchanged at AAA. To illustrate a more difficult step up in debt, consider the change in the debt ratio from 20% to 30%:

[10]The present value of operating leases ($1,720 million) was multiplied by the pretax cost of debt of 6% to arrive at an interest expense of $103 million, which is added to both operating income and interest expense. Multiplying the pretax 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.

		Iteration 1 (Debt @AAA Rate)	*Iteration 2 (Debt @AA Rate)*
D/(D + E)	20.00%	30.00%	30.00%
D/E	25.00%	42.86%	42.86%
$ Debt	$12,375	$ 18,563	$18,563
EBITDA	$ 8,422	$ 8,422	$ 8,422
Depreciation	$ 1,593	$ 1,593	$ 1,593
EBIT	$ 6,829	$ 6,829	$ 6,829
Interest	$ 588	18563 × .0475 = $881	18563 × .0525 = $974
Pretax coverage	11.62	7.74	7.01
Likely rating	AAA	AA	AA
Pretax cost of debt	4.75%	5.25%	5.25%

While the initial estimate of the interest expenses at the 30% debt ratio reflects the AAA rating and 4.75% interest rate) that the firm enjoyed at the 20% debt ratio, the resulting interest coverage ratio of 7.74 pushes the rating down to AA and the interest rate to 5.25%. Consequently, we have to recompute the interest expenses at the higher rate (in iteration 2) and reach steady state: The interest rate that we use matches up to the estimated interest rate.[11] This process is repeated for each level of debt from 10% to 90%, and the iterated after-tax costs of debt are obtained at each level of debt in the following table:

Disney: Cost of Debt and Debt Ratios

Debt Ratio	*$ Debt*	*Interest Expense*	*Interest coverage ratio*	*Bond Rating*	*Interest rate on debt*	*Tax Rate*	*After-tax cost of debt*
0%	$ 0	$ 0	∞	AAA	4.75%	38.00%	2.95%
10%	$ 6,188	$ 294	23.24	AAA	4.75%	38.00%	2.95%
20%	$12,375	$ 588	11.62	AAA	4.75%	38.00%	2.95%
30%	$18,563	$ 975	7.01	AA	5.25%	38.00%	3.26%
40%	$24,750	$1,485	4.60	A	6.00%	38.00%	3.72%
50%	$30,938	$2,011	3.40	A–	6.50%	38.00%	4.03%
60%	$37,125	$2,599	2.63	BBB	7.00%	38.00%	4.34%
70%	$43,313	$5,198	1.31	B–	12.00%	38.00%	7.44%
80%	$49,500	$6,683	1.02	CCC	13.50%	38.00%	8.37%
90%	$55,688	$7,518	0.91	CCC	13.50%	34.52%	8.84%

Note that the interest expenses increase more than proportionately as the debt increases, since the cost of debt rises with the debt ratio. There are three points to make about these computations.

1. At each debt ratio, we compute the dollar value of debt by multiplying the debt ratio by the existing market value of the firm ($61,875 million). In reality, the value of the firm will change as the cost of capital changes and the dollar debt that we will need to get to a specified debt ratio, say 30%, will be different from the values that we have estimated. The reason that we have not tried to incorporate this effect is that it leads to more circularity in our computations, since the value at each debt ratio is a function of the savings from the interest expenses at that debt ratio, which in turn, will depend upon the value.

2. 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 an A rating, is assumed to be refinanced at the interest rate corresponding to a A– rating when Disney moves to a 50% debt ratio. This is done for two reasons. The first is that existing debt

[11]Because the interest expense rises, it is possible for the rating to drop again. Thus, a third iteration might be necessary in some cases.

holders might have protective puts that enable them to put their bonds back to the firm and receive face value.[12] 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 value. If we lock in current rates on existing bonds and recalculate the optimal debt ratio, we will allow for this wealth transfer.[13]

3. Although 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 EBIT. To illustrate this point, note that the EBIT at Disney is $6,829 million. As long as interest expenses are less than $6,829 million, interest expenses remain fully tax-deductible and earn the 38% tax benefit. For instance, even at an 80% debt ratio, the interest expenses are $6,683 million, and the tax benefit is therefore 38% of this amount. At a 90% debt ratio, however, the interest expenses balloon to $7,518 million, which is greater than the EBIT of $6,829 million. We consider the tax benefit on the interest expenses up to this amount:

Maximum tax benefit = EBIT × Marginal tax rate = $6,829 million × 0.38 = $2,595 million

As a proportion of the total interest expenses, the tax benefit is now only 34.52%:

Adjusted marginal tax rate = Maximum tax benefit/Interest expenses = $2,595/$7,518 = 34.52%

This in turn raises the after-tax cost of debt. This is a conservative approach, because losses can be carried forward. Given that this is a permanent shift in leverage, it does make sense to be conservative. We used this tax rate to recompute the levered beta at a 90% debt ratio, to reflect the fact that tax savings from interest are depleted.

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 the following table. The cost of capital, which is 7.90% when the firm is unlevered, decreases as the firm initially adds debt, reaches a minimum of 7.32% at a 40% debt ratio, and then starts to increase again. (See the table for the full details of the numbers in this table.)

Cost of Equity, Debt, and Capital, Disney

Debt Ratio	*Beta*	*Cost of Equity*	*Cost of Debt (After-Tax)*	*Cost of Capital*
0%	0.73	7.90%	2.95%	7.90%
10%	0.78	8.20%	2.95%	7.68%
20%	0.85	8.58%	2.95%	7.45%
30%	0.93	9.07%	3.26%	7.32%
40%	1.04	9.72%	3.72%	7.32%
50%	1.19	10.63%	4.03%	7.33%
60%	1.42	11.99%	4.34%	7.40%
70%	1.79	14.26%	7.44%	9.49%
80%	2.55	18.81%	8.37%	10.46%
90%	5.05	33.83%	8.84%	11.34%

[12]If they do not have protective puts, it is in the best interests of the stockholders not to refinance the debt if debt ratios are increased.

[13]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.

Note that we are moving in 10 percent increments and that the cost of capital flattens out between 30 and 50%, we can get a more precise reading of the optimal by looking at how the cost of capital moves between 30 and 50%, in smaller increments. Using 1% increments, the optimal debt ratio that we compute for Disney is 43%. with a cost of capital of 7.28%. We will stick with the approximate optimal of 40% the rest of this illustration.

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; the results are summarized in the following table.

Costs of Equity, Debt, and Capital with Debt Carrying Market Risk, Disney

Debt Ratio	*Beta of Equity*	*Beta of Debt*	*Cost of Equity*	*Cost of Debt (After-Tax)*	*Cost of Capital*
0%	0.73	0.05	7.90%	2.95%	7.90%
10%	0.78	0.05	8.18%	2.95%	7.66%
20%	0.84	0.05	8.53%	2.95%	7.42%
30%	0.91	0.07	8.95%	3.26%	7.24%
40%	0.99	0.10	9.46%	3.72%	7.16%
50%	1.11	0.13	10.16%	4.03%	7.10%
60%	1.28	0.00	11.18%	4.34%	7.08%
70%	1.28	0.35	11.19%	7.44%	8.57%
80%	1.52	0.42	12.61%	8.37%	9.22%
90%	2.60	0.42	19.10%	8.84%	9.87%

If the debt holders bear some market risk, the cost of equity is lower at higher levels of debt, and Disney's optimal debt ratio increases to 60%, higher than the optimal debt ratio of 40% that we computed using the conventional beta measure.[14]

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.

$$\text{Firm value} = \frac{\text{Expected cash flow to firm}_{\text{Next year}}}{(\text{Cost of capital} - g)}$$

where g is the growth rate in the cash flow to the firm (in perpetuity). We begin by computing Disney's current free cash flow using its current earnings before interest and taxes of $6,829 million, its tax rate of 38%, and its reinvestment in 2008 in long-term assets (ignoring working capital):

EBIT(1 – Tax rate) = 6829 (1 – 0.38) =	$4,234
+ Depreciation and amortization =	$1,593
– Capital expenditures =	$1,628
– Change in noncash working capital	$ 0
Free cash flow to the firm =	$4,199

[14] To estimate the beta of debt, we used the default spread at each level of debt, and assumed that 25 percent this risk is market risk. Thus, at an A – rating, the default spread is 3%. Based on the market risk premium of 6% that we used elsewhere, we estimated the beta at a A rating to be:

$$\text{Imputed debt beta at a C rating} = (3\%/6\%) \times 0.25 = 0.125$$

The assumption that 25% of the default risk is market risk is made to ensure that at a D rating, the beta of debt (0.83) is close to the unlevered beta of Disney (1.09).

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 =	\$45,193
+ Market value of debt =	\$16,682
= Value of the firm	\$61,875

If we assume that the market is correctly pricing the firm, we can back out an implied growth rate:

$$\text{Value of firm} = \$61{,}875 = \frac{\text{FCFF}_0(1+g)}{\text{Cost of capital} - g} = \frac{4{,}199(1+g)}{.0751 - g}$$

$$\begin{aligned}\text{Growth rate} &= (\text{Firm value} \times \text{Cost of capital} - \text{CF to firm})/(\text{Firm value} + \text{CF to firm})\\ &= (61{,}875 \times 0.0751 - 4199)/(61{,}875 + 4{,}199) = 0.0068 \text{ or } 0.68\%\end{aligned}$$

Now assume that Disney shifts to 40% debt and a cost of capital of 7.32%. The firm can now be valued using the following parameters:

Cash flow to firm = \$4,199 million
WACC = 7.32%
Growth rate in cash flows to firm = 0.68%

$$\text{Firm value} = \frac{\text{FCFF}_0(1+g)}{\text{Cost of capital} - g} = \frac{4{,}199(1.0068)}{(.0732 - 0.0068)} = \$63{,}665 \text{ million}$$

The value of the firm will increase from \$61,875 million to \$63,665 million if the firm moves to the optimal debt ratio:

$$\text{Increase in firm value} = \$63{,}665 \text{ million} - \$61{,}875 \text{ million} = \$1{,}790 \text{ million}$$

The limitation of this approach is that the growth rate is heavily dependent on both our estimate of the cash flow in the most recent year and the assumption that the firm is in stable growth.[15] We can use an alternate approach to estimate the change in firm value. Consider first the change in the cost of capital from 7.51% to 7.32%, a drop of 0.19%. This change in the cost of capital should result in the firm saving on its annual cost of financing its business:

$$\begin{aligned}\text{Cost of financing Disney at existing debt ratio} &= 61{,}875 \times 0.0751 = \$4{,}646.82 \text{ million}\\ \text{Cost of financing Disney at optimal debt ratio} &= 61{,}875 \times 0.0732 = \$\ 4{,}529.68 \text{ million}\\ \text{Annual savings in cost of financing} &= \$4{,}646.82 \text{ million} - \$4{,}529.68 \text{ million} = \$117.14 \text{ million}\end{aligned}$$

Note that most of these savings are implicit rather than explicit and represent the savings next year.[16] The present value of these savings over time can now be estimated using the new cost of capital of 7.32% and the capped growth rate of 0.68% (based on the implied growth rate):

[15] No company can grow at a rate higher than the long-term nominal growth rate of the economy. The risk-free 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.

[16] 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.

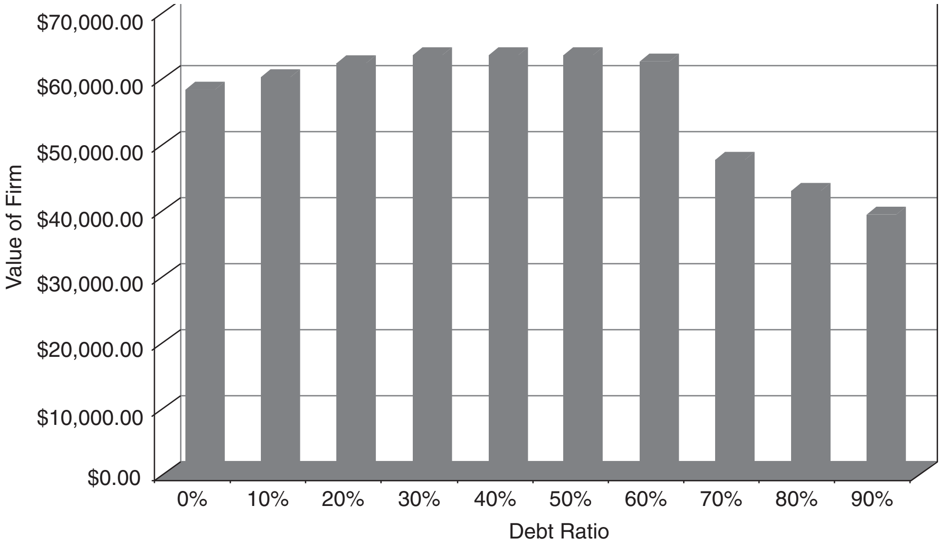

FIGURE 15.3 Firm Value and Debt Ratios

$$\text{PV of savings} = \frac{\text{Annual savings next year}}{(\text{Cost of capital} - g)} = \frac{\$17.14}{(0.0732 - 0.0068)} = \$1{,}763 \text{ million}$$

$$\begin{aligned}\text{Value of the firm after recapitalization} &= \text{Existing firm value} + \text{PV of savings} \\ &= \$61{,}875 + \$1{,}763 = \$63{,}638 \text{ million}\end{aligned}$$

Using this approach, we estimated the firm value at different debt ratios in Figure 15.3.

There are two ways of getting from firm value to the value per share. Because the 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:*

$$\text{Increase in value per share} = \$1{,}763/1856.732 = \$\ 0.95$$

$$\text{New stock price} = \$24.34 + \$0.95 = \$25.29$$

Since the change in cost of capital is being accomplished by borrowing $8,068 million (to get from the existing debt of $16,682 million to the debt of $24,750 million at the optimal) and buying back shares, it may seem surprising that we are using the shares outstanding before the buyback. Implicit in this computation 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, and that is why we term this the rational solution, since it leaves investors indifferent between selling back their shares and holding on to them. The alternative approach to arriving at the value per share is to compute the number of shares outstanding after the buyback:

$$\begin{aligned}\text{Number of shares after buyback} &= \#\text{ Shares before} - \frac{\text{Increase in debt}}{\text{Share price}} \\ &= 1{,}856.732 - \frac{\text{Increase in debt}}{\text{Share price}} = 1537.713 \text{ million shares}\end{aligned}$$

Value of firm after recapitalization = $63,638 million
Debt outstanding after recapitalization = $24,750 million
Value of equity after recapitalization = $38,888 million

$$\text{Value of equity per share after recapitalization} = \frac{38{,}888}{1537.713} = \$25.29$$

To the extent that stock can be bought back at the current price of $24.34 or some value lower than $25.29, the remaining stockholders will get a bigger share of the increase in value. For instance, if Disney could have bought stock back at the existing price of $24.34, the increase in value per share would be $1.16.[17] If the stock buyback occurs at a price higher than $25.29, investors who sell their stock back will gain at the expense of those who remain stockholder in the firm.

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

Disney: Cost of Capital Worksheet

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	$6,188	$12,375	$18,563	**$24,750**	$30,938	$37,125	$43,313	$49,500	$55,688
Beta	0.73	0.78	0.85	0.93	**1.04**	1.19	1.42	1.79	2.55	5.05
Cost of Equity	7.90%	8.20%	8.58%	9.07%	**9.72%**	10.63%	11.99%	14.26%	18.81%	33.83%
EBITDA	$8,422	$8,422	$8,422	$8,422	**$8,422**	$8,422	$8,422	$8,422	$8,422	$8,422
Depreciation	$1,593	$1,593	$1,593	$1,593	**$1,593**	$1,593	$1,593	$1,593	$1,593	$1,593
EBIT	$6,829	$6,829	$6,829	$6,829	**$6,829**	$6,829	$6,829	$6,829	$6,829	$6,829
Interest	$0	$294	$588	$975	**$1,485**	$2,011	$2,599	$5,198	$6,683	$7,518
Interest coverage ratio	∞	23.24	11.62	7.01	**4.60**	3.40	2.63	1.31	1.02	0.91
Likely Rating	AAA	AAA	AAA	AA	**A**	A-	BBB	B-	CCC	CCC
Pre-tax cost of debt	4.75%	4.75%	4.75%	5.25%	**6.00%**	6.50%	7.00%	12.00%	13.50%	13.50%
Effective tax rate	38.00%	38.00%	38.00%	38.00%	**38.00%**	38.00%	38.00%	38.00%	38.00%	34.52%

Cost of Capital Calculations

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	$6,188	$12,375	$18,563	**$24,750**	$30,938	$37,125	$43,313	$49,500	$55,688
Cost of equity	7.90%	8.20%	8.58%	9.07%	**9.72%**	10.63%	11.99%	14.26%	18.81%	33.83%
Cost of debt	2.95%	2.95%	2.95%	3.26%	**3.72%**	4.03%	4.34%	7.44%	8.37%	8.84%
Cost of capital	7.90%	7.68%	7.45%	7.32%	**7.32%**	7.33%	7.40%	9.49%	10.46%	11.34%

[17]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 $ 8,068 million (debt at 40% optimal of $24,750 million – Current debt of $16,682 million) and the stock price of $24.34. We then divide the increase in firm value of $1,763 million by the remaining shares outstanding:

Change in stock price = $1,763 million/(– [8068/24.34]) = $1.16 per share

DEFAULT RISK, OPERATING INCOME, AND OPTIMAL LEVERAGE

The ~~Boeing~~ analysis just completed assumed that operating income would remain constant while the debt ratios changed. While this assumption simplifies the 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 label as an indirect bankruptcy cost. 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 Boeing~~ would change as debt ratios and default risk changes by looking at the effects of rating downgrades on the operating income of other retailers.

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.

ADJUSTED PRESENT VALUE AND FINANCIAL LEVERAGE

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

The unlevered firm value is not a function of expected leverage and can be estimated as described in the earlier section—by discounting the free cash flows to the firm at the unlevered cost of equity. In fact, if you do not want to estimate this value and ~~take~~ the market value of the firm ~~as~~ correct, you could back out the unlevered firm value by subtracting out the tax benefits and adding back the expected bankruptcy cost from the existing debt.

$$\text{Current firm value} = \text{Value of unlevered firm} + \text{Present value of tax benefits} - \text{Expected bankruptcy cost}$$

$$\text{Value of unlevered firm} = \text{Current firm value} - \text{Present value of tax benefits} + \text{Expected bankruptcy cost}$$

The only components that change as a firm changes its leverage are the expected tax benefits and the expected bankruptcy costs. To obtain these values as you change leverage, you would go through the following five steps:

1. *Estimate the dollar debt outstanding at each debt ratio.* This process mirrors what was done in the cost of capital approach. Keeping firm value fixed, consider how much debt the firm will have at 20 percent debt, 30 percent debt, and so on.
2. *Estimate the tax benefits of debt by multiplying the dollar debt by the tax rate.* This essentially assumes that the debt is permanent and that the tax benefits will continue in perpetuity.
3. *Estimate the rating, interest rate, and interest expense at each debt ratio.* This process again replicates what was done in the cost of capital approach.
4. *Use the rating to estimate a probability of default.* Note that Table 15.2 provides these probabilities for each rating.
5. *Estimate the expected bankruptcy cost* by multiplying the probability of bankruptcy by the bankruptcy cost, stated as a percent of unlevered firm value.

~~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.

ILLUSTRATION 15.8: APV Approach to Optimal Capital Structure: Disney in March 2009

The APV 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 2009 and net out the effect of the tax savings and bankruptcy costs arising from the existing debt.

$$\begin{aligned}\text{Current market value of Disney} &= \text{Value of equity} + \text{Value of debt}\\ &= \$45{,}193 + \$16{,}682 = \$61{,}875 \text{ million}\end{aligned}$$

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 38%.

$$\begin{aligned}\text{PV of tax savings from existing debt} &= \text{Existing debt} \times \text{Tax rate}\\ &= \$16{,}682 \times 0.38 = \$6{,}339 \text{ million}\end{aligned}$$

Based on Disney's current rating of A, we estimate a probability of bankruptcy of 0.66% from Table ~~8.19~~. The bankruptcy cost is assumed to be 25% of the firm value, prior to the tax savings. 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 because projects tend be shorter-term and on a smaller scale.

$$\begin{aligned}\text{PV of expected bankruptcy cost} &= \text{Probability of default} \times \text{Bankruptcy cost}\\ &= 0.66\% \times (0.25 \times 61{,}875) = \$\ 102 \text{ million}\end{aligned}$$

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
= $61,875 – $6,339 + $102
= $55,638 million

The next step in the process is to estimate the tax savings in the following table at different levels of debt. Although we use the standard approach of assuming that the present value is calculated as a perpetuity, we reduce the tax rate used in the calculation, if interest expenses exceed the EBIT. The adjustment to the tax rate was described earlier in the cost of capital approach.

Tax Savings from Debt (tcD): Disney

Debt Ratio	*$ Debt*	*Tax Rate*	*Tax Benefits*
0%	$ 0	38.00%	$ 0
10%	$ 6,188	38.00%	$ 2,351
20%	$12,375	38.00%	$ 4,703
30%	$18,563	38.00%	$ 7,054
40%	$24,750	38.00%	$ 9,405
50%	$30,938	38.00%	$11,756
60%	$37,125	38.00%	$14,108
70%	$43,313	38.00%	$16,459
80%	$49,500	38.00%	$18,810
90%	$55,688	34.52%	$19,223

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

Expected Bankruptcy Cost, Disney

Debt Ratio	*Bond Rating*	*Probability of Default*	*Expected Bankruptcy Cost*
0%	AAA	0.07%	$ 10
10%	AAA	0.07%	$ 10
20%	AAA	0.07%	$ 11
30%	A+	0.60%	$ 94
40%	A	0.66%	$ 107
50%	A–	2.50%	$ 421
60%	B	36.80%	$ 6,417
70%	CCC	59.01%	$10,636
80%	CCC	59.01%	$10,983
90%	CCC	59.01%	$11,044

The expected bankruptcy cost at a 40% debt ratio is computed thus:

$$\text{Expected bankruptcy cost} = (\text{Unlevered firm value} + \text{Tax savings})(.25)(.0066)$$
$$= (55{,}638 + \$9{,}405)(.25)(0.0066) = \$\,107 \text{ million}$$

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

Value of Disney with Leverage

Debt Ratio	*$ Debt*	*Tax Rate*	*Unlevered Firm Value*	*Tax Benefits*	*Expected Bankruptcy Cost*	*Value of Levered Firm*
0%	$ 0	38.00%	$55,638	$ 0	$ 10	$55,629
10%	$ 6,188	38.00%	$55,638	$ 2,351	$ 10	$57,979
20%	$12,375	38.00%	$55,638	$ 4,703	$ 11	$60,330
30%	$18,563	38.00%	$55,638	$ 7,054	$ 94	$62,598
40%	$24,750	38.00%	$55,638	$ 9,405	$ 107	$64,936
50%	$30,938	38.00%	$55,638	$11,756	$ 421	$66,973
60%	$37,125	38.00%	$55,638	$14,108	$ 6,417	$63,329
70%	$43,313	38.00%	$55,638	$16,459	$10,636	$61,461
80%	$49,500	38.00%	$55,638	$18,810	$10,983	$63,466
90%	$55,688	34.52%	$55,638	$19,223	$11,044	$63,817

The firm value is maximized at about 50% debt, slightly higher than the optimal computed using the cost of capital approach. 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.**

VALUING THE PIECES RATHER THAN THE WHOLE

The adjusted present value model values debt separately from the operating assets, and firm value is the sum of the two components. In fact, one of the biggest benefits of discounted cash flow valuation is that breaking up cash flows into individual components and valuing them separately should not change the value. Thus, you could value a firm like General Electric (GE) by valuing each of its divisions separately and adding them up, or Coca-Cola by valuing its operations in each country separately and summing those up.

The advantage of piecewise valuation is that you can estimate cash flows and discount rates separately for each piece and thus get more precise estimates of value. For example, you would use very different assumptions about operating margins, reinvestment needs, and costs of capital when valuing the appliance and aircraft engine divisions of GE. Similarly, you could apply different country risk premiums for each country that Coca-Cola operates in to value the firm. Since this is always the case, you might ask why we do not do this for all firms. The problem is with the information. Many firms do not break down their earnings and cash flows in sufficient detail to allow for piecewise valuation. Even firms that do, like GE, often have large centralized expenses that get allocated, often arbitrarily, to individual divisions.

The benefits of breaking a firm down into pieces clearly increase as a firm becomes more diverse in its operations. These benefits have to be weighed against the costs associated with more imprecise information and greater estimation problems.

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 addition, 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, this will yield the conclusion that the optimal debt ratio for a firm is 100 percent 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.[18]

CONCLUSION

This chapter develops an alternative approach to discounted cash flow valuation. The cash flows to the firm are discounted at the weighted average cost of capital to obtain the value of the firm, which when reduced by the market value of outstanding debt yields the value of equity. Since the cash flow to the firm is a cash flow prior to debt payments, this approach is more straightforward to use when ~~there is significant leverage or~~ when leverage changes over time, though the weighted average cost of capital, used to discount free cash flows to the firm, has to be adjusted for changes in leverage. Finally, the costs of capital can be estimated at different debt ratios and used to estimate the optimal debt ratio for a firm.

The alternative approach to firm valuation is the APV approach, where the effect on value of debt (tax benefits minus bankruptcy costs) is added to the unlevered firm value. This approach can also be used to estimate the optimal debt ratio for the firm.

QUESTIONS AND SHORT PROBLEMS

In the problems following, use an equity risk premium of 5.5 percent if none is specified.

1. Respond true or false to the following statements about the free cash flow to the firm:
   a. The free cash flow to the firm is always higher than the free cash flow to equity.
      True ____ False ____

[18]See Inselbag and Kaufold (1997).

b. The free cash flow to the firm is the cumulated cash flow to all investors in the firm, though the form of their claims may be different.
True ____ False ____
c. The free cash flow to the firm is a predebt, pretax cash flow.
True ____ False ____
d. The free cash flow to the firm is an after-debt, after-tax cash flow.
True ____ False ____
e. The free cash flow to the firm cannot be estimated for a firm with debt without knowing interest and principal payments.
True ____ False ____

2. Union Pacific Railroad reported net income of $770 million in 1993 after interest expenses of $320 million. (The corporate tax rate was 36%.) It reported depreciation of $960 million in that year, and capital spending was $1.2 billion. The firm also had $4 billion in debt outstanding on the books, rated AA (carrying a yield to maturity of 8%) and trading at par (up from $3.8 billion at the end of 1992). The beta of the stock was 1.05, and there were 200 million shares outstanding (trading at $60 per share), with a book value of $5 billion. Union Pacific's working capital requirements were negligible. (The Treasury bond rate was 7%, and the risk premium was 5.5%.)
   a. Estimate the free cash flow to the firm in 1993.
   b. Estimate the value of the firm at the end of 1993.
   c. Estimate the value of equity at the end of 1993, and the value per share, using the FCFF approach.
3. Lockheed Corporation, one of the largest defense contractors in the United States, reported EBITDA of $1,290 million in 1993, prior to interest expenses of $215 million and depreciation charges of $400 million. Capital expenditures in 1993 amounted to $450 million, and working capital was 7% of revenues (which were $13,500 million). The firm had debt outstanding of $3.068 billion (in book value terms), trading at a market value of $3.2 billion and yielding a pretax interest rate of 8%. There were 62 million shares outstanding, trading at $64 per share, and the most recent beta was 1.10. The tax rate for the firm was 40%. (The Treasury bond rate was 7%, and the risk premium was 5.5%.)

   The firm expected revenues, earnings, capital expenditures and depreciation to grow at 9.5% a year from 1994 to 1998, after which the growth rate was expected to drop to 4%. (Capital spending will be 120% of depreciation in the steady state period.) The company also planned to lower its debt/equity ratio to 50% for the steady state (which will result in the pretax interest rate dropping to 7.5%).
   a. Estimate the value of the firm.
   b. Estimate the value of the equity in the firm, and the value per share.
4. In the face of disappointing earnings results and increasingly assertive institutional stockholders, Eastman Kodak was considering a major restructuring in 1993. As part of this restructuring, it was considering the sale of its health division, which earned $560 million in earnings before interest and taxes in 1993, on revenues of $5.285 billion. The expected growth in earnings was expected to moderate to 6% between 1994 and 1998, and to 4% after that. Capital expenditures in the health division amounted to $420 million in 1993, while depreciation was $350 million. Both were expected to grow 4% a year in the long term. Working capital requirements were negligible.

The average beta of firms competing with Eastman Kodak's health division was 1.15. While Eastman Kodak had a debt ratio [D/(D + E)] of 50%, the health division could sustain a debt ratio [D/(D + E)] of only 20%, which was similar to the average debt ratio of firms competing in the health sector. At this level of debt, the health division could expect to pay 7.5% on its debt, before taxes. (The tax rate is 40%, the Treasury bond rate is 7%, and the risk premium is 5.5%.)

a. Estimate the cost of capital for the division.
b. Estimate the value of the division.
c. Why might an acquirer pay more than this estimated value for the division?

5. You are analyzing a valuation done on a stable firm by a well-known analyst. Based on the expected free cash flow to firm next year of $30 million and an expected growth rate of 5%, the analyst has estimated a value of $750 million. However, he has made the mistake of using the book values of debt and equity in his calculation. While you do not know the book value weights he used, you know that the firm has a cost of equity of 12% and an after-tax cost of debt of 6%. You also know that the market value of equity is three times the book value of equity, while the market value of debt is equal to the book value of debt. Estimate the correct value for the firm.
6. Santa Fe Pacific, a major rail operator with diversified operations, had earnings before interest, taxes, and depreciation of $637 million in 1993, with depreciation amounting to $235 million (offset by capital expenditure of an equivalent amount). The firm was in steady state and expected to grow 6% a year in perpetuity. Santa Fe Pacific had a beta of 1.25 in 1993, and debt outstanding of $1.34 billion. The stock price was $18.25 at the end of 1993, and there were 183.1 million shares outstanding. The expected ratings and the costs of debt at different levels of debt for Santa Fe are shown in the following table:

D/(D + E)	*Rating*	*Cost of Debt (Pretax)*
0%	AAA	6.23%
10%	AAA	6.23%
20%	A+	6.93%
30%	A–	7.43%
40%	BB	8.43%
50%	B+	8.93%
60%	B–	10.93%
70%	CCC	11.93%
80%	CCC	11.93%
90%	CC	13.43%

The earnings before interest and taxes were expected to grow 3% a year in perpetuity, with capital expenditures offset by depreciation. (The tax rate is 40%, and the Treasury bond rate is 7% and the market risk premium is 5.5%.)

a. Estimate the cost of capital at the current debt ratio.
b. Estimate the costs of capital at debt ratios ranging from 0% to 90%.
c. Estimate the value of the firm at debt ratios ranging from 0% to 90%.

7. You have been asked to estimate the value of Cavanaugh Motels, a motel chain. The firm reported earnings of $200 million before interest and taxes in the most recent year and paid 40% of its taxable income in taxes. The book value of

capital at the firm is $1.2 billion, and the firm expects to grow 4% a year in perpetuity. The firm has a beta of 1.2, a pretax cost of debt of 6%, equity with a market value of $1 billion, and debt with a market value of $500 million. (The risk-free rate is 5%, and the market risk premium is 5.5%.)

a. Estimate the value of the firm, using the cost of capital approach.
b. If you were told the probability of default at this firm at its current debt level is 10% and that the cost of bankruptcy is 25% of unlevered firm value, estimate the value of the firm using the adjusted present value approach.
c. How would you reconcile the two estimates of value?

8. 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 2.3%, and the cost of bankruptcy is expected to be 30% of firm value.
   a. Estimate the unlevered value of the firm from the current market 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% of unlevered firm value.